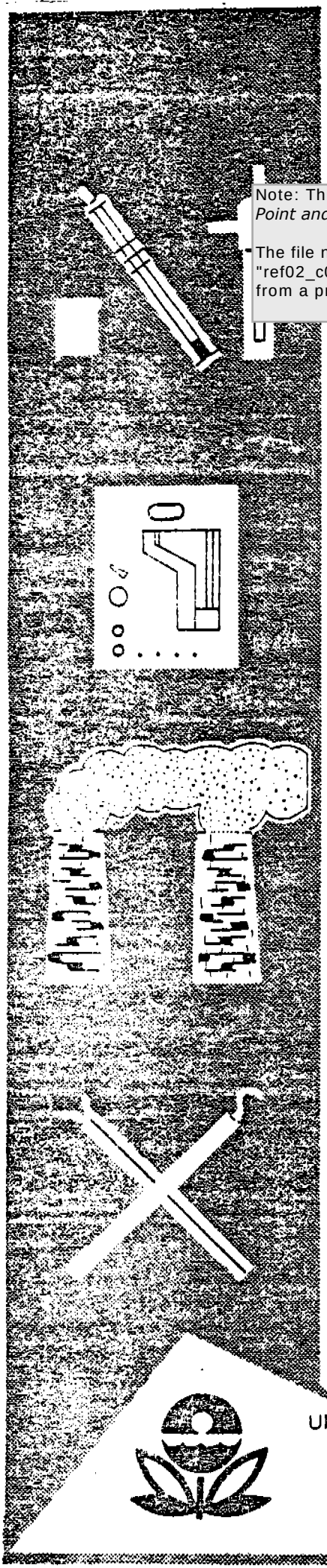
EPA PROJECT REPORT N

AP-42 Section 11.17
Reference 6
Report Sect. 4
Reference 2

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.

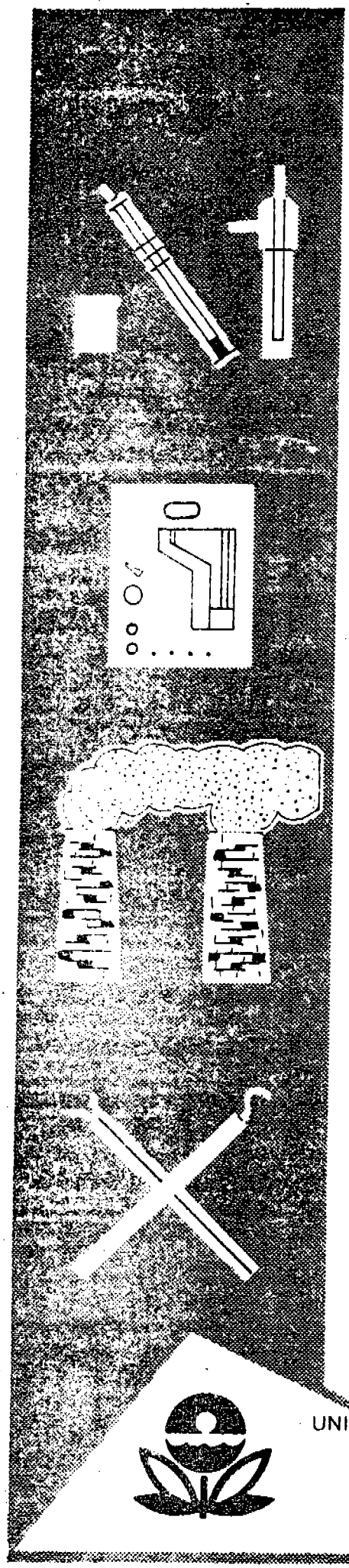


AIR POLLUTION EMISSION TEST

J. M. BRENNER COMPANY

Lancaster, Pennsylvania

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Emission Measurement Branch
Research Triangle Park, North Carolina



EPA PROJECT REPORT NO. 75-STN-7

AIR POLLUTION EMISSION TEST

J. M. BRENNER COMPANY

Lancaster, Pennsylvania

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
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Emission Measurement Branch
Research Triangle Park, North Carolina

SOURCE TESTING OF A STONE CRUSHING OPERATION

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

EMB Report No. 75-STN-7

Prepared for

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Measurement Branch
Research Triangle Park, North Carolina 27711

Prepared by

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25711 Southfield Road
Southfield, Michigan 48075

Contract No. 68-02-1408, Task No. 6

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I. INTRODUCTION

The U.S. Environmental Protection Agency commissioned George D. Clayton & Associates (Task 6; Contract No. 68-02-1408) to conduct a source test and baghouse efficiency study at the stone crushing operation of the J.M. Brenner Company in Lancaster, Pennsylvania.

This source sampling and analysis study was conducted to establish the particulate emission rates and concentrations from a stone crushing operation for possible use as part of the Standards of Performance for New Stationary Sources development program.

The task order specified that two baghouse outlet locations and the three inlet locations to these two baghouses were to be sampled simultaneously and in triplicate. Visible emissions were to be measured at both outlet ducts and for the entire plant. Additionally, process stone samples were to be acquired by the U.S. EPA and their moisture content determined by Clayton and Associates. Finally, samples of the dust collected in the two baghouses were to be acquired and subsequently analyzed by EPA. A schematic diagram of the emission control systems exhausting the stone crushing operation is provided in Figure 1. A flow diagram of the entire process is provided in Figure 2.

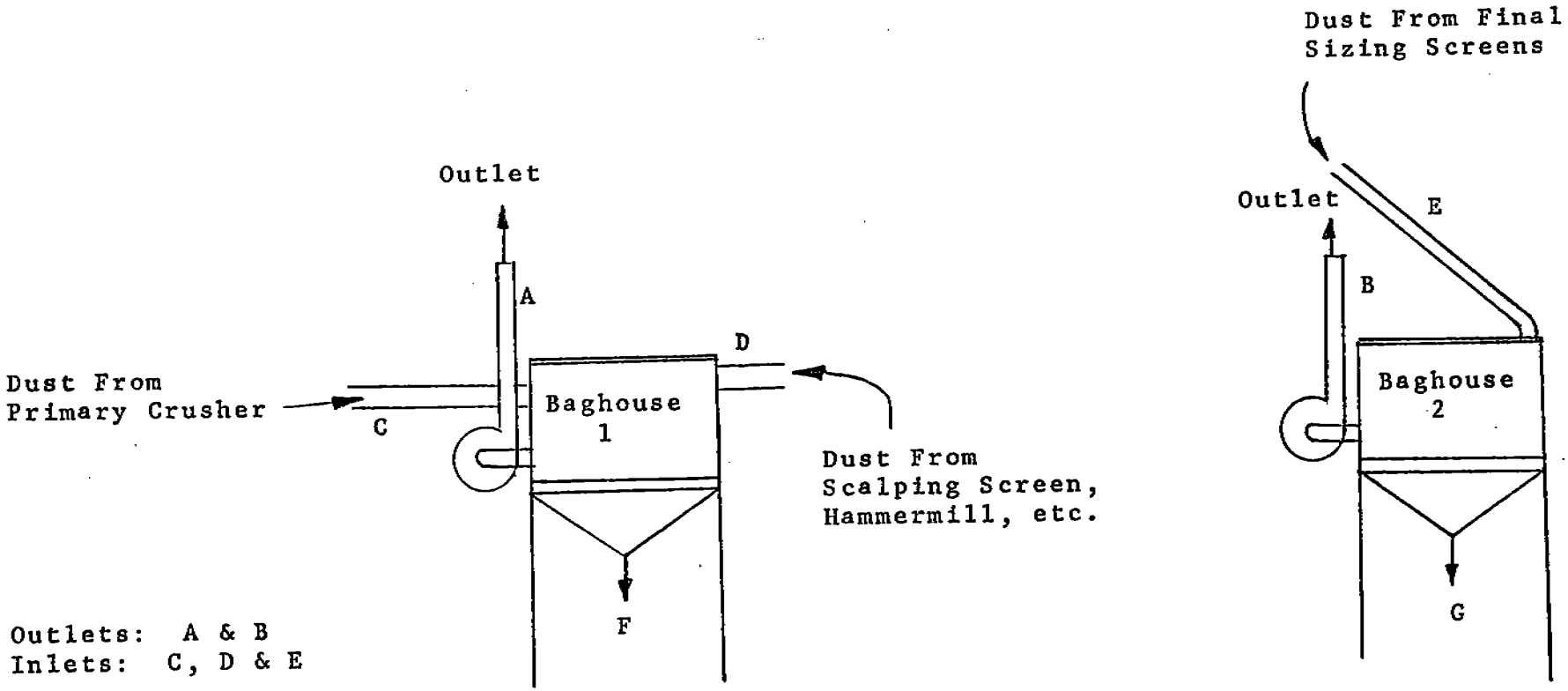


FIGURE 1

SCHEMATIC OF EMISSION CONTROL SYSTEMS

J.M. Brenner Company
Lancaster, Pennsylvania

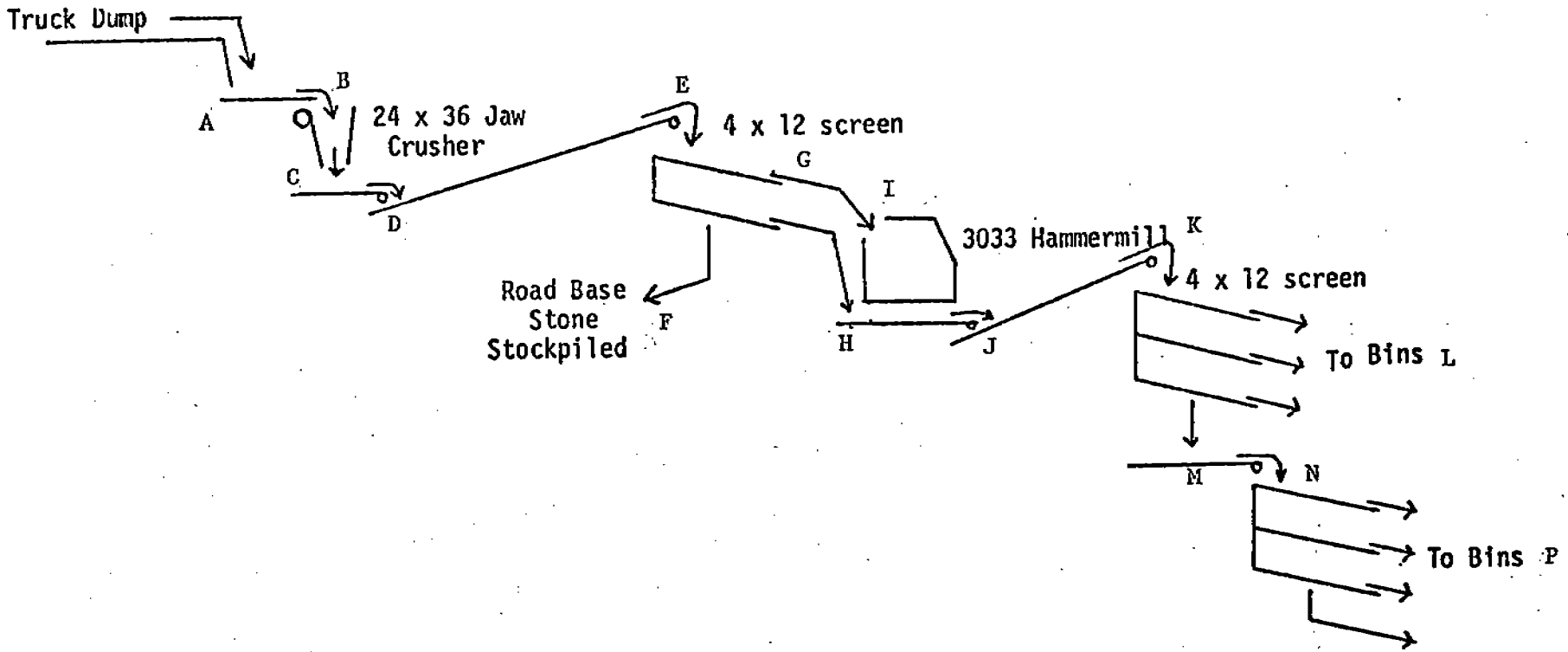


FIGURE 2

PROCESS FLOW DIAGRAM AND
GENERAL PLANT VISIBLE EMISSIONS POINTS

J.M. Brenner Company
Lancaster, Pennsylvania

Sampling was performed on November 19-22, 1974 at the J.M. Brenner Company in Lancaster, Pennsylvania. However, the requirement of triplicate particulate samples at each inlet location was not met. Duplicate samples only were obtained.

Particulate tests on the outlet locations were designed to measure average emissions over three four-hour durations. However, the first set of outlet samples were collected over a shorter period of about two hours. Particulate emission tests on the inlet locations were designed to measure average emissions over durations to be determined in the field. Both Mr. R.T. Harrison, Task Project Officer, U.S. EPA, Emission Measurement Branch, and Mr. R.J. Powals, Project Leader, George D. Clayton & Associates, agreed on November 19 that nominal two-hour sample durations would be sufficient to adequately measure the particulate mass emission rate at each inlet location.

A list of all project participants is presented in Appendix A.

II. SUMMARY AND DISCUSSION OF RESULTS

The results of this study are presented in Tables I - III. It should be noted that the gas composition of all five sampling locations was not determined because only ambient air moved through the system. Therefore, the gas composition was assumed to be that of air plus any moisture which might enter the emission control system.

The last run at Inlet E had a percent isokinetic value of 168.5 percent. Examination of this percent isokinetic figure along with the stack gas flowrate data obtained at Inlet E indicates that the results obtained there appear to be erroneous since the measured flowrate at Inlet E is nearly double that measured at Outlet B. Since Outlet B discharges the gas from Inlet E the flowrates should be relatively similar, that is, within 20 percent, at these low gas flowrates.

The auxiliary source testing data provided in Table I complement the emissions information provided by itemizing flowrates, stack gas temperatures, and sampling times for the various tests.

The data obtained at Outlet A are in good agreement with each other, as are the data obtained at Outlet B. Additionally, the results from Inlet C appear valid. However, although the sampling rates obtained at Inlet D are well within the acceptable isokinetic range, the emission data show a wide disparity. Although this trend is very evident at Inlet D, the same trend occurs, but to a lesser extent, when comparing all the second versus third sample runs performed at each location, whether

TABLE I

SUMMARY OF PARTICULATE* EMISSIONS

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Sampled Source: Outlet A Dimensions: 16" x 13-1/4"

Test Number		1	2	3
Date		11-19	11-21	11-22
Sampling Period	Start	14:21	12:10	09:03
	Stop	16:23	16:20	13:59
Sampled Volume	Am^3 (1)	1.547	7.088	7.173
	DNm^3 (2)	1.524	7.219	7.403
	ACF (3)	54.64	250.3	253.3
	DSCF (4)	53.80	254.9	261.4
Percent Moisture by Volume		1.0	0.4	0.1
Average Stack Temperature	°C	19	3.3	6.7
	°F	66	38	44
Stack Gas Flowrate	Am^3/sec (5)	3.46	3.57	3.55
	DNm^3/sec (6)	3.43	3.64	3.68
	ACFM (7)	7340	7560	7520
	DSCFM (8)	7260	7720	7800
Percent Isokinetic		106.6	97.3	98.9
Feed Rate	M tons/hr (9)	120	108	115
	tons/hr	132	119	127
Sample Weight (mg)		10.3	11.9	44.1
Particulate Concentration	mg/Am^3	6.7	1.7	6.1
	mg/DNm^3	6.8	1.6	6.0
	gr/ACF	0.003	0.0007	0.003
	gr/DSCF	0.003	0.0007	0.003
Particulate Emission Rate	kg/hr	0.08	0.02	0.08
	kg/M ton of feed	0.0007	0.0002	0.0007
	lb/hr	0.18	0.05 0.0477	0.17
	lb/ton of feed	0.001	0.0004	0.001

(1) Actual cubic meters - stack conditions
(2) Dry normal cubic meters - 20°C, 760 mm Hg
(3) Actual cubic feet - stack conditions
(4) Dry standard cubic feet - 20°C, 760 mm Hg
(5) Actual cubic meters per second - stack conditions
(6) Dry normal cubic meters per second - 20°C, 760 mm Hg
(7) Actual cubic feet per minute - stack conditions
(8) Dry standard cubic feet per minute - 20°C, 760 mm Hg
(9) Metric tons per hour (1 metric ton = 1000 kg)

* EPA Method 5

TABLE I

SUMMARY OF PARTICULATE* EMISSIONS

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Sampled Source: Outlet B Dimensions: 16" x 13-1/2"

Test Number		1	2	3
Date		11-19	11-21	11-22
Sampling Period	Start	14:22	12:05	08:58
	Stop	16:24	16:15	13:54
Sampled Volume	Am^3 (1)	2.951	6.777	6.355
	DNm^3 (2)	2.948	6.763	6.488
	ACF (3)	104.2	239.3	224.4
	DSCF (4)	104.1	238.8	229.1
Percent Moisture by Volume		0.4	0.3	0.1
Average Stack Temperature	°C	17	10	11
	°F	62	50	51
Stack Gas Flowrate	Am^3/sec (5)	2.94	3.24	3.09
	DNm^3/sec (6)	2.95	3.25	3.16
	ACFM (7)	6220	6870	6540
	DSCFM (8)	6260	6880	6700
Percent Isokinetic		102.0	106.4	104.8
Feed Rate	M tons/hr (9)	120	108	115
	tons/hr	132	119	127
Sample Weight (mg)		38.7	0.5	5.5
Particulate Concentration	mg/Am^3	13.1	0.07	0.87
	mg/DNm^3	13.1	0.07	0.85
	gr/ACF	0.006	0.00003	0.0004
	gr/DSCF	0.006	0.00003	0.0004
Particulate Emission Rate	kg/hr	0.14	0.0009	0.01
	kg/M ton of feed	0.001	0.000008	0.00008
	lb/hr	0.31	0.002	0.02
	lb/ton of feed	0.002	0.00002	0.0002

(1) Actual cubic meters - stack conditions
(2) Dry normal cubic meters - 20°C, 760 mm Hg
(3) Actual cubic feet - stack conditions
(4) Dry standard cubic feet - 20°C, 760 mm Hg
(5) Actual cubic meters per second - stack conditions
(6) Dry normal cubic meters per second - 20°C, 760 mm Hg
(7) Actual cubic feet per minute - stack conditions
(8) Dry standard cubic feet per minute - 20°C, 760 mm Hg
(9) Metric tons per hour (1 metric ton = 1000 kg)

* EPA Method 5

TABLE I

SUMMARY OF PARTICULATE* EMISSIONS

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Sampled Source: Inlet C Dimensions: 9-1/2" I.D.

Test Number		1	2
Date		11-21	11-22
Sampling Period	Start	09:00	11:28
	Stop	12:27	15:30
Sampled Volume	Am^3 (1)	2.539	2.533
	DNm^3 (2)	2.537	2.579
	ACF (3)	89.66	89.44
	DSCF (4)	89.58	91.05
Percent Moisture by Volume		0.6	0.6
Average Stack Temperature	°C	4.4	5.6
	°F	40	42
Stack Gas Flowrate	Am^3/sec (5)	0.524	0.519
	DNm^3/sec (6)	0.524	0.529
	ACFM (7)	1110	1100
	DSCFM (8)	1110	1120
Percent Isokinetic		101.8	96.7
Feed Rate	M tons/hr (9)	108	115
	tons/hr	119	127
Sample Weight (mg)		1102.4	1407.4
Particulate Concentration	mg/Am^3	434	556
	mg/DNm^3	435	546
	gr/ACF	0.190	0.243
	gr/DSCF	0.190	0.239
Particulate Emission Rate	kg/hr	0.82	1.0
	kg/M ton of feed	0.008	0.009
	lb/hr	1.8	2.3
	lb/ton of feed	0.02	0.02

(1) Actual cubic meters - stack conditions
(2) Dry normal cubic meters - 20°C, 760 mm Hg
(3) Actual cubic feet - stack conditions
(4) Dry standard cubic feet - 20°C, 760 mm Hg
(5) Actual cubic meters per second - stack conditions
(6) Dry normal cubic meters per second - 20°C, 760 mm Hg
(7) Actual cubic feet per minute - stack conditions
(8) Dry standard cubic feet per minute - 20°C, 760 mm Hg
(9) Metric tons per hour (1 metric ton = 1000 kg)

* EPA Method 5

TABLE I

SUMMARY OF PARTICULATE* EMISSIONS

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Sampled Source: Inlet D Dimensions: 18" I.D.

Test Number		1	2
Date		11-21	11-22
Sampling Period	Start	12:02	13:50
	Stop	09:06	11:14
Sampled Volume	Am^3 (1)	2.513	2.376
	DNm^3 (2)	2.507	2.406
	ACF (3)	88.74	83.91
	DSCF (4)	88.54	84.97
Percent Moisture by Volume		1.2	1.1
Average Stack Temperature	°C	2.8	5.0
	°F	37	41
Stack Gas Flowrate	Am^3/sec (5)	3.65	3.46
	DNm^3/sec (6)	3.66	3.52
	ACFM (7)	7740	7340
	DSCFM (8)	7750	7460
Percent Isokinetic		96.6	96.4
Feed Rate	M tons/hr (9)	108	115
	tons/hr	119	127
Sample Weight (mg)		6.0	13635.2
Particulate Concentration	mg/Am^3	2.4	5740
	mg/DNm^3	2.4	5670
	gr/ACF	0.001	2.51
	gr/DSCF	0.001	2.48
Particulate Emission Rate	kg/hr	0.03	71.8
	kg/M ton of feed	0.0003	0.62
	lb/hr	0.07	158
	lb/ton of feed	0.0006	1.2

(1) Actual cubic meters - stack conditions
(2) Dry normal cubic meters - 20°C, 760 mm Hg
(3) Actual cubic feet - stack conditions
(4) Dry standard cubic feet - 20°C, 760 mm Hg
(5) Actual cubic meters per second - stack conditions
(6) Dry normal cubic meters per second - 20°C, 760 mm Hg
(7) Actual cubic feet per minute - stack conditions
(8) Dry standard cubic feet per minute - 20°C, 760 mm Hg
(9) Metric tons per hour (1 metric ton = 1000 kg)

* EPA Method 5

TABLE I

SUMMARY OF PARTICULATE* EMISSIONS

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Sampled Source: Inlet E** Dimensions: 18" I.D.

Test Number		1	2
Date		11-21	11-22
Sampling Period	Start	12:05	14:10
	Stop	08:58	10:58
Sampled Volume	Am^3 (1)	4.511	2.700
	DNm^3 (2)	4.454	2.713
	ACF (3)	159.3	95.34
	DSCF (4)	157.3	95.79
Percent Moisture by Volume		0.3	0.8
Average Stack Temperature	°C	7.2	7.2
	°F	45	45
Stack Gas Flowrate	Am^3/sec (5)	5.62	4.58
	DNm^3/sec (6)	5.57	4.62
	ACFM (7)	11,900	9710
	DSCFM (8)	11,800	9790
Percent Isokinetic		97.6	168.5
Feed Rate	M tons/hr (9)	108	115
	tons/hr	119	127
Sample Weight (mg)		733.9	1936.3
Particulate Concentration	mg/Am^3	163	717
	mg/DNm^3	165	714
	gr/ACF	0.071	0.313
	gr/DSCF	0.072	0.312
Particulate Emission Rate	kg/hr	3.3	11.9
	kg/M ton of feed	0.03	0.10
	lb/hr	7.3	26.2
	lb/ton of feed	0.06	0.21

(1) Actual cubic meters - stack conditions
(2) Dry normal cubic meters - 20°C, 760 mm Hg
(3) Actual cubic feet - stack conditions
(4) Dry standard cubic feet - 20°C, 760 mm Hg
(5) Actual cubic meters per second - stack conditions
(6) Dry normal cubic meters per second - 20°C, 760 mm Hg
(7) Actual cubic feet per minute - stack conditions
(8) Dry standard cubic feet per minute - 20°C, 760 mm Hg
(9) Metric tons per hour (1 metric ton = 1000 kg)

* EPA Method 5
** Validity of data for Inlet E is questionable.

TABLE II

SUMMARY OF BAGHOUSE PARTICULATE EFFICIENCIES

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Test Number	Baghouse 1				Baghouse 2		
	Inlet C (lbs/hr)	Inlet D (lbs/hr)	Outlet A (lbs/hr)	Efficiency (%)	Inlet E (lbs/hr)	Outlet B (lbs/hr)	Efficiency (%)
1	No Data	No Data	0.18	NA	No Data	0.31	NA
2	1.8	0.07	0.05	97.3	7.3	0.002	100
3	2.3	158	0.17	99.9	26.2	0.02	99.9
Average	2.0	79.0	0.13	99.8	16.8	0.01	99.9

NA = Not Applicable

George D. Clayton & Associates

TABLE III

SUMMARY OF GENERAL PLANT VISIBLE EMISSIONS

J.M. Brenner Company
Lancaster, Pennsylvania
November 22, 1974

Location (Figure 2)	Approximate Opacity (%)	Condition
A	5-10	Truck dumps, little or no wind
	10-30	Truck dumps, wind substantial
B	5-10	Truck dumps, little or no wind
	10-30	Truck dumps, wind substantial
C	0	Normal condition
	5	Slight wind
D	0	Normal condition
	5	Occasional and instantaneous
E	5-20	Normal condition
	20-30	Occasional and instantaneous
F	0-20	Wind less than about 5 mph
	20-30	Wind between about 5-10 mph
	30-50	Wind greater than about 10 mph
G	0-20	Little or no wind
	20-30	Start-up
	30-50	Wind greater than about 10 mph
	50-70	Occasionally when large gust of wind
H	0-20	Normal condition
I	0-5	Normal condition
J	0-20	Normal condition
K	0-5	Normal condition
	5-20	Occasional and instantaneous
L	0-5	Normal condition
	5-30	Wind up to about 10 mph
	30-50	Wind greater than about 10 mph
M	0-20	Little or no wind
	20-30	Wind about 5-10 mph
	30-40	Wind greater than about 10 mph
N	0-20	Little or no wind
	20-30	Wind about 5-10 mph
	30-40	Wind greater than about 10 mph
P	0-10	Little or no wind
	10-30	When wind occurs

at inlets or outlets. This difference may be due in part to the fact that the second set of tests was performed under light to moderately heavy rain and gusting wind conditions whereas the third test was performed under essentially dry and less windy conditions.

The two baghouses (No. 1 and No. 2) exhibited high control efficiency in reducing particulate emissions. These data are summarized in Table II, and indicate that on an average basis, both baghouses were well over 99 percent efficient in the removal of particulate.

Visible emissions were observed on November 21 and 22. On November 21 a four-hour record (in accordance with EPA Method 9, readings were taken at 15-second intervals) of the visible emissions from both outlet locations (A and B) was performed. All measurements were zero opacity except for a small wisp of smoke which was recorded and observed for about 15 seconds at 12:22 p.m.

On November 22 visible emissions measurements were performed over the entire general plant. These general plant visible emissions data have been reduced by considering each emission point of the process independently (see Figure 2) and summarizing the various opacities recorded by the two certified observers. These summarized observations are presented in Table III. The data indicate that locations F, G, L, M, and N (see Figure 2) exhibited the greatest opacities that were measured from given point sources in and around the J.M. Brenner Company stone crushing plant.

Total particulate emissions are presented in Appendix B.

III. PROCESS DESCRIPTION AND OPERATIONS

The J. M. Brenner Company operates a relatively small, well-controlled crushed stone facility in Lancaster, Pennsylvania. A low-grade limestone is quarried from an open-pit mine and processed through a crushed stone plant rated at about 125 tph. End products consist of a variety of Pennsylvania graded aggregates ranging from 2 1/2 inches to 200 mesh in size. Emission tests were conducted to evaluate the efficiency of the dry collection system used to control particulate emissions from stone processing plant operations.

Broken rock from the quarry is hauled by two 20-ton capacity haul trucks to the crushing plant. At the truck dump, the rock is discharged onto a hoppered reciprocating plate feeder and fed to a 24" x 26" Universal jaw crusher for primary crushing. The crusher product is discharged to a primary belt conveyor and elevated to a 4' x 12' Cedarapids 2-deck vibrating screen for scalping. The minus 1 1/2-inch throughs are chuted to a stacking conveyor and stockpiled as dense graded road-base stone. The plus 2 1/2-inch oversize is gravity fed to a Cedarapids 3033 hammer mill for final reduction. The mill discharge, along with the 1 1/2 to 2 1/2-inch undersizes from the scalping screen, are conveyed to two AEI 4' x 12' screens equipped with 3 decks for final sizing. The material is discharged onto the first screen where 2 1/2, 1 1/2, and 3/4-inch sizes are chuted to open storage bins. The minus 3/4-inch throughsare discharged onto the second screen where 1/2, 1/4, 1/8, and minus 1/8-inch screenings are also chuted to open

bins. End-products are reclaimed and stockpiled by trucks. As indicated by the process flow diagram (Figure 2), this is a rather simple straight line operation.

Dust emissions throughout the plant are captured and vented to two Aggregates Equipment, Inc. Model 46 baghouse collectors. Each unit contains 46 cotton sateen bags and is equipped with a mechanical shaker mechanism for cleaning. The bags are cleaned for one minute about every four hours. Each collector has 3,220 square feet in cloth area and about a 9,000 cfm capacity at a 2.6 to 1 filtering ratio. The first baghouse unit collects emissions captured at the primary jaw crusher discharge, the scalping screen to stacking conveyor transfer point, and both the hammer mill feed and discharge. The second unit controls the two final sizing screens. Emissions are collected at the feed of both screens, from the top of both screens, and at both the head and tail of the shuttle conveyor between the screens. The collected fines, about 4 tons/day, are periodically discharged into a truck and used as choke material in road-base stone.

The process plant operations were closely monitored and testing conducted only when the facilities tested appeared to be operating normally. Throughput was determined by the number of truck dumps during each test period. Each truck is assumed to carry 22 tons/load. The average throughput during each of the three test periods was 132, 119, and 127 tph, respectively. Complete data appear in Appendix C.

The moisture content of the stone processed during testing on November 19, 1974, was determined at two locations, the primary

crusher and the hammer mill discharge points. The moisture content of the stone did not exceed 1/2 of one percent at either location. Moisture samples taken during subsequent testing were regrettably lost. Although there were periods of intermittent rain on November 21, 1974, it is not believed that the moisture content ever exceeded two percent.

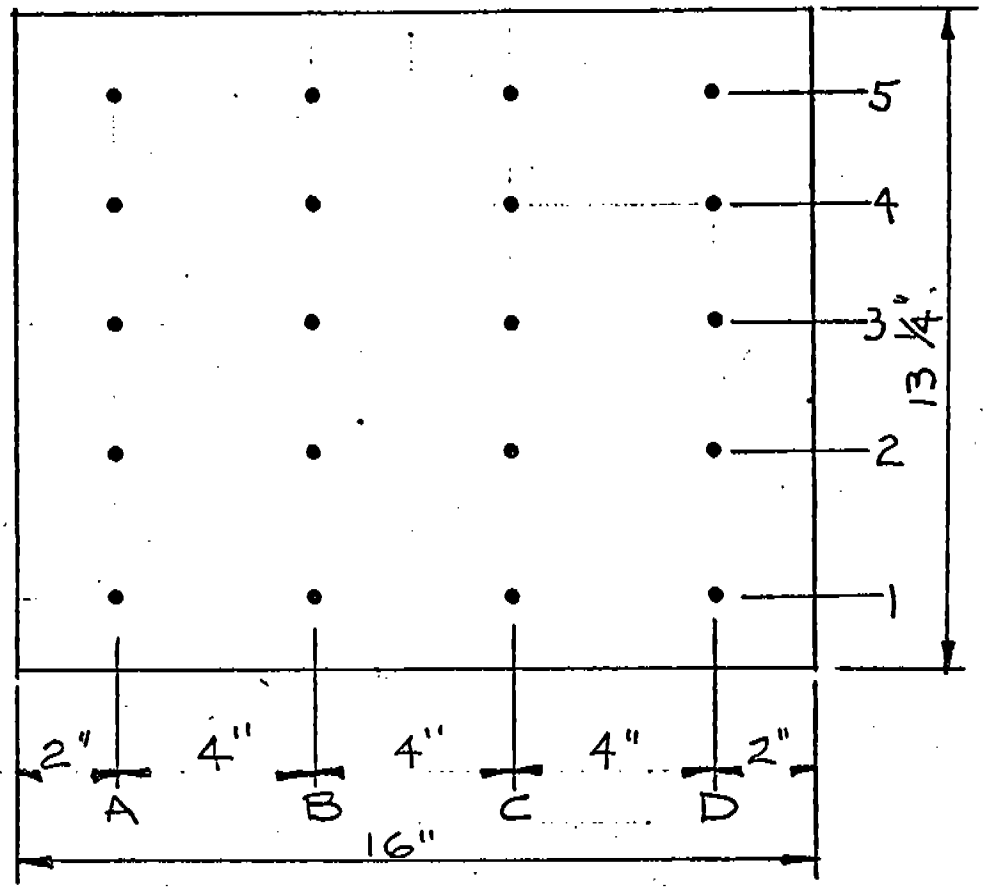
IV. LOCATION OF SAMPLING POINTS

The pertinent data summarizing the physical condition of each sampling location are presented in Figures 3 through 7. All sampling plane locations and sampling point locations met the minimum requirements specified by "Method 1 - Sample and Velocity Traverses for Stationary Sources, U.S. EPA, In-House Draft, 7-18-74," (see Appendix D).

V. SAMPLING AND ANALYTICAL PROCEDURES

All particulate sampling and analytical procedures, including calibration procedures, followed the procedures stipulated in the EPA reference Methods 1, 2, and 5, In-House Drafts. Copies of these draft revised methods are included in Appendix D. Visible emissions observations were made following the guidelines set forth in the November 12, 1974 Federal Register. (See Appendix D.) Exceptions are listed below:

1. Flexible Teflon tubing connected the heated glass probe to the heated filter at all inlet locations. This exception did not apply at the two outlet locations. The tubing was considered as part of the probe and was cleaned and reported accordingly. This alteration is not expected to significantly affect the results of this study and was utilized due to the relatively inaccessible sampling probe positions.



Stack internal dimensions: 13-1/4"deep x 16" wide

Equivalent stack diameters downstream: 6.2 (90")

Equivalent stack diameters upstream: 1.6 (23")

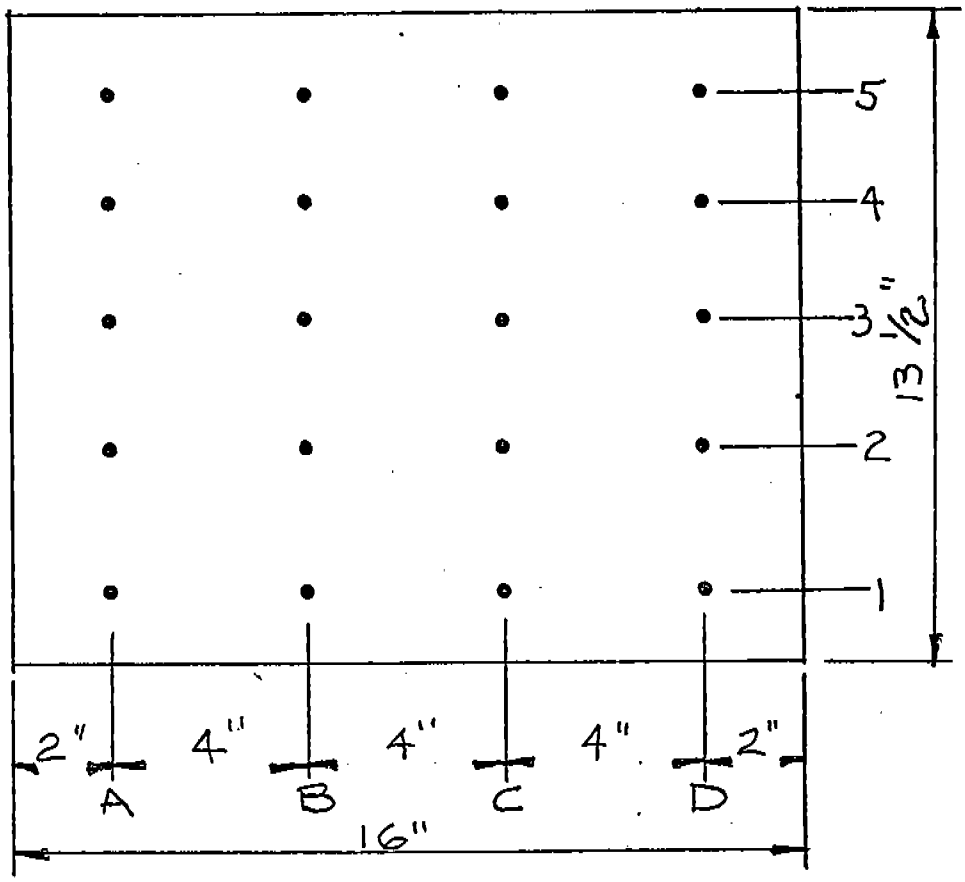
Sampling point locations:

Position	Distance (inches)
1	1-3/8
2	4
3	6-5/8
4	9-1/4
5	11-7/8

FIGURE 3

SCHEMATIC DIAGRAM OF SAMPLING POINT LOCATIONS IN OUTLET A

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974



Stack internal dimensions: 13-1/2"deep x 16" wide

Equivalent diameters downstream: 6.2 (90")

Equivalent diameters upstream: 1.6 (23")

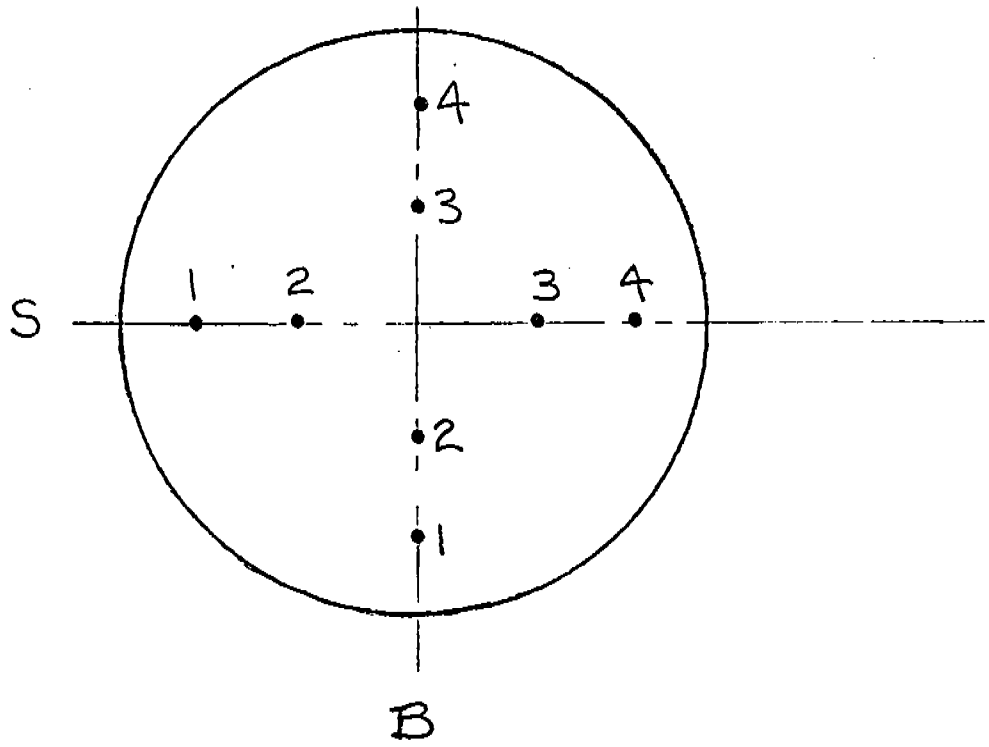
Sampling point locations:

Position	Distance (inches)
1	1-3/8
2	4
3	6-5/8
4	9-1/4
5	11-7/8

FIGURE 4

SCHEMATIC DIAGRAM OF SAMPLING POINT LOCATIONS
IN OUTLET B

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974



Stack diameter: 9-1/2"

Stack diameters downstream: greater than 10

Stack diameters upstream: greater than 10

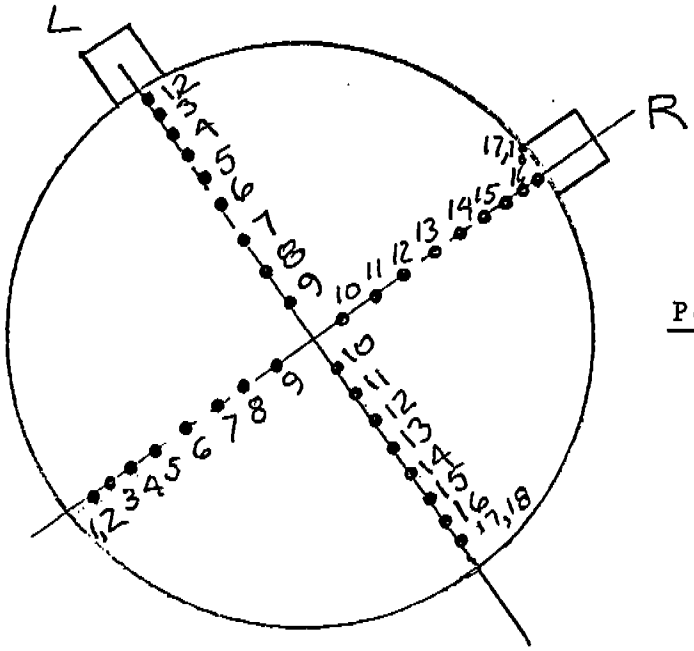
Sampling point locations:

Position	Distance (inches)
1	1
2	2-3/8
3	7-1/8
4	8-1/2

FIGURE 5

SCHEMATIC DIAGRAM OF SAMPLING POINT LOCATIONS
IN INLET C

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974



Stack diameter: 18"

Stack diameters downstream: 2.1 (38")

Stack diameters upstream: 0.6 (10")

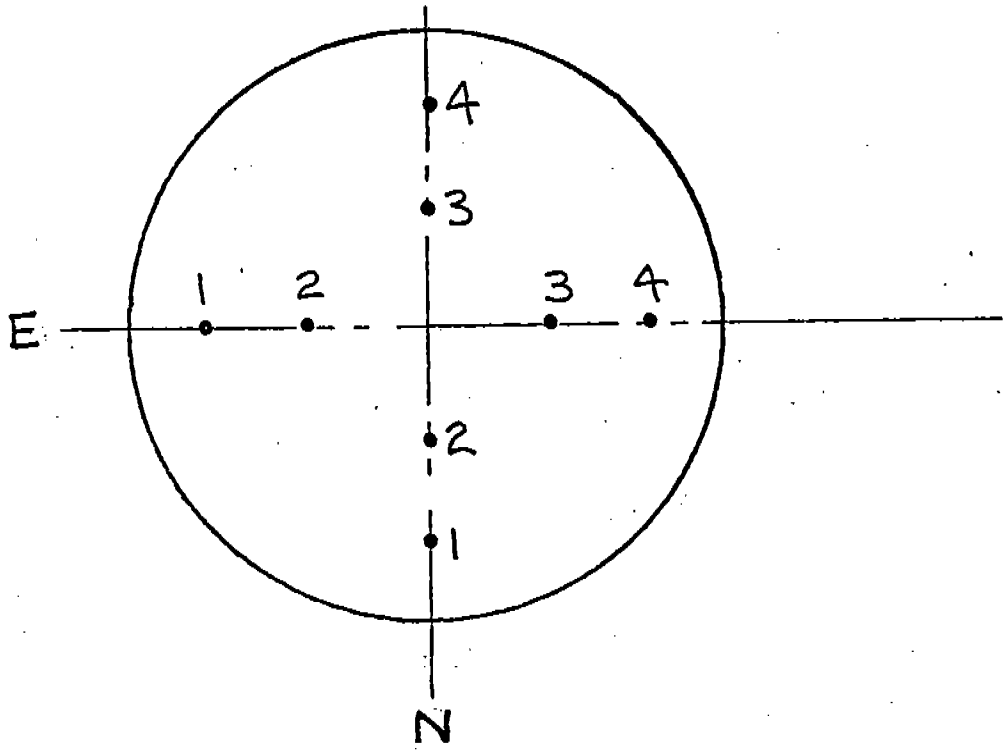
Sampling Point Locations

Position	Distance (inches)
1	1
2	1
3	1-3/8
4	2
5	2-5/8
6	3-3/8
7	4-1/4
8	5-3/8
9	6-7/8
10	11-1/8
11	12-5/8
12	13-3/4
13	14-5/8
14	15-3/8
15	16
16	16-5/8
17	17
18	17

FIGURE 6

SCHEMATIC DIAGRAM OF SAMPLING POINT LOCATIONS IN INLET D

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974



Stack diameter: 18"

Stack diameters downstream: 16 (288")

Stack diameters upstream: 4 (72")

Sampling point locations:

Position	Distance (inches)
1	1-1/4
2	4-1/2
3	13-1/2
4	16-3/4

FIGURE 7

SCHEMATIC DIAGRAM OF SAMPLING POINT LOCATIONS IN INLET E

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

2. "Before test" Pitot tube calibrations were performed at twelve fan settings on the "A" side leg of each Pitot tube and at only three "B" side fan settings. This minor alteration is not expected to significantly alter the results of this study.

3. Nozzle calibrations were performed in-field and at the conclusion of the sampling. Again, this procedure is not expected to significantly alter any of the results of this study.

4. The general plant visible emissions portion of the visible emissions data were obtained on an intermittent basis by moving about the entire stone crushing operation and making measurements and recordings whenever visible emissions occurred.

This report prepared by: Richard J. Rowals/jsna

Richard J. Rowals, P.E.
Environmental Control Engineer

Janet L. Vecchio

Janet L. Vecchio
Group Leader, Data Processing

A P P E N D I C E S

APPENDIX A

PROJECT PARTICIPANTS

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Standards and Engineering Division

R. Terry Harrison	Project Officer Emission Measurement Branch
John R. Floyd	Emission Measurement Branch
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Scott Good	Plant Superintendent
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Richard G. Keller	Environmental Control Specialist
Rebecca B. Knox	Environmental Control Specialist
Thomas A. Loch	Senior Environmental Control Engineer
Richard C. Marcus	Environmental Control Specialist
George M. Santorilla	Environmental Control Specialist

APPENDIX B

SUMMARY OF TOTAL PARTICULATE EMISSIONS

Particulate emissions reported are those collected on the glass fiber filter and in the impinger catch as well as the acetone wash of the sample train from the probe tip (nozzle) back to and including the front part of the filter holder immediately before the filter. This acetone wash includes the Teflon tubing used at Inlets C, D, and E, but does not include the back half of the sampling train.

SUMMARY OF TOTAL PARTICULATE EMISSIONS

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Sampled Source: Outlet A Dimensions: 16" x 13-1/4"

Test Number		1	2	3
Date		11-19	11-21	11-22
Sampling Period	Start	14:21	12:10	09:03
	Stop	16:23	16:20	13:59
Sampled Volume	Am^3 (1)	1.547	7.088	7.173
	DNm^3 (2)	1.524	7.219	7.403
	ACF (3)	54.64	250.3	253.3
	DSCF (4)	53.80	254.9	261.4
Percent Moisture by Volume		1.0	0.4	0.1
Average Stack Temperature	°C	19	3.3	6.7
	°F	66	38	44
Stack Gas Flowrate	Am^3/sec (5)	3.46	3.57	3.55
	DNm^3/sec (6)	3.43	3.64	3.68
	ACFM (7)	7340	7560	7520
	DSCFM (8)	7260	7720	7800
Percent Isokinetic		106.6	97.3	98.9
Feed Rate	M tons/hr (9)	120	108	115
	tons/hr	132	119	127
Sample Weight (mg)		24.3	22.5	52.8
Particulate Concentration	mg/Am^3	15.7	3.2	7.4
	mg/DNm^3	15.9	3.1	7.1
	gr/ACF	0.007	0.001	0.003
	gr/DSCF	0.007	0.001	0.003
Particulate Emission Rate	kg/hr	0.20	0.04	0.09
	kg/M ton of feed	0.002	0.0004	0.0008
	lb/hr	0.43	0.09	0.21
	lb/ton of feed	0.003	0.0008	0.002

(1) Actual cubic meters - stack conditions
(2) Dry normal cubic meters - 20°C, 760 mm Hg
(3) Actual cubic feet - stack conditions
(4) Dry standard cubic feet - 20°C, 760 mm Hg
(5) Actual cubic meters per second - stack conditions
(6) Dry normal cubic meters per second - 20°C, 760 mm Hg
(7) Actual cubic feet per minute - stack conditions
(8) Dry standard cubic feet per minute - 20°C, 760 mm Hg
(9) Metric tons per hour (1 metric ton = 1000 kg)

SUMMARY OF TOTAL PARTICULATE EMISSIONS

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Sampled Source: Outlet B Dimensions: 16" x 13-1/2"

Test Number		1	2	3
Date		11-19	11-21	11-22
Sampling Period	Start	14:22	12:05	08:58
	Stop	16:24	16:15	13:54
Sampled Volume	Am^3 (1)	2.951	6.777	6.355
	DNm^3 (2)	2.948	6.763	6.488
	ACF (3)	104.2	239.3	224.4
	DSCF (4)	104.1	238.8	229.1
Percent Moisture by Volume		0.4	0.3	0.1
Average Stack Temperature	°C	17	10	11
	°F	62	50	51
Stack Gas Flowrate	Am^3/sec (5)	2.94	3.24	3.09
	DNm^3/sec (6)	2.95	3.25	3.16
	ACFM (7)	6220	6870	6540
	DSCFM (8)	6260	6880	6700
Percent Isokinetic		102.0	106.4	104.8
Feed Rate	M tons/hr (9)	120	108	115
	tons/hr	132	119	127
Sample Weight (mg)		57.3	10.0	14.0
Particulate Concentration	mg/Am^3	19.4	1.5	2.2
	mg/DNm^3	19.4	1.5	2.2
	gr/ACF	0.008	0.0006	0.001
	gr/DSCF	0.008	0.0006	0.0009
Particulate Emission Rate	kg/hr	0.21	0.02	0.02
	kg/M ton of feed	0.002	0.0002	0.0002
	lb/hr	0.46	0.04	0.05
	lb/ton of feed	0.003	0.0003	0.0004

(1) Actual cubic meters - stack conditions
(2) Dry normal cubic meters - 20°C, 760 mm Hg
(3) Actual cubic feet - stack conditions
(4) Dry standard cubic feet - 20°C, 760 mm Hg
(5) Actual cubic meters per second - stack conditions
(6) Dry normal cubic meters per second - 20°C, 760 mm Hg
(7) Actual cubic feet per minute - stack conditions
(8) Dry standard cubic feet per minute - 20°C, 760 mm Hg
(9) Metric tons per hour (1 metric ton = 1000 kg)

SUMMARY OF TOTAL PARTICULATE EMISSIONS

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Sampled Source: Inlet C Dimensions: 9-1/2" I.D.

Test Number		1	2
Date		11-21	11-22
Sampling Period	Start	09:00	11:28
	Stop	12:27	15:30
Sampled Volume	Am^3 (1)	2.539	2.533
	DNm^3 (2)	2.537	2.579
	ACF (3)	89.66	89.44
	DSCF (4)	89.58	91.0
Percent Moisture by Volume		0.6	0.6
Average Stack Temperature	°C	4.4	5.6
	°F	40	42
Stack Gas Flowrate	Am^3/sec (5)	0.524	0.519
	DNm^3/sec (6)	0.524	0.529
	ACFM (7)	1110	1100
	DSCFM (8)	1110	1120
Percent Isokinetic		101.8	96.7
Feed Rate	M tons/hr (9)	108	115
	tons/hr	119	127
Sample Weight (mg)		1123.8	1423.8
Particulate Concentration	mg/Am^3	443	562
	mg/DNm^3	443	552
	gr/ACF	0.193	0.246
	gr/DSCF	0.194	0.241
Particulate Emission Rate	kg/hr	0.84	1.1
	kg/M ton of feed	0.008	0.009
	lb/hr	1.8	2.3
	lb/ton of feed	0.02	0.02

(1) Actual cubic meters - stack conditions
(2) Dry normal cubic meters - 20°C, 760 mm Hg
(3) Actual cubic feet - stack conditions
(4) Dry standard cubic feet - 20°C, 760 mm Hg
(5) Actual cubic meters per second - stack conditions
(6) Dry normal cubic meters per second - 20°C, 760 mm Hg
(7) Actual cubic feet per minute - stack conditions
(8) Dry standard cubic feet per minute - 20°C, 760 mm Hg
(9) Metric tons per hour (1 metric ton = 1000 kg)

SUMMARY OF TOTAL PARTICULATE EMISSIONS

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Sampled Source: Inlet D Dimensions: 18" I.D.

Test Number		1	2
Date		11-21	11-22
Sampling Period	Start	12:02	13:50
	Stop	09:06	11:14
Sampled Volume	Am^3 (1)	2.513	2.376
	DNm^3 (2)	2.507	2.406
	ACF (3)	88.74	83.91
	DSCF (4)	88.54	84.97
Percent Moisture by Volume		1.2	1.1
Average Stack Temperature	°C	2.8	5.0
	°F	37	41
Stack Gas Flowrate	Am^3/sec (5)	3.65	3.46
	DNm^3/sec (6)	3.66	3.52
	ACFM (7)	7740	7340
	DSCFM (8)	7750	7460
Percent Isokinetic		96.6	96.4
Feed Rate	M tons/hr (9)	108	115
	tons/hr	119	127
Sample Weight (mg)		18.9	13654.7
Particulate Concentration	mg/Am^3	7.5	5750
	mg/DNm^3	7.5	5680
	gr/ACF	0.003	2.51
	gr/DSCF	0.003	2.48
Particulate Emission Rate	kg/hr	0.10	71.9
	kg/M ton of feed	0.0009	0.63
	lb/hr	0.22	159
	lb/ton of feed	0.002	1.3

(1) Actual cubic meters - stack conditions
(2) Dry normal cubic meters - 20°C, 760 mm Hg
(3) Actual cubic feet - stack conditions
(4) Dry standard cubic feet - 20°C, 760 mm Hg
(5) Actual cubic meters per second - stack conditions
(6) Dry normal cubic meters per second - 20°C, 760 mm Hg
(7) Actual cubic feet per minute - stack conditions
(8) Dry standard cubic feet per minute - 20°C, 760 mm Hg
(9) Metric tons per hour (1 metric ton = 1000 kg)

SUMMARY OF TOTAL PARTICULATE EMISSIONS

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Sampled Source: Inlet E* Dimensions: 18" I.D.

Test Number		1	2
Date		11-21	11-22
Sampling Period	Start	12:05	14:10
	Stop	08:58	10:58
Sampled Volume	Am^3 (1)	4.511	2.700
	DNm^3 (2)	4.454	2.713
	ACF (3)	159.3	95.34
	DSCF (4)	157.3	95.79
Percent Moisture by Volume		0.3	0.8
Average Stack Temperature	°C	7.2	7.2
	°F	45	45
Stack Gas Flowrate	Am^3/sec (5)	5.62	4.58
	DNm^3/sec (6)	5.57	4.62
	ACFM (7)	11,900	9710
	DSCFM (8)	11,800	9790
Percent Isokinetic		97.6	168.5
Feed Rate	M tons/hr (9)	108	115
	tons/hr	119	127
Sample Weight (mg)		741.9	1944.8
Particulate Concentration	mg/Am^3	164	720
	mg/DNm^3	167	717
	gr/ACF	0.072	0.315
	gr/DSCF	0.073	0.313
Particulate Emission Rate	kg/hr	3.3	11.9
	kg/M ton of feed	0.03	0.10
	lb/hr	7.4	26.3
	lb/ton of feed	0.06	0.21

(1) Actual cubic meters - stack conditions
(2) Dry normal cubic meters - 20°C, 760 mm Hg
(3) Actual cubic feet - stack conditions
(4) Dry standard cubic feet - 20°C, 760 mm Hg
(5) Actual cubic meters per second - stack conditions
(6) Dry normal cubic meters per second - 20°C, 760 mm Hg
(7) Actual cubic feet per minute - stack conditions
(8) Dry standard cubic feet per minute - 20°C, 760 mm Hg
(9) Metric tons per hour (1 metric ton = 1000 kg)

* Validity of data for Inlet E is questionable.

APPENDIX C

PROCESS OPERATION LOG

J.M. Brenner Company
Lancaster, Pennsylvania
November 19-22, 1974

Date	Time	Elapsed Time (min)	No. of Truck Dumps[a]	Tons	TPH	Remarks
11/19	1420	--	--	--	--	Start of test period
	1520	60	6	132	132	
	1620	60	6	132	132	End of test period
		120	12	264	132[b]	
11/21	1200	--	--	--	--	Start of test period
	1300	60	5	110	110	
	1400	60	5	110	110	
	1500	60	5	110	110	
	1600	60	6	132	132	
	1620	20	2	44	132	End of test period
		260	23	506	119	
11/22	0900	--	--	--	--	Start of test period
	1000	60	6	132	132	
	1025	25	--	--	--	Crusher down
	1040	15[c]	--	--	--	Crusher restarted
	1100	20	4	88	117	
	1130	30	3	66	132	Stopped for lunch
	1205	--	--	--	--	Restarted process
	1300	55	5	110	120	
	1400	60	6	132	132	End of test period
		250	24	528	127	

(a) Assumes 22 tons/dump

(b) Average throughput over test period

(c) Not included in elapsed time

APPENDIX D

CALIBRATION, SAMPLING, AND ANALYTICAL PROCEDURES

METHOD 1--SAMPLE AND VELOCITY TRAVERSES FOR STATIONARY SOURCES

1. Principle and Applicability

1.1 Principle. A sampling site and the number of traverse points are selected to aid in the extraction of a representative sample.

1.2 Applicability. This method should be applied only when specified by the test procedures for determining compliance with the new source performance standards. In addition, unless otherwise specified, this method is intended to apply only to gas streams that emit directly to the atmosphere without further processing and only to new sources.

If applied to existing sources, some sites may not lend themselves to this method and temporary alterations to the stack or deviation from the standard procedure may be required. Such cases are subject to approval by the Administrator.

This method is not applicable to stacks containing cyclonic or swirling flow or stacks smaller than about 0.3 m (1 ft) in diameter or 0.07 m^2 (0.8 ft^2) in cross sectional area. When these cases are encountered, consult with the Administrator to determine an acceptable solution.

2. Procedure

2.1 Sampling site. Select a sampling site that is at least 8 stack or duct diameters downstream and 2 diameters upstream from any flow disturbance such as a bend, expansion, contraction, or

visible flame. If impractical, select an alternate site that is at least 2 stack or duct diameters downstream and 0.5 diameter upstream from the flow disturbances. For a rectangular cross section, use an equivalent diameter calculated from the following equation to determine the respective distances:

$$D_e = \frac{2LW}{(L + W)} \qquad \text{Equation 1-1}$$

where:

D_e = equivalent diameter

L = length

W = width

2.2 Minimum number of traverse points. When the 8 and 2 diameter criteria can be met, the minimum number of traverse points shall be 12 for stack diameters greater than 0.6 m (24 in.) and 8 for stack diameters equal to or less than 0.6 m (24 in.).

When the 8 and 2 diameter criteria cannot be met, use Figure 1-1 to determine the minimum number of traverse points. To use this figure, first determine the distances from the chosen sampling location to the nearest upstream and downstream disturbances. Divide each distance by the diameter or equivalent diameter to determine the distance in terms of the number of duct diameters. Then, determine from Figure 1-1 the minimum number of traverse points that corresponds (1) to the number of duct diameters upstream and (2) to the number of diameters downstream. Select the higher of the two minimum numbers of traverse points, or a greater value, such that for circular stacks the number is a multiple of four, and for

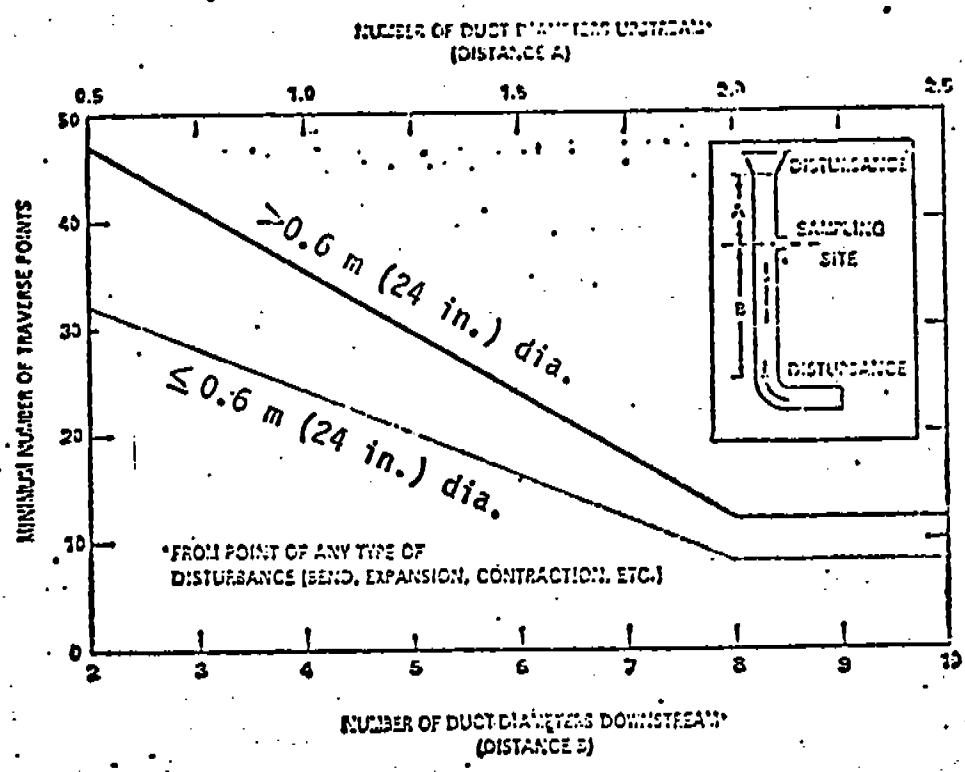


Figure 1-1. Minimum number of traverse points.

Traverse Pt.	Dist. In %
1	4.4
2	14.7
3	29.5
4	70.5
5	85.3
6	95.6

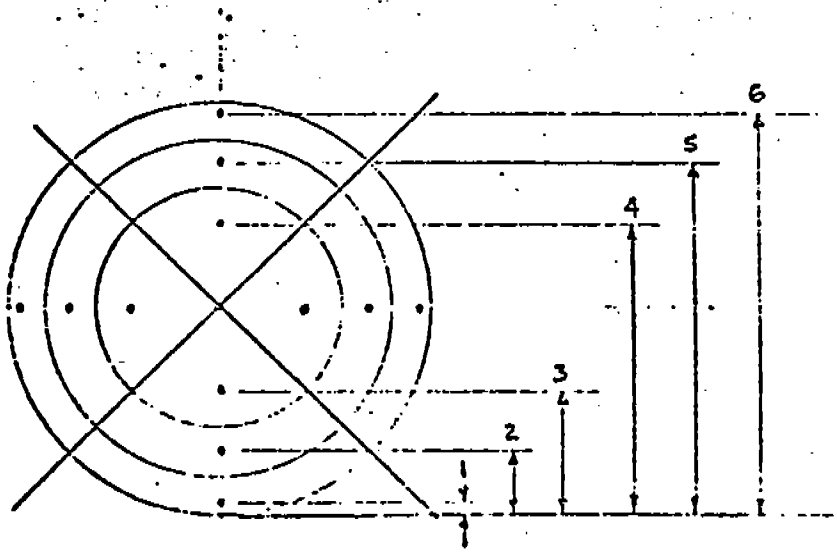


Figure 1-2. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points of each area.

rectangular stacks, the number follows the criteria in section 2.3.2.

2.3 Cross sectional layout and location of traverse points.

2.3.1 Circular stacks. Locate the traverse points on two perpendicular diameters according to Table 1-1 and the example shown in Figure 1-2.

When large cross sectional variation of the pollutant concentration is suspected, the Administrator may specify that more than two diameters which divide the stack cross section into equal parts shall be used. More than two diameters may also be used with approval from the Administrator for unusually large diameter stacks.

One of the diameters shall be in a plane containing the greatest expected concentration variation, e.g., after bends one diameter shall be in the plane of the bend. This latter requirement becomes less critical as the distance from the disturbance increases. Therefore, with approval from the Administrator, other diameter locations may be used.

In addition, for stacks greater than 0.6 m (24 in.) no sampling points shall be selected within 2.54 cm (1 in.) of the stack walls, and for stacks equal to or less than 0.6 m (24 in.), within 1.27 cm (1/2 in.) of the stack walls. To meet this criteria, do the following:

2.3.1.1 Stacks greater than 0.6 m (24 in.). First, determine the larger distance of (1) 2.54 cm (1 in.) plus the nozzle inside diameter and (2) 2 times the nozzle inside diameter. Then, determine if any of the traverse points as located in section 2.3.1 fall

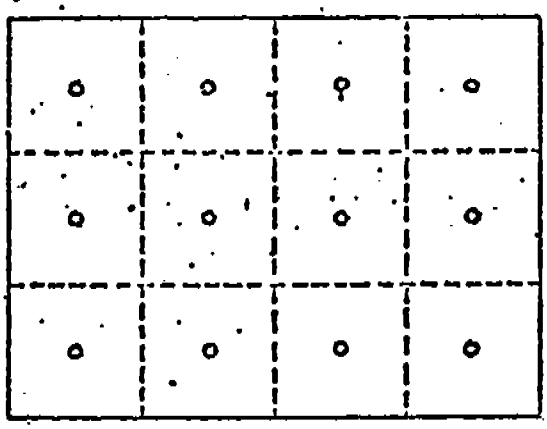


Figure 1-3 Example showing rectangular stack cross section divided into 12 equal areas, with traverse points at centroid of each area.

Table 1-1. Location of traverse points in circular stacks
(Percent of stack diameter from inside wall to traverse point)

Traverse point number on a diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.3	2.5	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.3	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.5	10.5
6			95.6	80.6	65.8	35.5	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.5	36.6	28.3	23.6	20.4	18.0	16.1
8				96.7	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	52.2	38.6	33.1	29.0
10					97.5	88.2	78.0	71.7	61.8	52.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	52.3	32.3
12						97.9	90.1	83.1	76.1	68.4	60.7	39.8
13							94.3	87.5	81.2	73.0	65.5	60.2
14							98.2	91.5	85.4	78.8	73.9	67.7
15								95.1	88.1	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	92.8	88.4	83.9
19										95.1	91.2	86.8
20										97.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

within the larger of the two distances. If there are any, relocate them to the larger of (1) 2.54 cm (1 in.) or (2) the nozzle inside diameter of the stack walls. This relocated traverse point shall be the "adjusted" traverse point.

Count the number of traverse points relocated to the adjusted traverse point. The sampling time at this adjusted traverse point shall be this number times the sampling time increment at a non-adjusted sampling point as obtained by the respective pollutant sampling method, e.g., Method 5.

2.3.1.2 Stacks equal to or less than 0.6 m (24 in.). Follow the procedure in section 2.3.1.1, except use 1.27 cm (0.5 in.) instead of 2.54 cm (1 in.).

2.3.2 Rectangular stacks. Divide the cross section into as many equal rectangular areas as traverse points, such that the ratio of the length to the width of the elemental areas is between one and two. Locate the traverse points at the centroid of each equal area according to the example in Figure 1-3.

The situation of section 2.3.1 concerning sampling points too close to the stack walls is not expected to arise with rectangular stacks. On the remote possibility that it does occur, consult with the Administrator.

3. References

3.1 Determining Dust Concentration in a Gas Stream, ASME Performance Test Code #27, New York, N. Y., 1957.

3.2 Devorkin, Howard, et al., Air Pollution Source Testing Manual, Air Pollution Control District, Los Angeles, Calif., November 1963.

3.3 Methods for Determination of Velocity. Volume, Dust and Mist Content of Gases, Western Precipitation Division of Joy Manufacturing Co., Los Angeles, Calif. Bulletin WP-50, 1963.

3.4 Standard Method for Sampling Stacks for Particulate Matter, In: 1971 Book of ASTM Standards, Part 23, Philadelphia, Pa. 1971. ASTM Designation D-2928-71.

METHOD 2--DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE (TYPE S PITOT TUBE)

1. Principle and Applicability

1.1 Principle. Stack gas velocity is determined from the gas density and from measurement of the velocity head using a Type S (Stausscheibe or reverse type) pitot tube.

1.2 Applicability. This method should be applied only when specified by the test procedures for determining compliance with the new source performance standards.

This procedure is not applicable for direct measurement in cyclonic or swirling gas streams. When these conditions exist, procedures such as the use of flow straightening devices must be employed as necessary to make accurate flow rate determinations. Such procedures are subject to approval by the Administrator.

2. Apparatus

Specifications for the apparatus are given below. Any apparatus which has been demonstrated to the Administrator's satisfaction to be capable of meeting the specifications will be considered acceptable for the purposes of this method.

2.1 Pitot tube. Type S (Figure 2-1), or equivalent, with a coefficient within 5% over the working range. The pitot tube shall be calibrated according to the procedure in section 4. Other devices may be used when approved by the Administrator.

2.2 Differential pressure gauge. Inclined manometer capable of measuring velocity head to within 10% of the minimum measured

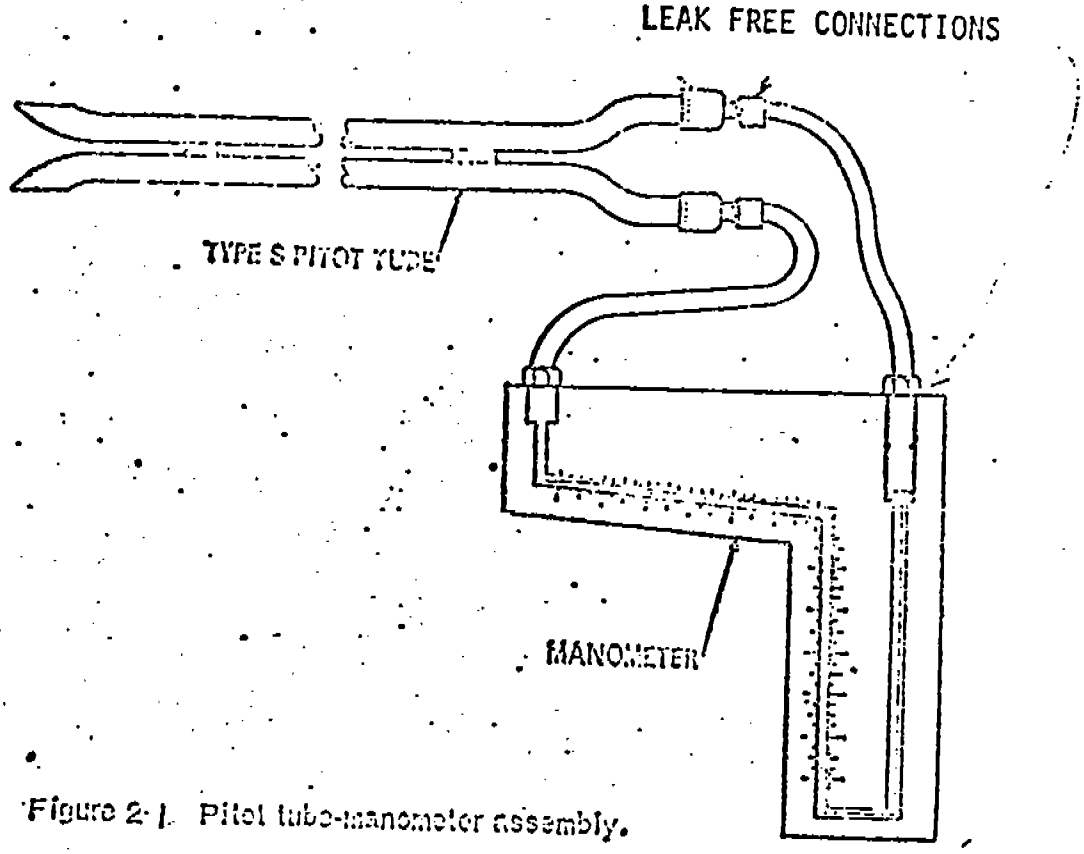


Figure 2-1. Pitot tube-manometer assembly.

value. Below a differential pressure of 1.3 mm (0.05 in.) water gauge, micromanometers with sensitivities of 0.013 mm (0.0005 in.) should be used. However, micromanometers are not easily adaptable to field conditions and are not easy to use with pulsating flow. Thus, methods or other devices acceptable to the Administrator may be used when conditions warrant.

2.3 Temperature gauge. Thermocouple, liquid filled bulb thermometer, bimetallic thermometer, mercury-in-glass thermometer, or other gauges that are capable of measuring temperature to within 1.5% of the minimum absolute stack temperature. The temperature gauge shall be attached to the pitot tube such that the sensor does not touch any metal and its position is adjacent and about 1.27 to 2.54 cm (0.5 to 1 in.) from the pitot tube openings. If it can be shown to the satisfaction of the Administrator that a difference of not more than 1% in.the velocity measurement will be introduced, the temperature gauge need not be attached to the pitot tube.

2.4 Pressure probe and gauge. Piezometer tube and mercury- or water-filled U-tube manometer capable of measuring stack pressure to within 2.5 mm Hg (0.1 in. Hg). The static tap of a standard type pitot tube or one leg of a Type S pitot tube with the face openings positioned parallel to the gas flow may also be used as the pressure probe.

2.5 Barometer. Mercury, aneroid, or other barometers capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby weather bureau station, in which case the station value shall be

requested and an adjustment for elevation differences shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase.

2.6 Gas analyzer. To analyze gas composition for determining molecular weight. Use Method 3 or other methods specified by the Administrator for dry molecular weight and use Method 5 or Reference Method 4 for moisture content. Other methods may be used when approved by the Administrator.

2.7 Calibration pitot tube. Standard type, to calibrate the Type S pitot tube. The standard type pitot tube shall have a known coefficient obtained from the National Bureau of Standards, Route 70 S, Quince Orchard Road, Gaithersburg, Maryland. An alternative is to use a Prandtl type pitot tube designed according to the criteria (given below and illustrated in Figure 2-2) which ensure that its coefficient will be 0.99 ± 0.01.

2.7.1 Hemispherical tip (inlet end of the impact tube).

2.7.2 Eight diameters of straight run (based on the diameter of the external tube) between the tip and the static pressure holes.

2.7.3 Sixteen diameters between the static pressure holes and the centerline of the external tube, following the 90^{o} bend.

2.7.4 Eight static pressure holes of equal size (approximately 1/32 in. diameter), equally spaced in a piezometer ring configuration.

2.7.5 Ninety-degree bend of relatively large radius (approximately three diameters).

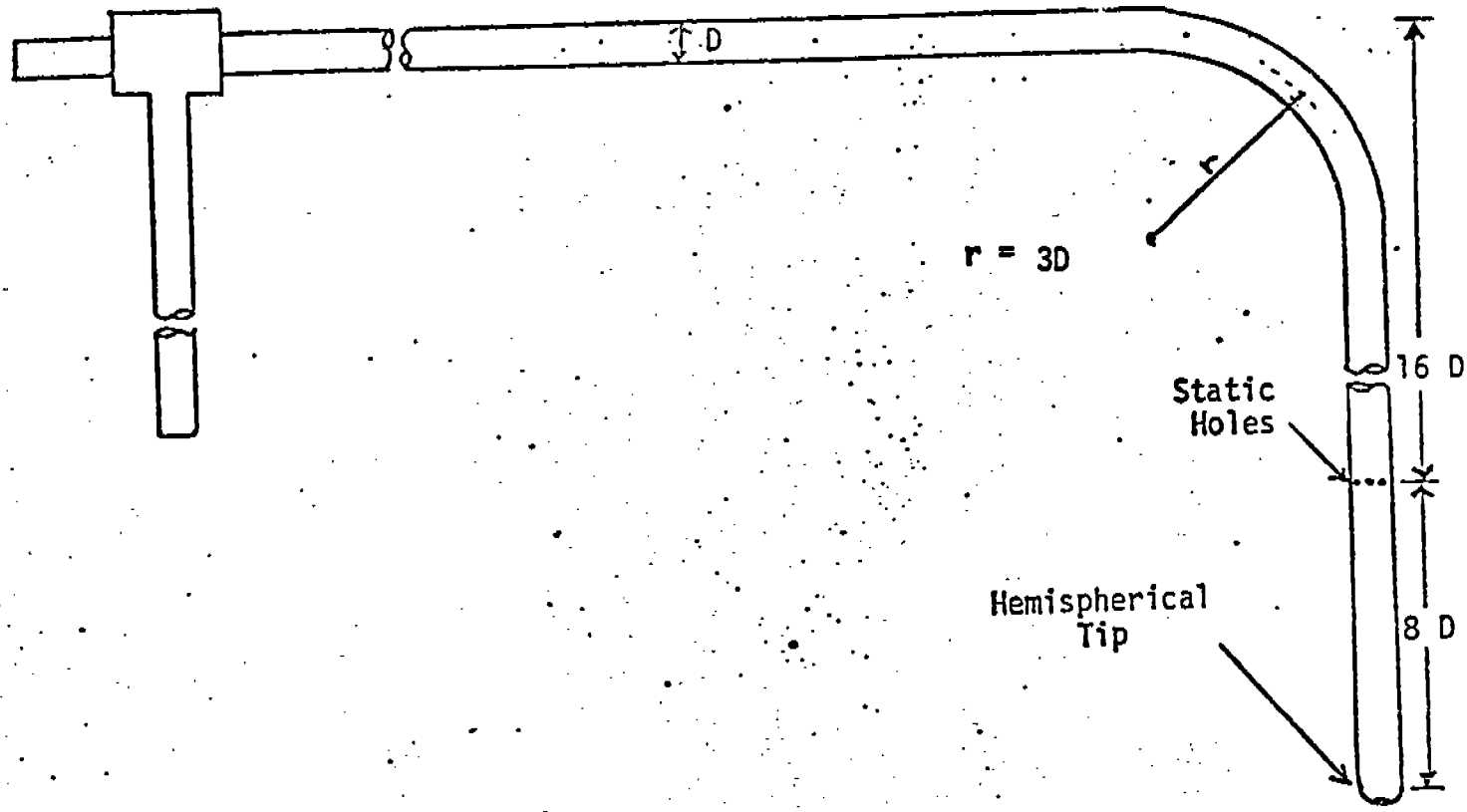


Figure 2-2. Standard Pitot Tube.

2.8 Calibration differential pressure gauge--For calibration purposes, inclined manometer capable of measuring velocity head to within 5%.

3. Procedure

3.1 Set up the apparatus as shown in Figure 2-1. Make sure all connections are tight and leak free. Level and zero the manometer. Record all necessary data as shown in the example data sheet (Figure 2-3).

3.2 Measure the velocity head and temperature at the traverse points specified by Method 1.

3.3 Measure the static pressure in the stack. One reading is usually adequate for all measuring points during the test; however, this must be confirmed by randomly moving the pressure probe over the cross section to see if there are any significant variations, i.e., greater than about 75 mm H_2O (3 in. H_2O). If there are significant variations, check the location for disturbances. If none are found, measure the static pressure at each traverse point.

3.4 Determine the atmospheric pressure.

3.5 Determine the dry stack gas molecular weight. For combustion processes, use Method 3. For processes emitting essentially air, an analysis need not be conducted; use a molecular weight of 29. For other processes, consult the Administrator.

3.6. Obtain the moisture content from Method 5 or by using Reference Method 4.

3.7 Determine the cross sectional area of the stack or duct at the sampling location.

Figure 2-3. Velocity Traverse Data

PLANT _____

DATE _____

RUN NO. _____

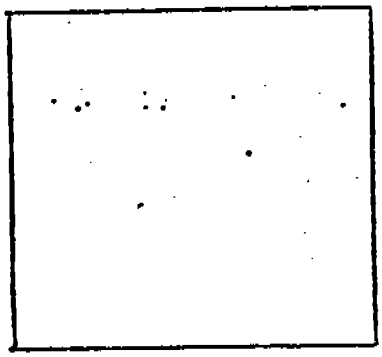
STACK DIAMETER, m (in.) _____

BAROMETRIC PRESSURE, mm Hg (in. Hg) _____

STATIC PRESSURE IN STACK (P_g), mm Hg (in. Hg) _____

CROSS SECTIONAL AREA, m^2 (ft^2) _____

OPERATORS _____



SCHEMATIC OF STACK CROSS SECTION

Traverse Pt. No.	Vel. Hd., Δp mm (in.) H_2O	Stack Temperature		$\sqrt{T_s \Delta p}$
		t_s, ^oC (^oF)	T_s, ^oK (^oR)	
		Average		

4. Calibration

4.1 Pitot tube.

4.1.1 Calibration set-up--Calibration shall be done in a flow system having the following essential design features:

4.1.1.1 The "flowing gas stream" must be confined to a definite cross sectional area, either circular or rectangular. For circular ducts, the diameter must be at least 20 cm (8 in.), and for rectangular ducts, the width (shorter side) must be at least 20 cm (8 in.). The cross sectional area must be constant over a distance of 10 or more duct diameters. For a rectangular cross section, use an equivalent diameter calculated from the following equation to determine the number of duct diameters:

$$D_e = \frac{2 L W}{(L + W)} \qquad \text{Equation 2-1}$$

where:

D_e = equivalent diameter

L = length

W = width

4.1.1.2 To ensure the presence of stable, fully developed turbulent flow patterns at the calibration site, or "test section", the site must be located at least 8 diameters downstream and two diameters upstream from the nearest disturbances.

4.1.1.3 The system must have the capacity to generate at least six different test section velocities, at approximately equal intervals, in the range of 300 to 1525 m/min (1000 to 5000 fpm). (Note:

When velocities beyond this range are expected, consult with the Administrator to determine an acceptable procedure.) The velocity at each fan setting must be constant with time, to guarantee the presence of steady flow during calibration.

4.1.1.4 In order to calibrate the Type S pitot tube, velocity head readings must be taken at a specific point in a flowing gas stream with both the standard and Type S pitot tubes. Thus, two entry ports, one each for the standard and Type S pitot tubes, shall be cut in the test section; the standard pitot entry port shall be located slightly downstream of the Type S port, so that the standard and Type S impact openings will lie in the same plane during calibration. To facilitate alignment of the pitot tubes during calibration, it is advisable that the test section be constructed of plexiglas or some other transparent material.

4.1.2 Calibration procedure. It is recommended that an identification number be assigned to the pitot tube, and that this number be permanently marked or engraved on the body of the tube; also, one leg of the tube should be marked "A", and ther other, "B".

Obtain calibration data for both the "A" and "B" sides at the 6 or more different test section velocities. Proceed as follows:

4.1.2.1 Clean and fill the manometer. Inspect and leak check all pitot lines and fittings; repair or replace if necessary.

4.1.2.2 Level and zero the manometer. Turn on the fan to setting No. 1, and allow the flow to stabilize. Seal with tape the Type S entry port.

4.1.2.3 Using the standard type pitot tube, locate an area where there is little or no velocity variation over a 5 cm (2 in.) square sgement. Using this area, align the standard pitot tube so that its tip is pointing directly into the flow; if the tube is inserted and held manually, particular care should be taken to avoid "yaw" and "pitch" angles. Make sure that the entry port surrounding the tube is properly sealed.

4.1.2.4 Read Δp_{std} and record its value in a data table similar to that shown in Figure 2-4. Remove the standard pitot tube from the duct; disconnect it from the manometer.

4.1.2.5 Seal the standard port and open the Type S port. Connect the Type S tube to the manometer. Insert and align the Type S pitot tube so that the "A" side impact opening is at the same measuring point as was the standard tube and is pointing directly into the flow. Make sure that the entry port surrounding the tube is properly sealed.

4.1.2.6 Read Δp_S and record its value in the data table. Remove the Type S tube from the duct and disconnect the manometer.

4.1.2.7 Repeat steps 4.1.2.2 through 4.1.2.6 above for a second set of readings until two sets of velocity head measurements are within 5%.

4.1.2.8 Repeat steps 4.1.2.2 through 4.1.2.7 for fan setting No. 1 for the "B" side.

4.1.2.9 Repeat step 4.1.2.2 through 4.1.2.9 for fan settings No. 2 through No. 6, or as applicable.

Figure 2-4. Pitot Tube Calibration Data

Pitot Tube Identification Number:

	"A" Side Calibration			
Fan Setting	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(S)}$	$C_{p(S)}$ Average
1a				
1b				
2a				
2b				
3a				
3b				
4a				
4b				
5a				
5b				
6a				
6b				

	"B" Side Calibration			
Fan Setting	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(S)}$	$C_{p(S)}$ Average
1a				
1b				
2a				
2b				
3a				
3b				
4a				
4b				
5a				
5b				
6a				
6b				

4.1.3 Calculations.

4.1.3.1 For each data point, calculate the Type S pitot tube coefficient using the following formula:

$$C_{p(S)} = C_{p(std)} \sqrt{\frac{\Delta p_{std}}{\Delta p_S}} \qquad \text{Equation 2-2}$$

where:

$C_{p(S)}$ = Type S pitot tube coefficient.

$C_{p(std)}$ = Standard pitot tube coefficient; use 0.99 if the coefficient is unknown and the tube is designed according to the guidelines in section 2.7.

Δp_{std} = Velocity head measured by the standard pitot tube, cm H_2O (in. H_2O).

Δp_S = Velocity head measured by the Type S pitot tube, cm H_2O (in. H_2O).

4.1.3.2 For each fan setting, determine the average C_p of the two values taken in step 4.1.2.7 for side "A" and likewise for the two values taken in step 4.1.2.8 for side "B". Determine the difference. Use the pitot tube only if the differences at each fan setting differ by no more than 0.01.

4.1.3.3 Plot each calculated C_p for each "A" and "B" side against the velocity. Use the pitot tube in that range of velocities where the coefficient varies no more than 5%.

4.1.4 Recalibration and Maintenance. If the tube has been significantly damaged by field use, i.e., if impact faces are badly

bent out of shape, cut, nicked, or noticeably misaligned, the tube shall be repaired and recalibrated, or replaced.

4.2 Temperature gauges. Calibrate against mercury-in-glass thermometers.

4.3 Barometers. Calibrate against a mercury barometer.

5. Calculations

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

5.1 Nomenclature.

A = Cross sectional area of stack, m^2 (ft^2).

B_{ws} = Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.

C_p = Pitot tube coefficient, dimensionless.

K_p = Pitot tube constant, $34.97 \frac{m}{sec} \left[\frac{(g/g\text{-mole})(mm\ Hg)}{(^oK)\ (mm\ H_2O)}\right]^{1/2}$

for the metric system and

$85.48 \frac{ft}{sec} \left[\frac{(lb/lb\text{-mole})(in.\ Hg)}{(^oR)\ (in.\ H_2O)}\right]^{1/2}$ for the English syste

M_d = Molecular weight of stack gas, dry basis (from Method 3 or other approved methods), g/g-mole (lb/lb-mole).

M_s = Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole).

$= M_d(1-B_{ws}) + 18\ B_{ws}$ Equation 2-3

P_{bar} = Atmospheric pressure, mm Hg (in. Hg).

P_g = Stack static pressure, mm Hg (in. Hg).

P_s = Absolute stack gas pressure, mm Hg (in. Hg).

$$= P_{bar} + P_g \qquad \text{Equation 2-4}$$

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr).

t_s = Stack temperature, ^{o}C (^{o}F).

T_s = Absolute stack temperature, ^{o}K (^{o}R).

$$= 273 + t_s \text{ for metric} \qquad \text{Equation 2-5}$$

$$= 460 + t_s \text{ for English} \qquad \text{Equation 2-6}$$

T_{std} = Standard absolute temperature, 293^{o} K (528^{o} R).

v_s = Stack gas velocity, m/sec (ft/sec).

Δp = Velocity head of stack gas, mm H_2O (in. H_2O).

3600 = Conversion factor, sec/hr.

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

5.2 Average stack gas velocity.

$$v_s = \frac{K_p C_p}{\sqrt{P_s M_s}} \left(\sqrt{T_s \Delta p}\right)_{avg} \qquad \text{Equation 2-7}$$

See Figure 2-3 on how to calculate the average of the product of T_s and Δp. Note: Equation 2-7 assumes that P_s and M_s do not change appreciably with cross section and with time. For other cases, consult with the Administrator to determine an acceptable procedure.

5.3 Average stack gas dry volumetric flow rate.

$$Q_{sd} = 3600\ (1 - B_{ws})\ v_s\ A \left[\frac{T_{std}}{T_{s(avg)}}\right] \left[\frac{P_s}{P_{std}}\right] \quad \text{Equation 2-8}$$

See Figure 2-3 on how to calculate the average absolute stack temperature, $T_{s(avg)}$.

6. References

6.1 Mark, L. S., Mechanical Engineer's Handbook, McGraw-Hill Book Co., Inc., New York, N. Y., 1951.

6.2 Perry, J. H., Chemical Engineers' Handbook, McGraw-Hill Book Co., Inc., New York, N. Y., 1960.

6.3 Shigehara, R. T., W. F. Todd, and W. S. Smith, Significance of Errors in Stack Sampling Measurements. Paper presented at the Annual Meeting of the Air Pollution Control Association, St. Louis, Mo., June 14-19, 1970.

6.4 Standard Method for Sampling Stacks for Particulate Matter. In: 1971 Book of ASTM Standards, Part 23, Philadelphia, Pa., 1971. ASTM Designation D-2928-71.

6.5 Vennard, J. K., Elementary Fluid Mechanics, John Wiley & Sons, Inc., New York, N.Y., 1947.

6.6 ASME, Fluid Meters - Their Theory and Application, ASME, N. Y., 1959.

METHOD 5--DETERMINATION OF PARTICULATE EMISSIONS FROM STATIONARY SOURCES

1. Principle and Applicability

1.1 Principle. Particulate matter is withdrawn isokinetically from the source and collected on glass fiber filter maintained at temperatures equal to or less than 120 ± 14° C (248 ± 25° F) or such other temperature as specified by an applicable subpart of the standards. The particulate mass is determined gravimetrically after removal of uncombined water.

1.2 Applicability. This method is applicable for the determination of particulate emissions from stationary sources only when specified by the test procedures for determining compliance with new source performance standards.

2. Apparatus

2.1 Sampling train. A schematic of the sampling train used in this method is shown in Figure 5-1. Commercial models of this train are available. However, if one desires to build his own, complete construction details are described in APTD-0581; for changes from the APTD-0581 document and for allowable modifications to Figure 5-1, see the following subsections.

The operating and maintenance procedures for the sampling train are described in APTD-0576. Since correct usage is important in obtaining valid results, all users should read the APTD-0576 document and adopt the operating and maintenance procedures outlined in it, unless otherwise specified herein.

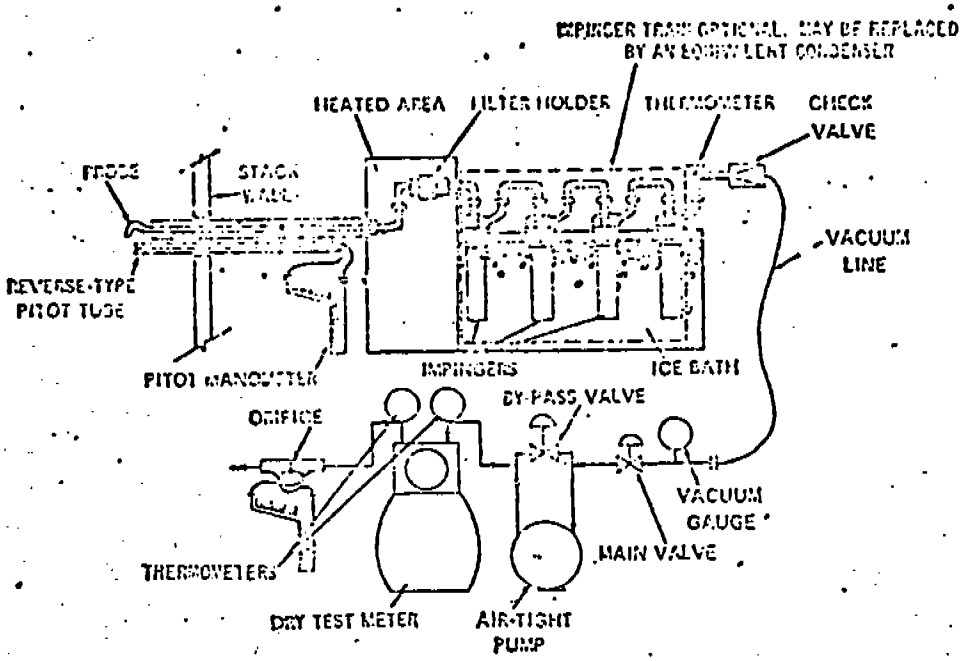


Figure 5-1. Particulate-sampling train.

NOZZLE IDENTIFICATION NO.

PLANT
LOCATION
OPERATOR
DATE
RUN NO.
SAMPLE BOX NO.
METER BOX NO.
METER $\Delta H_@$
C FACTOR

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE
ASSUMED MOISTURE, %
HEATER BOX SETTING
PROBE LENGTH, m
NOZZLE DIAMETER, in.
PROBE HEATER SETTING
LEAK RATE, m^3/min (cfm)

EXACT

—m (ft)
—cm (in)

SCHEMATIC OF STACK CROSS SECTION

TRAVERSE POINT NUMBER	SAMPLING TIME, min	STACK PRESSURE, mm Hg (in Hg)	STACK TEMPERATURE, °C (°F)	VELOCITY HEAD, mm H_2O (in H_2O)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER, mm H_2O (in H_2O)	GAS SAMPLE VOLUME, m^3 (ft^3)	GAS SAMPLE TEMPERATURE AT DRY GAS METER		AVG. PROBE TEMPERATURE, °C (°F)	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, °C (°F)
							INLET, °C (°F)	OUTLET, °C (°F)		
TOTAL							Avg.	Avg.		
Average										

mmHg(in Hg) mm H_2O(in H_2O) °C(°F) °C(°F)

°C(°F) $m^3(ft^3)$ °C(°F) °C(°F)

2.1.1 Probe nozzle--Stainless steel (316) with sharp, tapered leading edge. The angle of taper shall be $\leq 30^{\circ}$ and the taper shall be on the outside to preserve a constant internal diameter. The probe nozzle shall be of the button-hook or elbow design, unless otherwise specified by the Administrator. The wall thickness of the nozzle shall be less than or equal to that of a 20 gauge tubing, i.e., 0.165 cm (0.065 in.) and the distance from the tip of the nozzle to the first bend or point of disturbance shall be at least two times the outside nozzle diameter. The nozzle shall be constructed from seamless stainless steel tubing. Other configurations and construction material may be used with approval from the Administrator.

A range of sizes suitable for isokinetic sampling should be available, e.g., 0.32 cm (1/8 in.) up to 1.27 cm (1/2 in.) (or larger if higher volume sampling trains are used) inside diameter (ID) nozzles in increments of 0.16 cm (1/16 in.). Each nozzle shall be calibrated according to the procedures outlined in the calibration section.

2.1.2 Probe liner--Borosilicate or quartz glass tubing with a heating system capable of maintaining a gas temperature at the exit end during sampling of no greater than $120 \pm 14^{\circ}$ C ($248 \pm 25^{\circ}$ F) or no greater than such other temperature as specified by an applicable subpart of the standards. Since the actual temperature at the outlet of the probe is not monitored during sampling, probes constructed according to APTD-0581 and utilizing the calibration curves of APTD-05[illegible] or calibrated according to the procedure outlined in APTD-0576 will be considered as acceptable.

Borosilicate or quartz glass probe liners shall be used for temperatures up to about 480° C (900° F) and quartz liners for temperatures up to about 900° C (1650° F). Both may be used at higher temperatures for short periods of time, but must be approved by the Administrator. The softening temperature for borosilicate is 820° C (1508° F) and for quartz it is 1500° C (2732° F).

When length limitations, i.e. greater than about 2.5 m (8.2 ft), are encountered at temperatures less than 320° C (608° F), stainless steel (316) or Incoloy 825[1] (both of seamless tubing), or other materials as approved by the Administrator, may be used. Metal probes for sampling gas streams at temperatures in excess of 320° C (608° F) must be approved by the Administrator.

2.1.3 Pitot tube--Type S, or other device approved by the Administrator, attached to probe to allow constant monitoring of the stack gas velocity. The face openings of the pitot tube and the probe nozzle shall be adjacent and parallel to each other, not necessarily on the same plane, during sampling. The free space between the nozzle and pitot tube shall be at least 1.3 cm (0.5 in.). The free space shall be set based on a 1.3 cm (0.5 in.) ID nozzle. If the sampling train is designed for sampling at higher flow rates than that described in APTD-0581, thus necessitating the use of larger sized nozzles, the largest sized nozzle shall be used to set the free space.

The pitot tube must also meet the criteria specified in Method 2 and calibrated according to the procedure in the calibration section of that method.

---

[1]Trade name.

2.1.4 Differential pressure gauge--Inclined manometer capable of measuring velocity head to within 10% of the minimum measured value. Below a differential pressure of 1.3 mm (0.05 in.) water gauge, micromanometers with sensitivities of 0.013 mm (0.0005 in.) should be used. However, micromanometers are not easily adaptable to field conditions and are not easy to use with pulsating flow. Thus, methods or other devices acceptable to the Administrator may be used when conditions warrant.

2.1.5 Filter holder--Borosilicate glass with a glass frit filter support and a silicone rubber gasket. Other materials of construction may be used with approval from the Administrator, e.g. if probe liner is stainless steel, then filter holder may be stainless steel. The holder design shall provide a positive seal against leakage from the outside or around the filter.

2.1.6 Filter heating system--Any heating system capable of maintaining a temperature around the filter holder during sampling of no greater than 120 ± 14° C (248 ± 25° F), or such other temperature as specified by an applicable subpart of the standards. A temperature gauge capable of measuring temperature to within 3° C (5.4° F) shall be installed such that temperature around the filter holder can be regulated and monitored during sampling. Heating systems other than shown in APTD-0581 may be used.

2.1.7 Condenser--Any system that cools the sample gas stream and allows measurement of the water condensed and moisture leaving the condenser, each to within 1 ml or 1 g. Acceptable means are to

measure the condensed water either gravimetrically or volumetrically and to measure the moisture leaving the condenser by (1) monitoring the temperature and pressure at the exit of the condenser and using Dalton's law or (2) by passing the sample gas stream through a tared silica gel trap with exit gases kept below 20° C (68° F) and determining the weight gain.

Note: If "condensible particulate matter" is desired, in addition to moisture content, the following system shall be used--four impingers connected in series with ground glass, leak free fittings or any similarly leak free noncontaminating fittings. The first, third, and fourth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with a 1.3 cm (1/2 in.) ID glass tube extending to about 1.3 cm (1/2 in.) from the bottom of the flask. The second impinger shall be of the Greenburg-Smith design with the standard tip. Individual States or control agencies requiring this information shall be contacted as to the sample recovery and analysis of the impinger contents.

For purposes of writing the procedure of this method, the system described in the note above will be used for determining the moisture content of the stack gas. Modifications (e.g. using flexible connections between the impingers or using materials other than glass) may be used with approval from the Administrator.

If means other than silica gel are used to determine the amount of moisture leaving the condenser, it is recommended that silica gel still be used between the condenser system and pump to prevent moisture condensation in the pump and metering devices.

Unless otherwise specified by the Administrator, flexible vacuum lines may be used to connect the filter holder to the condenser.

2.1.8 Metering system--Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3° C (5.4° F), dry gas meter with 2% accuracy, and related equipment, or equivalent, as required to maintain an isokinetic sampling rate and to determine sample volume. Sampling trains utilizing metering systems designed for higher flow rates than that described in APTD-0581 or APTD-0576 may be used provided that the specifications in section 2 of this method are met. When the metering system is used in conjunction with a pitot tube, the system shall enable checks of isokinetic rates.

2.1.9 Barometer--Mercury, aneroid, or other barometers capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby weather bureau station, in which case the station value shall be requested and an adjustment for elevation differences shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase.

2.1.10 Gas density determination equipment--Temperature and pressure gauges and gas analyzer as described in Methods 2 and 3.

2.1.11 Temperature and pressure gauges--If Dalton's law is used, to monitor temperature and pressure at condenser outlet. The temperature gauge shall have an accuracy of 1° C (2° F). The pressure gauge shall be capable of measuring pressure to within 2.5 mm Hg

(0.1 in. Hg). If silica gel is used in the condenser system the temperature and pressure must be measured before the silica gel component.

2.2 Sample recovery.

2.2.1 Probe liner and probe nozzle brushes--Nylon bristles with stainless steel wire handles. The probe brush shall have extensions, at least as long as the probe, of stainless steel, nylon, teflon, or similarly inert material. Both brushes shall be properly sized and shaped to brush out the probe liner and nozzle.

2.2.2 Glass wash bottles--Two.

2.2.3 Glass sample storage containers--Widemouth, for acetone washes. The cap shall be teflon lined or of such construction so as to prevent chemical attack from the acetone. Other types of containers must be approved by the Administrator.

2.2.4 Petri dishes--For filter samples, glass or plastic, unless otherwise specified by the Administrator.

2.2.5 Graduated cylinder and/or balance--To measure condensed water to within 1 ml or 1 g. Graduated cylinders shall have subdivisions no greater than 2 ml. Most laboratory balances are capable of weighing to the nearest 0.5 g or less. Any of these balances are suitable for use here and in section 2.3.4.

2.2.6 Plastic storage containers--Air tight containers to store silica gel.

2.2.7 Funnel and rubber policeman--To aid in transfer of silica gel to container; not necessary if silica gel is weighed in the field.

2.3 Analysis.

2.3.1 Glass weighing dishes.

2.3.2 Desiccator.

2.3.3 Analytical balance--To measure to within 0.1 mg.

2.3.4 Balance--To measure to within 0.5 g.

2.3.5 Beakers--250 ml.

2.3.6 Hygrometer--To measure the relative humidity of the laboratory environment.

2.3.7 Temperature gauge--To measure the temperature of the laboratory environment.

3. Reagents

3.1 Sampling.

3.1.1 Filters--Glass fiber filters, without organic binder, of near neutral pH (7 ± 1), exhibiting at least 99.95% efficiency (≤ 0.05% penetration) on 0.3 micron dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM standard method D 2986-71. Test data from the supplier's quality control program is sufficient for this purpose.

3.1.2 Silica gel--Indicating type, 6-16 mesh. If previously used, dry at 175° C (350° F) for 2 hours. New silica gel may be used as received.

3.1.3 Water--When analysis of the material caught in the impingers is required, distilled water shall be used. Run blanks prior to field use to eliminate a high blank on test samples.

3.1.4 Crushed ice.

3.1.5 Stopcock grease--Acetone insoluble, heat stable silicone grease. This is not necessary if screw-on connectors with teflon sleeves, or similar, are used.

3.2 Sample recovery.

3.2.1 Acetone--Reagent grade, ≤ 0.001% residue, in glass bottles. Acetone from metal containers generally has a high residue blank and should not be used. Sometimes, suppliers transfer acetone to glass bottles from metal containers. Thus, acetone blanks shall be run prior to field use and only acetone with low blank values (≤ 0.001%) shall be used.

3.3 Analysis.

3.3.1 Acetone--Same as 3.2.1.

3.3.2 Desiccant--Anhydrous calcium sulfate, indicating type.

4. Procedure

4.1 Sampling. The sampling shall be conducted by competent personnel experienced with this test procedure.

4.1.1 Pretest preparation. All the components shall be maintained and calibrated according to the procedure described in APTD-0576, unless otherwise specified herein.

Weigh approximately 200-300 g of silica gel in air tight containers to the nearest 0.5 g. Record the total weight, both silica gel and container, on the container. More silica gel may be used but care should be taken during sampling that it is not entrained and carried out from the impinger. As an alternative, the silica gel may be weighed directly in the impinger or its sampling holder just prior to the train assembly.

Check filters visually against light for irregularities and flaws or pinhole leaks. Label a filter of proper diameter on the back side near the edge using numbering machine ink. As an alternative, label the shipping container (glass or plastic petri dishes) and keep the filter in this container at all times except during sampling and weighing.

Desiccate the filters at 20 ± 5.6° C (68 ± 10° F) and ambient pressure for at least 24 hours and weigh at 6 or more hour intervals to a constant weight, i.e., ≤ 0.5 mg change from previous weighing, and record results to the nearest 0.1 mg. During each weighing the filter must not be exposed to the laboratory atmosphere for a period greater than 2 minutes and a relative humidity above 50%.

4.1.2 Preliminary determinations. Select the sampling site and the minimum number of sampling points according to Method 1 or as specified by the Administrator. Determine the stack pressure, temperature, and the range of velocity heads using Method 2 and moisture content using Approximation Method 4 or its alternatives for the purpose of making isokinetic sampling rate calculations. Estimates may be used. However, final results will be based on actual measurements made during the test.

Select a nozzle size based on the range of velocity heads such that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates. During the run, do not change the nozzle size. Ensure that the differential pressure gauge is capable of measuring the minimum velocity head value to within 10%, or as specified by the Administrator.

Select a suitable probe liner and probe length such that all traverse points can be sampled. Consider sampling from opposite sides for large stacks to reduce the length of probes.

Select a total sampling time greater than or equal to the minimum total sampling time specified in the test procedures for the specific industry such that the sampling time per point is not less than 2 min. or some greater time interval as specified by the Administrator and the sample volume that will be taken will exceed the required minimum total gas sample volume specified in the test procedures for the specific industry. The latter is based on an approximate average sampling rate. Note also that the minimum total sample volume is corrected to standard conditions.

It is recommended that 1/2 or an integral number of minutes be sampled at each point in order to avoid timekeeping errors.

In some circumstances, e.g. batch cycles, it may be necessary to sample for shorter times at the traverse points and to obtain smaller gas sample volumes. In these cases, the Administrator's approval must first be obtained.

4.1.3 Preparation of collection train. During preparation and assembly of the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin.

Place 100 ml of water in each of the first two impingers, leave the third impinger empty, and place approximately 200-300 g or more, if necessary, of preweighed silica gel in the fourth impinger Record

the weight of the silica gel and container to the nearest 0.5 g. Place the container in a clean place for later use in the sample recovery.

Using a tweezer or clean disposable surgical gloves, place the labeled and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed so as to not allow the sample gas stream to circumvent the filter. Check filter for tears after assembly is completed.

When glass liners are used, install selected nozzle using a Viton A O-ring when stack temperatures are less than 260° C (500° F) or an asbestos string gasket when temperatures are higher. The Viton A O-ring and asbestos string gasket are installed as a seal where the nozzle is connected to a glass liner. See APTD-0576 for details. When metal liners are used, install the nozzle as above or by a leak free direct mechanical connection. Mark probe with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

Unless otherwise specified by the Administrator, attach a temperature probe to the metal sheath of the sampling probe so that the sensor extends beyond the probe tip and does not touch any metal. Its position should be about 1.27 to 2.54 cm (0.5 to 1 in.) from the pitot tube and probe nozzle to avoid interference with the gas flow.

Set up the train as in Figure 5-1, using, if necessary, a very light coat of silicone grease on all ground glass joints, greasing only the outer portion to avoid possibility of contamination by the

silicone grease. With approval from the Administrator, a glass cyclone may be used between the probe and filter holder.

Place crushed ice around the impingers.

4.1.4 Leak check procedure--After the sampling train has been assembled, turn on the filter and probe heating system to 120 ± 14° C (248 ± 25° F) or such other temperature as specified by an applicable subpart of the standards for the leak check. (If water condensation is not a problem the probe and/or filter heating system need not be used.) Allow time for the temperature to stabilize. If a Viton A O-ring or other leak free connection is used in assembling the probe nozzle to the probe liner, leak check the train at the sampling site by plugging the nozzle and pulling a 380 mm Hg (15 in. Hg) vacuum. If an asbestos string is used, do not connect the probe to the train during the leak check. Instead, leak check the train as above by first plugging the inlet to the filter holder. Then connect the probe to the train and leak check at about 25 mm Hg (1 in. Hg) vacuum. A leakage rate in excess of 4% of the average sampling rate or 0.00057 m^3/min. (0.02 cfm), whichever is less, is unacceptable in either case.

The following leak check instructions for the sampling train described in APTD-0576 and APTD-0581 may be helpful. Start the pump with by-pass valve fully open and coarse adjust valve completely closed. Partially open the coarse adjust valve and slowly close the by-pass valve until 380 mm Hg (15 in. Hg) vacuum is reached. Do not reverse direction of by-pass valve. This will cause water to back up into the filter holder. If 380 mm Hg (15 in. Hg) is exceeded,

either leak check at this higher vacuum or end the leak check as shown below and start over.

When the leak check is completed, first slowly remove the plug from the inlet to the probe or filter holder and immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the filter holder and silica gel from being entrained backward into the third impinger.

Leak checks shall be conducted as described whenever the train is disengaged, e.g. for silica gel or filter changes, during the test, prior to each test run, and at the completion of each test run. If leaks are found to be in excess of the acceptable rate, the test will be considered invalid. To reduce lost time due to leakage occurrences, it is recommended that leak checks be conducted between port changes.

4.1.5 Particulate train operation--During the sampling run, isokinetic sampling rate to within 10%, or as specified by the Administrator, of true isokinetic and the temperature around the filter of no greater than 120 ± 14° C (248 ± 25° F), or as specified by an applicable subpart of the standards, shall be maintained.

For each run, record the data required on the example data sheet shown in Figure 5-2. Be sure to record the initial dry gas meter reading. Record the dry gas meter readings at the beginning and end of each sampling time increment, when changes in flow rates are made, and when sampling is halted. Take other data point readings at least once at each sample point during each time increment and

additional readings when significant changes (20% variation in velocity head readings) necessitate additional adjustments in flow rate.

Clean the portholes prior to the test run to minimize chance of sampling the deposited material. To begin sampling, remove the nozzle cap, verify that the filter and probe are up to temperature, and that the pitot tube and probe are properly positioned. Position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Nomographs are available for sampling trains using type S pitot tubes with 0.85 ± 0.02 coefficient and when sampling in air or a stack gas with equivalent density (molecular weight equal to 29 ± 4), which aid in the rapid adjustment of the isokinetic sampling rate without excessive computations. APTD-0576 details the procedure for using these nomographs. If C_p and M_d are outside the above stated ranges, do not use the nomograph unless appropriate steps are taken to compensate for the deviations.

When the stack is under significant negative stack pressure (height of impinger stem), take care to close the coarse adjust valve before inserting the probe into the stack to avoid water backing into the filter holder. If necessary, the pump may be turned on with the coarse adjust valve closed.

When the probe is in position, block off the openings around the probe and porthole to prevent unrepresentative dilution of the gas stream.

Traverse the stack cross section being careful not to bump the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe through the portholes to minimize chance of extracting deposited material.

During the test run, make periodic adjustments to keep the temperature around the filter holder at the proper temperature and add more ice and, if necessary, salt to maintain a temperature of less than 20° C (68° F) at the condenser/silica gel outlet to avoid excessive moisture losses.

If the pressure drop across the filter becomes too high making isokinetic sampling difficult to maintain, the filter may be replaced in the midst of a sample run. It is recommended that another complete filter assembly be used rather than attempting to change the filter itself. After the new filter or filter assembly is installed conduct a leak check. The particulate weight shall include the summation of all filter assembly catches.

A single train shall be used for the entire sample run, except for filter and silica gel changes. However, if approved by the Administrator, two or more trains may be used for a single test run when there are two or more ducts or sampling ports. The results shall be the total of all sampling train catches.

At the end of the sample run, turn off the pump, remove the probe and nozzle from the stack, and record the final dry gas meter reading. Perform a leak check. Calculate percent isokinetic (see calculation section) to determine whether another test run should be

made. If there is difficulty in maintaining isokinetic rates due to source conditions, consult with the Administrator for possible variance on the isokinetic rates.

4.2 Sample recovery. Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period.

When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over it to prevent losing or gaining particulate matter. Do not cap off the probe tip while the sampling train is cooling down as this would create a vacuum in the filter holder, thus drawing water from the impingers into the filter.

Before moving the sample train to the cleanup site, remove the probe from the sample train, wipe off the silicone grease, and cap the open outlet of the probe. Wipe off the silicone grease from the filter inlet where the probe was fastened and cap it. Remove the umbilical cord from the last impinger and cap the impinger. If a flexible line is used between the first impinger or condenser and the filter holder, disconnect the line at the filter holder and let any condensed water or liquid drain into the impingers or condenser. After wiping off the silicone grease, cap off the filter holder outlet and impinger inlet. Either ground glass stoppers or plastic caps or serum caps may be used to close these openings.

Transfer the probe and filter-impinger assembly to the cleanup area. This area should be clean and protected from the wind so that

the chances of contaminating or losing the sample will be minimized.

Save a portion of the acetone used for cleanup as a blank. Place about 200 ml of this acetone in a glass sample container labeled "acetone blank."

Inspect the train prior to and during disassembly and note any abnormal conditions. Treat the samples as follows:

Container No. 1. Carefully remove the filter from the filter holder and place in its identified petri dish container. Use a pair of tweezers and/or clean disposable surgical gloves to handle the filter. If it is necessary to fold the filter, do so such that the particulate cake is inside the fold. Quantitatively remove any particulate matter and/or filter which adheres to the filter holder by carefully using a dry nylon bristle brush and/or a sharp-edged blade and place into this container. Seal the container.

Container No. 2. Taking care to see that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover particulate matter or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components with acetone and placing the wash into a glass container in the following manner.

Distilled water may be used when approved by the Administrator or shall be used when specified by the Administrator. In these cases, save a water blank and follow Administrator's directions on analysis.

Carefully remove the probe nozzle and clean the inside surface by rinsing with acetone from a wash bottle and brushing with a nylon

bristle brush. Brush until acetone rinse shows no visible particles, after which rinse the inside surface at least three times with acetone.

Brush and rinse with acetone the inside parts of the Swagelok fitting in a similar way until no visible particles remain.

Rinse the probe liner with acetone by tilting the probe and squirting acetone into its upper end, while rotating the probe so that all inside surfaces will be rinsed with acetone. Let the acetone drain from the lower end into the sample container. Follow the acetone rinse with a probe brush. Hold the probe in an inclined position, squirt acetone into the upper end as the probe brush is being pushed with a twisting action through the probe, hold a sample container underneath the lower end of the probe, and catch any acetone and particulate matter which is brushed from the probe. Run the brush through the probe three times or more until no visible particulate matter is carried out with the acetone or remains in the probe liner on visual inspection. With stainless steel or other metal probes, run the brush through in the above prescribed manner at least six times since metal probes have small crevices in which particulate matter can be entrapped. Rinse the brush with acetone and quantitatively collect these washings in the sample container. After the brushing make a final acetone rinse of the probe as described above.

It is recommended that two people be used to clean the probe to minimize losing the sample. Between sampling runs, keep brushes clean and protected from contamination.

After ensuring that all joints are wiped clean of silicone grease, clean the inside of the front half of the filter holder by rubbing the surfaces with a nylon bristle brush and rinsing with acetone. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush. After all acetone washings and particulate matter are collected in the sample container, tighten the lid on the sample container so that acetone will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to determine whether or not leakage occurred during transport. Label container to clearly identify its contents.

Container No. 3. Note color of indicating silica gel to determine if it has been completely spent and make a notation of its condition. Transfer the silica gel from the fourth impinger to the original container and seal. A funnel may make it easier to pour the silica gel without spilling. A rubber policeman may be used as an aid in removing the silica gel from the impinger. It is not necessary to remove the small amount of dust particles that may adhere to the walls and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, follow the procedure under analysis.

Impinger water. Treat the impingers or condenser as follows: Make a notation of any color or film in the liquid catch. Measure the liquid which is in the first three impingers to within ± 1 ml by

using a graduated cylinder or, if available, to within ± 0.5 g by using a balance. Record the volume or weight of liquid present. This information is required to calculate the moisture content of the effluent gas.

If analysis of the impinger catch is not required, discard the liquid after measuring and recording the volume or weight. If analysis of the impinger catch is required, leave the impingers intact to transfer the liquid, cap off the inlet, and pour the liquid through the outlet into the graduated cylinder or into a sample container after its weight has been determined.

If a different type of condenser is used, measure the amount of moisture condensed either volumetrically or gravimetrically.

4.3 Analysis. Record the data required on the example sheet shown in Figure 5-3. Handle each sample container as follows:

Container No. 1. Leave in shipping container or transfer the filter and any loose particulate from the sample container to a tared glass weighing dish and desiccate for 24 hours in a desiccator containing anhydrous calcium sulfate. Weigh to a constant weight and report the results to the nearest 0.1 mg. For purposes of this section 4.3, the term "constant weight" means a difference of no more than 0.5 mg or 1% of total weight less tare weight, whichever is greater, between two consecutive weighings, with no less than 6 hours of desiccation time between weighings and 2 minutes exposure to the laboratory atmosphere during weighing.

PLANT _____

DATE _____

RUN NO. _____

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED, mg		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
1			
2			
TOTAL	XXXXXX	XXXXXX	

	VOLUME OF LIQUID WATER COLLECTED		
	IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g	
FINAL			
INITIAL			
LIQUID COLLECTED			
TOTAL VOLUME COLLECTED		g*	ml

*CONVERT WEIGHT OF WATER TO VOLUME BY DIVIDING TOTAL WEIGHT INCREASE BY DENSITY OF WATER. (1 g/ml):

$$\frac{\text{INCREASE, g}}{(1\ \text{g/ml})} = \text{VOLUME WATER, ml}$$

Figure 5-3. Analytical data.

Acetone blank volume, ml _____

Acetone wash volume, ml _____

Acetone blank concentration, mg/mg (equation 5-4) _____

Acetone wash blank, mg (equation 5-5) _____

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED, mg		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
1			
2			
TOTAL	XXXXXX	XXXXXX	

Less Acetone Blank

Weight of particulate matter

Container No. 2. Measure the liquid in this container either volumetrically to ± 1 ml or gravimetrically to ± 0.5 g. Transfer the contents to a tared 250 ml beaker, and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

Container No. 3. Weigh the spent silica gel to the nearest 0.5 g using a balance. This step may be conducted in the field.

"Acetone Blank" Container. Measure acetone in this container either volumetrically or gravimetrically. Transfer the acetone to a tared 250 ml beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

5. Calibration

5.1 Probe nozzle. Using a micrometer, measure the inside diameter of the nozzle to the nearest 0.025 mm (0.001 in.). For nozzles greater than or equal to 0.635 cm (1/4 in.), make 3 separate measurements using different diameters each time and obtain the average of the measurements. The difference between the high and low numbers should not exceed 0.1 mm (0.004 in.).

When nozzles become nicked or corroded, they shall be reshaped, sharpened, and recalibrated before use.

Each nozzle shall be permanently and uniquely identified.

5.2 Pitot tube. The pitot tube shall be calibrated according to the procedure outlined in Method 2.

5.3 Dry gas meter and orifice meter. Both meters shall be calibrated according to the procedure outlined in APTD-0576. When diaphragm pumps with by-pass valves are used, check for proper metering system design by calibrating the dry gas meter at an additional flow rate of 0.0057 m^3/min. (0.2 cfm) with the by-pass valve fully opened and then with it fully closed. If there is more than ± 2% difference in flow rates when compared to the fully closed position of the by-pass valve, the system is not designed properly and must be corrected.

5.4 Probe heater calibration. The probe heating system shall be calibrated according to the procedure contained in APTD-0576. Probes constructed according to APTD-0581 need not be calibrated if the calibration curves in APTD-0576 are used.

5.5 Temperature gauges. Calibrate against mercury-in-glass thermometers.

6. Calculations

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

6.1 Nomenclature

A_n = Cross sectional area of nozzle, m^2 (ft^2)

B_{ws} = Water vapor in the gas stream, proportion by volume.

C_a = Acetone blank residue concentration, mg/mg

c_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm (g/dscf)

I = Percent of isokinetic sampling

m_n = Total amount of particulate matter collected, mg.

M_w = Molecular weight of water, 18 g/g-mole (18 lb/lb-mole)

m_a = Mass of residue of acetone after evaporation, mg

P_{bar} = Barometric pressure at the sampling site, mm Hg (in. Hg)

P_s = Absolute stack gas pressure, mm Hg (in. Hg)

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg)

R = Ideal gas constant, 0.06236 mm Hg-$m^3/{}^oK$-g-mole (21.83 in. Hg-$ft^3/{}^oR$-lb-mole)

T_m = Absolute average dry gas meter temperature (see Figure 5-2) ^oK (^oR)

T_s = Absolute average stack gas temperature (see Figure 5-2), ^oK (^oR).

T_{std} = Standard absolute temperature, 293° K (528° R)

V_a = Volume of acetone blank, ml

V_{aw} = Volume of acetone used in wash, ml

V_{lc} = Total volume of liquid collected in impingers and silica gel (see Figure 5-3, ml.

V_m = Volume of gas sample as measured by dry gas meter, dcm (dcf)

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

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

v_s = Stack gas velocity, calculated by Method 2, Equation 2-7 using data obtained from Method 5, m/sec (ft/sec)

W_a = Weight of residue in acetone wash, mg

ΔH = Average pressure differential across the orifice (see Figure 5-2), meter, mm H_2O (in. H_2O)

ρ_a = Density of acetone, mg/ml (see label on bottle)

ρ_w = Density of water, 1 g/ml (0.00220 lb/ml)

θ = Total sampling time, min.

13.6 = Specific gravity of mercury

60 = sec/min

100 = Conversion to percent

6.2 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 5-2).

6.3 Dry gas volume. Correct the sample volume measured by the dry gas meter to standard conditions (20° C, 760 mm Hg or 68° F, 29.92 in. Hg) by using Equation 5-1.

$$V_{m(std)} = V_m \left(\frac{T_{std}}{T_m} \right) \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}} \right] = K V_m \left[\frac{P_{bar} + \Delta H/13.6}{T_m} \right]$$

Equation 5-1

where:

K = 0.3855 °K/mm Hg for metric units

= 17.65 °R/in. Hg for English units

6.4 Volume of water vapor.

$$V_{w(std)} = V_{lc}\left(\frac{\rho_w}{M_w}\right)\left(\frac{RT_{std}}{P_{std}}\right) = K\,V_{lc} \qquad \text{Equation 5-2}$$

where

$K = 0.00134\ m^3/ml$ for metric units

$= 0.0472\ ft^3/ml$ for English units

6.5 Moisture content.

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}} \qquad \text{Equation 5-3}$$

6.6 Acetone blank concentration.

$$C_a = \frac{m_a}{V_a\ \rho_a} \qquad \text{Equation 5-4}$$

6.7 Acetone wash blank.

$$W_a = C_a\ V_{aw}\ \rho_a \qquad \text{Equation 5-5}$$

6.8 Total particulate weight. Determine the total particulate catch from the sum of the weights obtained from containers 1 and 2 less the acetone blank (see Figure 5-3).

6.9 Particulate concentration.

$$c_s = (0.001\ g/mg)\ (m_n/V_{m(std)}) \qquad \text{Equation 5-6}$$

6.10 Conversion factors:

From	To	Multiply by
scf	m^3	0.0283
g/ft^3	gr/ft^3	15.4
g/ft^3	lb/ft^3	2.205×10^{-3}
g/ft^3	g/m^3	35.34

6.11 Isokinetic variation.

6.11.1 Calculations from raw data.

$$I = \frac{100\ T_s\ [K\ V_{lc} + (V_m/T_m)\ (P_{bar} + \Delta H/13.6)]}{60\ \theta\ \bar{v}_s\ P_s\ A_n}$$

Equation 5-7

where:

K = 0.00346 mm Hg-m^3/ml-^oK for metric units

= 0.00267 in. Hg-ft^3/ml-^oR for English units

6.11.2 Calculations from intermediate values.

$$I = \frac{T_s\ V_{m(std)}\ P_{std}\ 100}{T_{std}\ v_s\ \theta\ A_n\ P_s\ 60\ (1-B_{ws})}$$

$$= K\ \frac{T_s\ V_{m(std)}}{P_s\ v_s\ A_n\ \theta\ (1-B_{ws})}$$

Equation 5-8

where:

K = 4.323 for metric units

= 0.0944 for English units

6.12 Acceptable results. If $90\% \leq I \leq 110\%$, the results are acceptable. If the results are low in comparison to the standards and I is beyond the acceptable range, the Administrator may option to accept the results. Use reference 7.4 to make judgments. Otherwise, reject the results and repeat the test.

7. References

7.1 Addendum to Specifications for Incinerator Testing at Federal Facilities, PHS, NCAPC, Dec. 6, 1967.

7.2 Martin, Robert M., Construction Details of Isokinetic Source Sampling Equipment, Environmental Protection Agency, APTD-0581.

7.3 Rom, Jerome J., Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment, Environmental Protection Agency, APTD-0576.

7.4 Smith, W. S., R. T. Shigehara, and W. F. Todd, A Method of Interpreting Stack Sampling Data, Paper presented at the 63d Annual Meeting of the Air Pollution Control Association, St. Louis, Mo., June 14-19, 1970.

7.5 Smith, W. S., et al., Stack Gas Sampling Improved and Simplified with New Equipment, APCA paper No. 67-119, 1967.

7.6 Specifications for Incinerator Testing at Federal Facilities, PHS, NCAPC, 1967.

METHOD 9

VISUAL DETERMINATION OF THE OPACITY OF EMISSIONS FROM STATIONARY SOURCES

Title 40—Protection of the Environment

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

SUBCHAPTER C—AIR PROGRAMS

[FRL 291–6]

PART 60—STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

Opacity Provisions

On June 29, 1973, the United States Court of Appeals for the District of Columbia in "Portland Cement Association v. Ruckelshaus," 486 F. 2d 375 (1973) remanded to EPA the standard of performance for Portland cement plants (40 CFR 60.60 et seq.) promulgated by EPA under section 111 of the Clean Air Act. In the remand, the Court directed EPA to reconsider among other things the use of the opacity standards. EPA has prepared a response to the remand. Copies of this response are available from the Emission Standards and Engineering Division, Environmental Protection Agency, Research Triangle Park, N.C. 27711, Attn: Mr. Don R. Goodwin. In developing the response, EPA collected and evaluated a substantial amount of information which is summarized and referenced in the response. Copies of this information are available for inspection during normal office hours at EPA's Office of Public Affairs, 401 M Street SW., Washington, D.C. EPA determined that the Portland cement plant standards generally did not require revision but did not find that certain revisions are appropriate to the opacity provisions of the standards. The provisions promulgated herein include a revision to § 60.11, Compliance with Standards and Maintenance Requirements, a revision to the opacity standard for Portland cement plants, and revisions to Reference Method 9. The bases for the revisions are discussed in detail in the Agency's response to the remand. They are summarized below.

The revisions to § 60.11 include the modification of paragraph (b) and the addition of paragraph (e). Paragraph (b) has been revised to indicate that while Reference Method 9 remains the primary and accepted means for determining compliance with opacity standards in this part, EPA will accept as probative evidence in certain situations and under certain conditions the results of continuous monitoring by transmissometer to determine whether a violation has in fact occurred. The revision makes clear that even in such situations the results of opacity readings by Method 9 remain presumptively valid and correct.

The provisions in paragraph (e) provide a mechanism for an owner or operator to petition the Administrator to establish an opacity standard for an affected facility where such facility meets all applicable standards for which a performance test is conducted under § 60.8 but fails to meet an applicable opacity standard. This provision is intended primarily to apply to cases where a source installs a very large diameter stack which causes the opacity of the emissions to be

greater than if a stack of the diameter ordinarily used in the industry were installed. Although this situation is considered to be very unlikely to occur, this provision will accommodate such a situation. The provision could also apply to other situations where for any reason an affected facility could fail to meet opacity standards while meeting mass emission standards, although no such situations are expected to occur.

A revision to the opacity standard for Portland cement plants is promulgated herein. The revision changes the opacity limit for kilns from 10 percent to 20 percent. This revision is based on EPA's policy on opacity standards and the new emission data from Portland cement plants evaluated by EPA during its reconsideration. The preamble to the standards of performance which were promulgated on March 8, 1974 (39 FR 9308) sets forth EPA's policy on opacity standards: (1) Opacity limits are independent enforceable standards; (2) where opacity and mass/concentration standards are applicable to the same source, the mass/concentration standards are established at a level which will result in the design, installation, and operation of the best adequately demonstrated system of emission reduction (taking costs into account); and (3) the opacity standards are established at a level which will require proper operation and maintenance of such control systems. The new data indicate that increasing the opacity limits for kilns from 10 percent to 20 percent is justified, because such a standard will still require the design, installation, and operation of the best adequately demonstrated system of emission reduction (taking costs into account) while eliminating or minimizing the situations where it will be necessary to promulgate a new opacity standard under § 60.11(e).

In evaluating the accuracy of results from qualified observers following the procedures of Reference Method 9, EPA determined that some revisions to Reference Method 9 are consistently able to evaluation showed that observers trained and certified in accordance with the procedures prescribed under Reference Method 9 are consistently able to read opacity with errors not exceeding ± 7.5 percent based upon single sets of the average of 24 readings. The revisions to Reference Method 9 include the following:

1. An introductory section is added. This includes a discussion of the concept of visible emission reading and describes the effect of variable viewing conditions. Information is also presented concerning the accuracy of the method noting that the accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

2. Provisions are added which specify that the determination of opacity requires at least 24 readings taken at 15-second intervals. The purpose for taking 24 readings is to extend the averaging time over which the observations are made, and to take sufficient readings to insure acceptable accuracy.

3. More specific criteria concerning observer position with respect to the sun are added. Specifically, the sun must be within a 140° sector to the observer's back.

4. Criteria concerning an observer's position with respect to the plume are added. Specific guidance is also provided for reading emissions from rectangular emission points with large length to width ratios, and for reading emissions from multiple stacks. In each of these cases, emissions are to be read across the shortest path length.

5. Provisions are added to make clear that opacity of contaminated water or steam plumes is to be read at a point where water does not exist in condensed form. Two specific instructions are provided: One for the case where opacity can be observed prior to the formation of the condensed water plume, and one for the case where opacity is to be observed after the condensed water plume has dissipated.

6. Specifications are added for the smoke generator used for qualification of observers so that State or local air pollution control agencies may provide observer qualification training consistent with EPA training.

In developing this regulation we have taken into account the comments received in response to the September 11, 1974 (39 FR 33052) notice of proposed rulemaking which proposed among other things certain minor changes to Reference Method 9. This regulation represents the rulemaking with respect to the revisions to Method 9.

The determination of compliance with applicable opacity standards will be based on an average of 24 consecutive opacity readings taken at 15 second intervals. This approach is a satisfactory means of enforcing opacity standards in cases where the violation is a continuing one and time exceptions are not part of the applicable opacity standard. However, the opacity standards for steam electric generators in 40 CFR 60.42 and fluid catalytic cracking unit catalyst regenerators in 40 CFR 60.102 and numerous opacity standards in State implementation plans specify various time exceptions. Many State and local air pollution control agencies use a different approach in enforcing opacity standards than the six-minute average period specified in this revision to Method 9. EPA recognizes that certain types of opacity violations that are intermittent in nature require a different approach in applying the opacity standards than this revision to Method 9. It is EPA's intent to propose an additional revision to Method 9 specifying an alternative method to enforce opacity standards. It is our intent that this method specify a minimum number of readings that must be taken, such as a minimum of ten readings above the standard in any one hour period prior to citing a violation. EPA is in the process of analyzing available data and determining the error involved in reading opacity in this manner and will propose this revision to Method 9 as soon as this analysis is completed. The Agency solicits comments and recommendations on the need for this additional revision to Method 9 and would welcome any suggestions particularly from air pollution control agencies on how we might make Method 9 more responsive to the needs of these agencies.

These actions are effective on November 12, 1974. The Agency finds good cause exists for not publishing these actions as a notice of proposed rulemaking and for making them effective immediately upon publication for the following reasons:

(1) Only minor amendments are being made to the opacity standards which were remanded.

(2) The U.S. Court of Appeals for the District of Columbia instructed EPA to complete the remand proceeding with respect to the Portland cement plant standards by November 5, 1974.

(3) Because opacity standards are the subject of other litigation, it is necessary to reach a final determination with respect to the basic issues involving opacity at this time in order to properly respond to this issue with respect to such other litigation.

These regulations are issued under the authority of sections 111 and 114 of the Clean Air Act, as amended (42 U.S.C. 1857c-6 and 9).

Dated: November 1, 1974.

JOHN QUARLES,
Acting Administrator.

Part 60 of Chapter I, Title 40 of the Code of Federal Regulations is amended as follows:

1. Section 60.11 is amended by revising paragraph (b) and adding paragraph (e), reading as follows:

§ 60.11 Compliance with standards and maintenance requirements.

* * * * *

(b) Compliance with opacity standards in this part shall be determined by conducting observations in accordance with Reference Method 9 in Appendix A of this part. Opacity readings of portions of plumes which contain condensed, uncombined water vapor shall not be used for purposes of determining compliance with opacity standards. The results of continuous monitoring by transmissometer which indicate that the opacity at the time visual observations were made was not in excess of the standard are probative but not conclusive evidence of the actual opacity of an emission, provided that the source shall meet the burden of proving that the instrument used meets (at the time of the alleged violation) Performance Specification 1 in Appendix B of this part, has been properly maintained and (at the time of the alleged violation) calibrated, and that the resultant data have not been tampered with in any way.

* * * * *

(e) (1) An owner or operator of an affected facility may request the Admin-

[illegible] to determine opacity of emissions from the affected facility during [redacted] initial performance tests required by [redacted]3.

[redacted] Upon receipt from such owner or operator of the written report of the results of the performance tests required [redacted] 60.8, the Administrator will make [redacted]nding concerning compliance with opacity and other applicable standards. If the Administrator finds that an affected facility is in compliance with all [redacted]cable standards for which performance tests are conducted in accordance with § 60.8 of this part but during the time such performance tests are being conducted fails to meet any applicable [redacted]ity standard, he shall notify the [redacted]r or operator and advise him that he may petition the Administrator within 10 days of receipt of notification to make [redacted]opriate adjustment to the opacity [redacted]dard for the affected facility.

[redacted] The Administrator will grant such a petition upon a demonstration by the owner or operator that the affected fa[redacted] and associated air pollution con[redacted]equipment was operated and maintained in a manner to minimize the opacity of emissions during the performance tests; that the performance tests w[redacted] performed under the conditions es[redacted]shed by the Administrator; and that the affected facility and associated air pollution control equipment were incapable of being adjusted or operated to [redacted] the applicable opacity standard.

[redacted] The Administrator will establish an opacity standard for the affected facility meeting the above requirements [redacted] level at which the source will be [redacted] as indicated by the performance [redacted] opacity tests, to meet the opacity standard at all times during which the source is meeting the mass or concentra[redacted]emission standard. The Adminis[redacted]r will promulgate the new opacity standard in the FEDERAL REGISTER.

2. In § 60.62, paragraph (a)(2) is re[redacted] to read as follows:

[redacted]62 Standard for particulate matter.

(a) * * *

[redacted] Exhibit greater than 20 percent [redacted]ity.

* * * * *

3. Appendix A—Reference Methods is amended by revising Reference Method [redacted]follows:

APPENDIX A—REFERENCE METHODS

* * * * *

[redacted] 9—VISUAL DETERMINATION OF THE [redacted]ACITY OF EMISSIONS FROM STATIONARY [redacted]RCES

Many stationary sources discharge visible emissions into the atmosphere; these emis[redacted] are usually in the shape of a plume. [redacted] method involves the determination of [redacted]e opacity by qualified observers. The [illegible] includes procedures for the training and certification of observers and procedures [illegible] determination of [redacted]e opacity [illegible] plume as [illegible] of which may be con[illegible] [redacted]ntrolled to an extent to which they no longer exert a significant influence upon plume appearance include: Angle of the observer with respect to the plume; angle of the observer with respect to the sun; point of observation of attached and detached steam plume; and angle of the observer with respect to a plume emitted from a rectangular stack with a large length to width ratio. The method includes specific criteria applicable to these variables.

Other variables which may not be controllable in the field are luminescence and color contrast between the plume and the background against which the plume is viewed. These variables exert an influence upon the appearance of a plume as viewed by an observer, and can affect the ability of the observer to accurately assign opacity values to the observed plume. Studies of the theory of plume opacity and field studies have demonstrated that a plume is most visible and presents the greatest apparent opacity when viewed against a contrasting background. It follows from this, and is confirmed by field trials, that the opacity of a plume, viewed under conditions where a contrasting background is present can be assigned with the greatest degree of accuracy. However, the potential for a positive error is also the greatest when a plume is viewed under such contrasting conditions. Under conditions presenting a less contrasting background, the apparent opacity of a plume is less and approaches zero as the color and luminescence contrast decrease toward zero. As a result, significant negative bias and negative errors can be made when a plume is viewed under less contrasting conditions. A negative bias decreases rather than increases the possibility that a plant operator will be cited for a violation of opacity standards due to observer error.

Studies have been undertaken to determine the magnitude of positive errors which can be made by qualified observers while reading plumes under contrasting conditions and using the procedures set forth in this method. The results of these studies (field trials) which involve a total of 769 sets of 25 readings each are as follows:

(1) For black plumes (133 sets at a smoke generator), 100 percent of the sets were read with a positive error[1] of less than 7.5 percent opacity; 99 percent were read with a positive error of less than 5 percent opacity.

(2) For white plumes (170 sets at a smoke generator, 168 sets at a coal-fired power plant, 298 sets at a sulfuric acid plant), 99 percent of the sets were read with a positive error of less than 7.5 percent opacity; 95 percent were read with a positive error of less than 5 percent opacity.

The positive observational error associated with an average of twenty-five readings is therefore established. The accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

1. *Principle and applicability.*

1.1 Principle. The opacity of emissions from stationary sources is determined visually by a qualified observer.

1.2 Applicability. This method is applicable for the determination of the opacity of emissions from stationary sources pursuant to § 60.11(b) and for qualifying observers for visually determining opacity of emissions.

2. *Procedures.* The observer qualified in accordance with paragraph 3 of this method shall use the following procedures for visually determining the opacity of emissions:

2.1 Position. The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. Consistent with maintaining the above requirement, the observer shall, as much as possible, make his observations from a position such that his line of vision is approximately perpendicular to the plume direction, and when observing opacity of emissions from rectangular outlets (e.g. roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight should not include more than one plume at a time when multiple stacks are involved, and in any case the observer should make his observations with his line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g. stub stacks on baghouses).

2.2 Field records. The observer shall record the name of the plant, emission location, type facility, observer's name and affiliation, and the date on a field data sheet (Figure 9–1). The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background are recorded on a field data sheet at the time opacity readings are initiated and completed.

2.3 Observations. Opacity observations shall be made at the point of greatest opacity in that portion of the plume where condensed water vapor is not present. The observer shall not look continuously at the plume, but instead shall observe the plume momentarily at 15-second intervals.

2.3.1 Attached steam plumes. When condensed water vapor is present within the plume as it emerges from the emission outlet, opacity observations shall be made beyond the point in the plume at which condensed water vapor is no longer visible. The observer shall record the approximate distance from the emission outlet to the point in the plume at which the observations are made.

2.3.2 Detached steam plume. When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the opacity of emissions should be evaluated at the emission outlet prior to the condensation of water vapor and the formation of the steam plume.

2.4 Recording observations. Opacity observations shall be recorded to the nearest 5 percent at 15-second intervals on an observational record sheet. (See Figure 9–2 for an example.) A minimum of 24 observations shall be recorded. Each momentary observation recorded shall be deemed to represent the average opacity of emissions for a 15-second period.

2.5 Data Reduction. Opacity shall be determined as an average of 24 consecutive observations recorded at 15-second intervals. Divide the observations recorded on the record sheet into sets of 24 consecutive observations. A set is composed of any 24 consecutive observations. Sets need not be consecutive in time and in no case shall two sets overlap. For each set of 24 observations, calculate the average by summing the opacity of the 24 observations and dividing this sum by 24. If an applicable standard specifies an averaging time requiring more than 24 observations, calculate the average for all observations made during the specified time period. Record the average opacity on a record sheet. (See Figure 9–1 for an example.)

3. *Qualifications and testing.*

3.1 Certification requirements. To receive certification as a qualified observer, a candidate must be tested and demonstrate the ability to [illegible] opacity readings [illegible] 5 percent [illegible] 25 different white plumes, with an error

[1] For a set, positive error = average opacity determined by [illegible] 25 [illegible] transmissometer's 25 readings.

[redacted]

not to exceed 15 percent opacity on any one reading and an average error not to exceed 7.5 percent opacity in such a test. Candidates shall be tested according to the procedures described in paragraph 3.2. Smoke generators used pursuant to paragraph 3.2 shall be equipped with a smoke meter which meets the requirements of paragraph 3.3.

The certification shall be valid for a period of 6 months, at which time the qualification procedure must be repeated by any observer in order to retain certification.

3.2 Certification procedure. The certification test consists of showing the candidate a complete run of 50 plumes—25 black plumes and 25 white plumes—generated by a smoke generator. Plumes within each set of 25 black and 25 white runs shall be presented in random order. The candidate assigns an opacity value to each plume and records his observation on a suitable form. At the completion of each run of 50 readings, the score of the candidate is determined. If a candidate fails to qualify, the complete run of 50 readings must be repeated in any retest. The smoke test may be administered as part of a smoke school or training program, and may be preceded by training or familiarization runs of the smoke generator during which candidates are shown black and white plumes of known opacity.

3.3 Smoke generator specifications. Any smoke generator used for the purposes of paragraph 3.2 shall be equipped with a smoke meter installed to measure opacity across the diameter of the smoke generator stack. The smoke meter output shall display instack opacity based upon a pathlength equal to the stack exit diameter, on a full 0 to 100 percent chart recorder scale. The smoke meter optical design and performance shall meet the specifications shown in Table 9-1. The smoke meter shall be calibrated as prescribed in paragraph 3.3.1 prior to the conduct of each smoke reading test. At the completion of each test, the zero and span drift shall be checked and if the drift exceeds ±1 percent opacity, the condition shall be corrected prior to conducting any subsequent test runs. The smoke meter shall be demonstrated, at the time of installation, to meet the specifications listed in Table 9-1. This demonstration shall be repeated following any subsequent repair or replacement of the photocell or associated electronic circuitry including the chart recorder or output meter, or every 6 months, whichever occurs first.

TABLE 9-1—SMOKE METER DESIGN AND PERFORMANCE SPECIFICATIONS

Parameter:	*Specification*
a. Light source	Incandescent lamp operated at nominal rated voltage.
b. Spectral response of photocell.	Photopic (multiple spectral response of the human eye—reference 4.3).
c. Angle of view	15° maximum total angle.
d. Angle of projection.	15° maximum total angle.
e. Calibration error.	±3% opacity, maximum.
f. Zero and span drift.	±1% opacity, 30 minutes.
g. Response time	≤5 seconds.

3.3.1 Calibration. The smoke meter is calibrated after allowing a minimum of 30 minutes warmup by alternately producing simulated opacity of 0 percent and 100 percent. When stable response at 0 percent or 100 percent is noted, the smoke meter is adjusted to produce an output of 0 percent or 100 percent, as appropriate. This calibration shall be repeated until stable 0 percent and 100 percent readings are produced without adjustment. Simulated 0 percent and 100 percent opacity values may be produced by alternately switching the power to the light source on and off while the smoke generator is not producing smoke.

3.3.2 Smoke meter evaluation. The smoke meter design and performance are to be evaluated as follows:

3.3.2.1 Light source. Verify from manufacturer's data and from voltage measurements made at the lamp, as installed, that the lamp is operated within ±5 percent of the nominal rated voltage.

3.3.2.2 Spectral response of photocell. Verify from manufacturer's data that the photocell has a photopic response; i.e., the spectral sensitivity of the cell shall closely approximate the standard spectral-luminosity curve for photopic vision which is referenced in (b) of Table 9-1.

3.3.2.3 Angle of view. Check construction geometry to ensure that the total angle of view of the smoke plume, as seen by the photocell, does not exceed 15°. The total angle of view may be calculated from: $\theta = 2 \tan^{-1} d/2L$, where θ = total angle of view; d = the sum of the photocell diameter + the diameter of the limiting aperture; and L = the distance from the photocell to the limiting aperture. The limiting aperture is the point in the path between the photocell and the smoke plume where the angle of view is most restricted. In smoke generator [illegible] is normally all white plate.

3.3.2.4 Angle of projection. Check construction geometry to ensure that the total angle of projection of the lamp on the smoke plume does not exceed 15°. The total angle of projection may be calculated from: $\theta = 2 \tan^{-1} d/2L$, where θ = total angle of projection; d = the sum of the length of the lamp filament + the diameter of the limiting aperture; and L = the distance from the lamp to the limiting aperture.

3.3.2.5 Calibration error. Using neutral-density filters of known opacity, check the error between the actual response and the theoretical linear response of the smoke meter. This check is accomplished by first calibrating the smoke meter according to 3.3.1 and then inserting a series of three neutral-density filters of nominal opacity of 20, 50, and 75 percent in the smoke meter pathlength. Filters calibarted within ±2 percent shall be used. Care should be taken when inserting the filters to prevent stray light from affecting the meter. Make a total of five nonconsecutive readings for each filter. The maximum error on any one reading shall be 3 percent opacity.

3.3.2.6 Zero and span drift. Determine the zero and span drift by calibrating and operating the smoke generator in a normal manner over a 1-hour period. The drift is measured by checking the zero and span at the end of this period.

3.3.2.7 Response time. Determine the response time by producing the series of five simulated 0 percent and 100 percent opacity values and observing the time required to reach stable response. Opacity values of 0 percent and 100 percent may be simulated by alternately switching the power to the light source off and on while the smoke generator is not operating.

4. *References.*

4.1 Air Pollution Control District Rules and Regulations, Los Angeles County Air Pollution Control District, Regulation IV, Prohibitions, Rule 50.

4.2 Weisburd, Melvin I., Field Operations and Enforcement Manual for Air, U.S. Environmental Protection Agency, Research Triangle Park, N.C., APTD-1100, August 1972, pp. 4.1-4.36.

4.3 Condon, E. U., and Odishaw, H., Handbook of Physics, McGraw-Hill Co., N.Y., N.Y., 1958, Table 3.1, p. 6-52.

FIGURE 9-1

RECORD OF VISUAL DETERMINATION OF OPACITY PAGE___of___

COMPANY_____
LOCATION_____
TEST NUMBER_____
DATE_____
TYPE FACILITY_____
CONTROL DEVICE_____

HOURS OF OBSERVATION_____
OBSERVER_____
OBSERVER CERTIFICATION DATE_____
OBSERVER AFFILIATION_____
POINT OF EMISSIONS_____
HEIGHT OF DISCHARGE POINT_____

	Initial			Final
CLOCK TIME				
OBSERVER LOCATION				
Distance to Discharge				
Direction from Discharge				
Height of Observation Point				
BACKGROUND DESCRIPTION				
WEATHER CONDITIONS				
Wind Direction				
Wind Speed				
Ambient Temperature				
SKY CONDITIONS (clear, overcast, % clouds, etc.)				
PLUME DESCRIPTION				
Color				
Distance Visible				
OTHER INFORMATION				

SUMMARY OF AVERAGE OPACITY

Set Number	Time	Opacity	
	Start--End	Sum	Average

Readings ranged from ____ to ____ % opacity

The source was/was not in compliance with ____ at the time evaluation was made.

FIGURE 9-2 OBSERVATION RECORD PAGE ___ OF ___

COMPANY _____ OBSERVER _____
LOCATION _____ TYPE FACILITY _____
TEST NUMBER _____ POINT OF EMISSIONS _____
DATE _____

Hr.	Min.	Seconds 0	15	30	45	STEAM PLUME (check if applicable) Attached	Detached	COMMENTS
	0							
	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	27							
	28							
	29							

FIGURE 9-2 OBSERVATION RECORD (Continued) PAGE ___ OF ___

COMPANY _____ OBSERVER _____
LOCATION _____ TYPE FACILITY _____
TEST NUMBER _____ POINT OF EMISSIONS _____
DATE _____

Hr.	Min.	Seconds 0	15	30	45	STEAM PLUME (check if applicable) Attached	Detached	COMMENTS
	30							
	31							
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							
	41							
	42							
	43							
	44							
	45							
	46							
	47							
	48							
	49							
	50							
	51							
	52							
	53							
	54							
	55							
	56							
	57							
	58							
	59							

[FR Doc.74-26150 Filed 11-11-74;8:45 am]

GEORGE D. CLAYTON AND ASSOCIATES

SPECIFIC METHODOLOGY FOR PARTICULATE SAMPLING AND ANALYSIS

1. Fibrous glass (type A) filters are dried at 105°C for one hour, equilibrated at 70°F in a humidity-controlled (<50% R.H.) balance room for one hour and weighed on a Mettler H-20T direct reading balance to the nearest 0.1 milligram. The weights are recorded in the filter weight record book.

2. Each filter is placed in an individual Petri dish bearing the identification number of the filter and transported to the sampling site.

3. A stack gas velocity traverse will be conducted and the estimated flowrate at each point will be calculated for nozzle selection.

4. In preparing for each particulate test, the sampling train (Method 5 - Determination of Particulate Emissions from Stationary Sources, 40CFR60, December 23, 1971) will be set up.

5. A filter will be selected for each particulate test and its identification number will be recorded on the field data sheet along with the other appropriate sampling data developed throughout and at the conclusion of the test.

6. The condensate volume is measured and recorded. The impinger catch is then discarded (unless the methodology specified in the August 17, 1971 Federal Register is specified).

7. The filter and sample are removed quantitatively from the filter holder and transferred to their plastic Petri dish for transport to the laboratory.

8. The probe nozzle, the probe and the filter holder are rinsed first with acetone (reagent grade) and this rinse is transferred to glass sample bottles; subsequent distilled water rinsings of the probe, nozzle and filter holder are transferred to new, capped polyethylene bottles for transport to the laboratory.

9. At the laboratory, samples are logged in the master record system and assigned laboratory numbers. A full description of each sample is entered in this system.

10. The filter is dried at 105°C to constant weight, equilibrated in the 70°F reduced humidity (<50% R.H.) balance room for one hour, and weighed on a Mettler H-20T balance to the nearest 0.01 milligram.

11. The acetone and distilled water rinsings are transferred to a separately tared Pyrex Griffin beaker, evaporated and finally dried at 105°C to constant weight.

12. Blank pre-conditioned and pre-weighed filters (two) are transferred to filter holders and subsequently to individual, labeled Petri dishes in the field without using them for sampling. These filters are oven-dried at 105°C and re-weighed upon their return to the laboratory. Any weight increases are averaged and used to correct the sample weights.

13. Acetone and distilled water reagent blanks are determined for each source of supply of these reagents and appropriate corrections are applied to the weight of particulate found in the probe and other rinsings.

METHOD OF BAROMETER CALIBRATION

GEORGE D. CLAYTON & ASSOCIATES

1.0 SCOPE

1.1 This method covers the equipment and operational procedure necessary for the calibration of a temperature-compensating, aneroid barometer.

1.2 This method is intended for determination of the actual barometric pressure at the sampling location.

2.0 SUMMARY OF PROCEDURE

2.1 At George D. Clayton & Associates, each barometer which is to be used in a field study is calibrated immediately prior to transport to the sampling location.

2.2 The manufacturer's stated calibration procedure is followed.

3.0 APPARATUS

3.1 Mercury In-Glass Barometer: Arthur H. Thomas, Scientific Apparatus, Phila., PA., U.S.A., Serial No. 0597

4.0 PROCEDURE

4.1 The actual barometric pressure indicated by the reference mercury-in-glass barometer located in the Clayton & Associates laboratory is compared to the temperature-compensating, aneroid barometer which is to be used in the field.

4.2 If the difference between the two barometers is less than 0.05 inches of mercury, the field barometer is considered accurate.

4.3 If the difference between the two barometers is greater than or equal to 0.05 inches of mercury, the field barometer is adjusted by means of its set screw to the proper indicated barometric pressure.

5.0 REFERENCES

1. Method 2 - Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube), Final In-House Draft, 7/23/74, U.S. Environmental Protection Agency.

METHOD OF METER AND ORIFICE CALIBRATION

GEORGE D. CLAYTON & ASSOCIATES

1.0 SCOPE

1.1 This method covers the instrumentation, equipment, and operational procedures necessary for the calibration of a "meter and orifice" sampling rate control unit.

1.2 This calibration is used to measure the exact volume of dry sampled stack gas.

2.0 SUMMARY OF PROCEDURE

2.1 At Clayton & Associates, all "meter and orifice" sampling rate control units are calibrated in our engineering laboratory according to U.S. E.P.A. reports APTD-0576 and APTD-0581.

2.2 Calibration of each control unit is done prior to and following each sampling study.

2.3 A secondary standard wet test meter is used for the calibration procedure. It was calibrated on 5-1-74 by the manufacturer (Attachment A).

3.0 APPARATUS

3.1 Wet Test Meter - American Meter Company, Size AL-20, Serial No. P-199, calibrated 5-1-74 (Attachment A).

4.0 PROCEDURE

4.1 The calibration procedure specified in the U.S.E.P.A. publication APTD-0581 on pages 31 and 32 is followed as written.

4.2 The data is recorded on the "Meter and Orifice Calibration" data sheet (Attachment B).

5.0 CALCULATIONS

5.1 Calculations are performed as outlined on the "Meter and Orifice Calibration" data sheet.

5.2 Salient equations are:

$$P_w = P_b - \frac{\varphi_w}{13.6}$$

$$P_d = P_b + \frac{\Delta m}{13.6}$$

$$\gamma = \frac{V_w \; P_w (t_d + 460)}{V_d \; P_d (t_w + 460)}$$

$$K_m = \frac{V_w}{\theta} \sqrt{\frac{P_w}{T_w \, \Delta m}}$$

$$\text{Isokinetic Factor (ISO)} = \frac{27.40}{(\overline{K}_m)^2}$$

where:

P_w = absolute pressure at wet test meter, inches of mercury

φ_w = vacuum pressure at wet test meter, inches of mercury

P_d = absolute pressure at dry gas meter, inches of mercury

Δm = orifice manometer reading, inches of water

γ = meter correction factor, dimensionless

V_w = gas volume through the wet test meter, cubic feet

V_d = gas volume through the dry test meter, cubic feet

t_w = temperature of the wet test meter, degrees Fahrenheit

t_d = average temperature of the dry gas meter, degrees Fahrenheit

T_w = absolute temperature of the wet test meter, degrees Rankine

θ = elapsed time, minutes

K_m = interim calculation parameter, (ft^3/min) $[inches\ Hg/(^oR)(inches\ water)]^{0.5}$

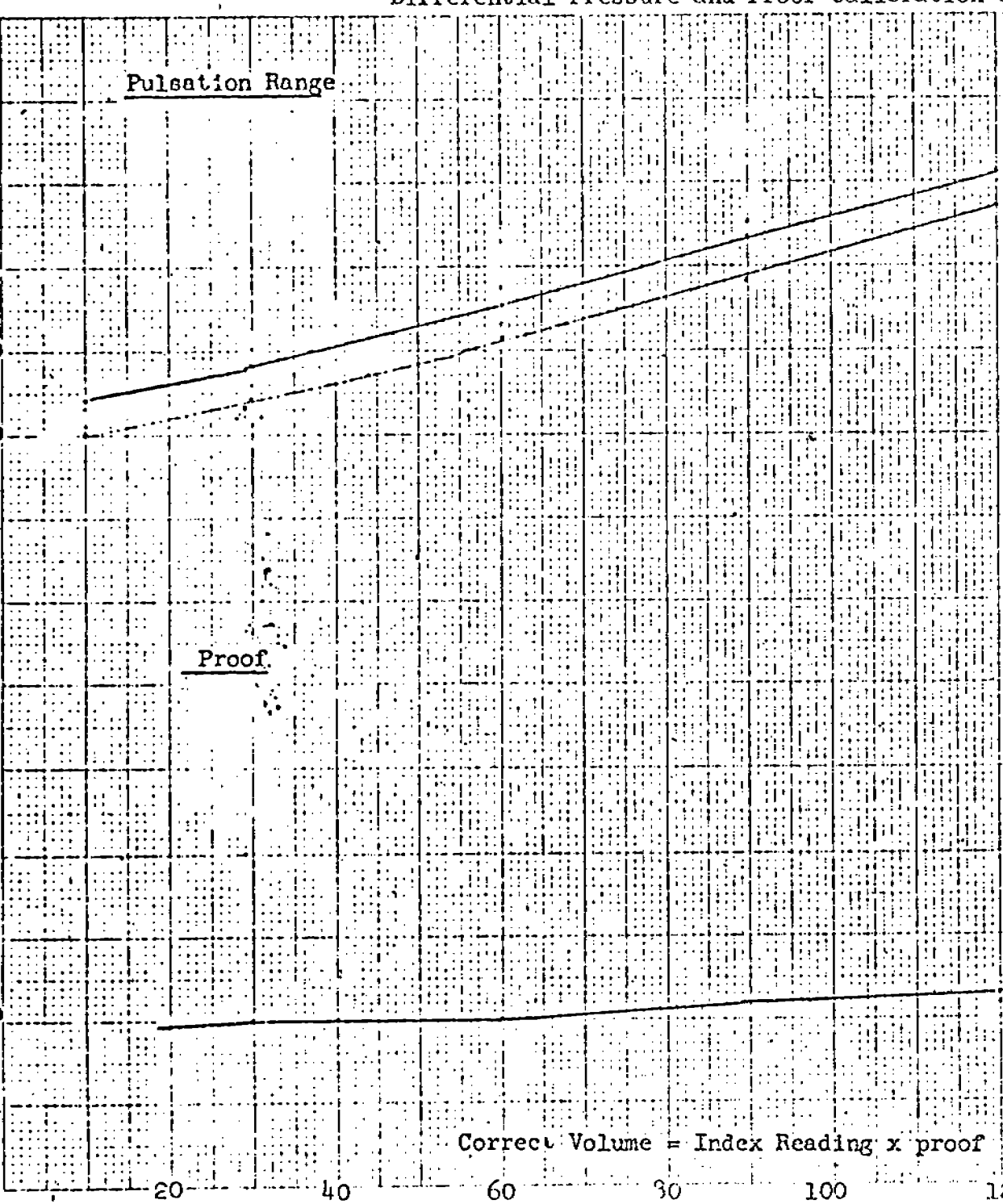
5.3 The average of the "before test" and "after test" average meter correction factor ($\bar{\gamma}$) is multiplied by the sampled dry gas volume to determine the true sampled dry gas volume.

6.0 REFERENCES

6.1 Maintenance, Calibration and Operation of Isokinetic Source Sampling Equipment, U.S.E.P.A., APTD-0576, pages 1, 12, 21, and 22.

6.2 Construction Details of Isokinetic Source Sampling Equipment, U.S.E.P.A., APTD-0581, pages 1, 31, and 32.

Differential Pressure and Proof Calibration Curves



AL-20 - 10 lt. Wet Test Meter
Serial No: P-199
Stainless Steel with Removable Back
Calibrated with Saturated Air
Water Temp. 78 deg. F.
Air Temp. 78 Deg. F.
Inlet Pressure 2" H_2O Constant
Calibration Rate 60 cu. ft. hr.
Capacity Rate 120 cu ft. hr.
Restricted Outlet for Rate Deviation

Date: 5-1-74
Bell Prover # 2260

Signed: [signature]

Singer American Meter Div.
Philadelphia, Pa.

Correct Volume = Index Reading x proof ÷ 100

ATTACHMENT A

[redacted] ET [redacted] ANL [redacted] IF [redacted] C/ [redacted] RA [redacted] N [redacted]

Date _____ Calibrator _____ Meter Box Number _____

Barometric Pressure Pb ("Hg) _____ Gas Meter Number _____

	Orifice Manometer Setting, Δm (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_{di} (°F)	Temperature: Dry Gas Meter Outlet t_{do} (°F)	Temperature: Dry Gas Meter Average t_d (°F)	Vacuum Wet Test Meter P_w (in. H_2O)	Time θ (min)	Meter Correction Factor (γ)	K_m
Stop	(0.5)										
Start											
verage		(5)									
Stop	(1.0)										
Start											
verage		(5)									
Stop	(2.0)										
Start											
verage		(10)									
Stop	(3.0)										
Start											
verage		(10)									
Stop	(4.0)										
Start											
verage		(10)									
Stop	(5.0)										
Start											
verage		(10)								AVERAGE	

$w = P_b - \frac{P_w}{13.6}$ $\quad P_d = P_b + \frac{\Delta m}{13.6}$ $\quad K_m = \frac{V_w}{\theta}\sqrt{\frac{P_w}{T_w \Delta m}}$

$= \frac{V_w P_w (t_d + 460)}{V_d P_d (t_w + 460)}$ $\quad$ Isokinetic Factor (ISO) $= \frac{27.40}{(K_m)^2} = \frac{27.40}{(\quad)^2} =$

ATTACHMENT B

METHOD OF NOZZLE CALIBRATION

GEORGE D. CLAYTON & ASSOCIATES

1.0 SCOPE

1.1 This method covers the equipment and operational procedure necessary for the calibration of any nozzle, whether it be button-hook, elbow or straight-edge (water-cooled), which is used by Clayton & Associates personnel.

1.2 The choice of type of nozzle used for a given source test shall be at the discretion of the Project Leader.

1.3 A single nozzle should be used for sampling during any one sample run.

1.4 Nozzle sizes below 1/4 inch inside diameter should not be used unless absolutely necessary for isokinetic sampling. The maximum relative error due to their calibration is substantially greater than nozzles larger than 1/4 inch inside diameter.

2.0 SUMMARY OF PROCEDURE

2.1 Each nozzle shall be calibrated both prior to and after each "sample run," i.e., for each sample acquired.

2.2 Prior to departure for the source testing assignment, each nozzle shall be inspected for nicks, misshapen facial area, corrosion, and dullness of the leading edge. If any of these or any other unacceptable conditions exist, the nozzle shall not be used and shall be returned to the engineering laboratory for correction of the unacceptable condition.

2.3 Each nozzle shall be permanently and uniquely identified.

3.0 APPARATUS

3.1 Micrometer Caliper: L.S. Starrett Co., Antol, Mass., U.S.A., No. 700

3.1.1 Use of the micrometer caliper follows the procedure stipulated in "How to Read a Micrometer Caliper"

4.0 PROCEDURE

4.1 Immediately prior to commencing each sample run examine the nozzle for nicks, misshapen facial area, corrosion, dullness of leading edge, etc. If unacceptable, do not use and replace with an acceptable, calibrated nozzle. Return unacceptable nozzle to engineering laboratory.

4.2 Immediately prior to commencing each sample run, measure each of three different inside diameters with the micrometer to the nearest 0.001 inch. The largest deviation between the high and low values must not exceed 0.004 inch or the nozzle shall not be used. If this requirement is met, record the average nozzle diameter on the Sampling Train Data sheet (See Attachment A).

4.3 Subsequent to each sample run, repeat 4.1 and 4.2. Record (Sampling Train Data sheet) if the nozzle was altered or damaged during the sample run.

Reference

1. Method 5 - Determination of Particulate Emissions from Stationary Sources, Final In-House Draft, 7/25/74, U.S. Environmental Protection Agency.

2. How to Read a Micrometer Caliper, The L.S. Starrett Company, Athol, Massachusetts.

SAMPLING TRAIN DATA

[redacted]any: _____

ource Designation: _____

[redacted]: _____ Meter Box No.,Coeff.: _____, _____

[redacted] Number: _____ Sample Box No.: _____

ield Person: _____ ilter Heater Setting: _____

[redacted]er Number: Front: Back: Probe Heater Setting: _____

esiccant Number: _____ Assumed Moisture(%): _____

[redacted]ometric Pressure("Hg): _____ Condensate Volume(ml): _____

[redacted]k Static Pressure("H_2O): _____ Nozzle No.,Diameter(in.) _____, _____

lume Appearance: _____ Meter Correction Factor: _____

[redacted]k Dimensions: _____ Pitot No.,Correction Factor: ____, ____

[redacted]se roint No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter			Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
				Volume (ft^3)	Temp.(°F) Inlet	Temp.(°F) Outlet				
[redacted]										
[redacted]ERAGE (TOTAL)				( )						

METHOD OF PITOT TUBE CALIBRATION

GEORGE D. CLAYTON & ASSOCIATES

1.0 SCOPE

1.1 This method covers the instrumentation, equipment, and operational procedures necessary for the calibration of a Staubscheibe pitot tube, commonly called a Type "S" pitot tube (See Figure 1).

1.2 At locations where a standard pitot tube cannot be inserted into the gas stream or where dust or moisture or both are present which might clog the small pressure sensing holes of the standard pitot tube, the Type "S" pitot tube is used.

1.3 The increased size of both pressure measuring ports of the Type "S" tubes and the relatively close proximity of the total pressure port to the static pressure port produces an inherently high velocity pressure reading.

1.4 In order to compensate for the higher velocity pressure readings obtained, a correction factor or pitot tube coefficient must be applied.

1.5 The pitot tube coefficient for the Type "S" pitot tube is determined by comparing the velocity pressure reading of the Type "S" pitot tube with that of a standard pitot tube at a reference point.

2.0 SUMMARY OF PROCEDURE

2.1 At Clayton & Associates, all Type "S" pitot tubes are calibrated in our engineering laboratory using an airflow-calibration test ductwork system.

2.2 The airflow-calibration test ductwork system enables the Type "S" pitot tube to be calibrated over a range of velocity pressure readings of 0.001 to 1.10 inches of water.

2.3 Calibration of each Type "S" pitot tube is done prior to and following each sampling study.

3.0 APPARATUS

3.1 Standard Pitot Tube - A Dwyer Instruments, Inc., Model 160-18, hemispherical tip, standard pitot tube, 18 inches in length (See Figure 2).

3.1.1 The coefficient used for the standard pitot tube is assumed to be 0.99.

3.2 Manometer - A Dwyer Instruments, Inc. "Microtector," Hook-Gage type, having a pressure range of 0-2 inches of water column, is used to measure all velocity pressures.

3.2.1 The differential pressure is measured by means of a micrometer by making fluid contact with the micrometer point forming a low power AC electrical circuit which provides the signal for indication on a sensitive DC microammeter.

4.0 PROCEDURE

4.1 The equipment is set up as shown in Figure 4. All connections are checked to ensure that they are tight and leak-free.

4.2 The Microtector unit is leveled. The fluid level and micrometer are zeroed.

4.3 The standard pitot tube is inserted at the centerline station in its ports, and positioned parallel to the axis of the duct and perpendicular to the duct wall. Following pitot tube placement the port is sealed and the airflow adjusted to the desired velocity pressure level for each required point.

4.4 The standard pitot tube is removed from the measuring point and the Type "S" pitot tube is inserted, aligned, the port sealed, and the comparison reading is obtained.

4.5 Prior to sampling at the J.M. Brenner Company, a minimum of six (6) different fan settings were used to establish the pitot tube coefficient curve. At each velocity pressure, the average of several measurements was recorded. At all fan settings the Type "S" tube was reversed to check that the coefficient did not vary by more than 0.01. The data were recorded on the calibration sheet (see Attachment A). The pitot tube was used in the range(s) wherever the pitot tube coefficient varied no more than five percent.
Following sampling a minimum of twelve different velocity pressure readings were obtained to establish the

coefficient curve. At three of the twelve points, the Type "S" tube was reversed to check that the coefficient did not vary by more than 0.01. All data were recorded and plotted on the calibration sheet (see Attachment A).

4.6 In the calculation of nozzle size, the pitot tube coefficient for the anticipated average velocity pressure is used.

5.0 CALCULATIONS

5.1 The pitot tube coefficient, C_p test, is calculated using the equation:

$$C_p \text{ test} = 0.99 \sqrt{\frac{\Delta p \text{ std}}{\Delta p \text{ test}}}$$

where:

0.99 = standard pitot tube coefficient

Δ_p std = velocity pressure measured by standard type pitot tube, inches of water

Δ_p test = velocity pressure measured by Type "S" pitot tube, inches of water.

5.2 The pitot tube coefficient for a sample run is calculated by averaging the "before test" and "after test" pitot tube coefficients measured nearest the average velocity pressure in the stack.

6.0 REFERENCES

1. Method 2 - Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube), Final In-House Draft, 7/23/74, U.S. Environmental Protection Agency.

2. Microtector Operating and Maintenance Instructions, Dwyer Instruments, Inc., Michigan City, Indiana.

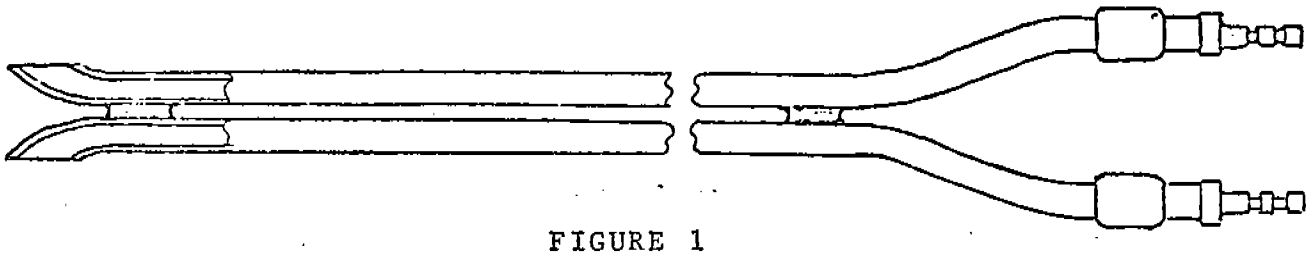


FIGURE 1

Type S Pitot Tube

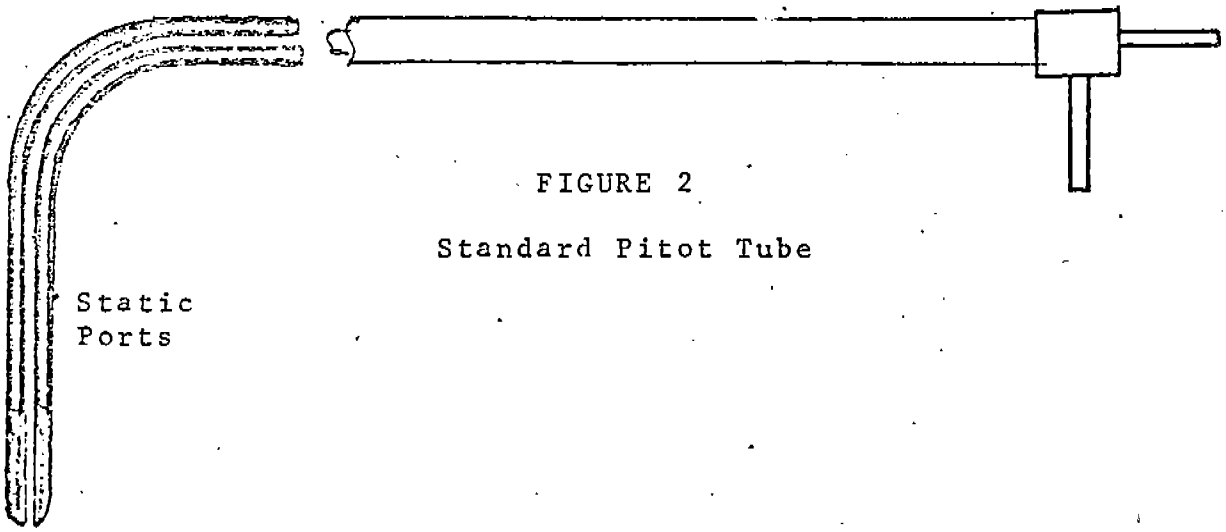


FIGURE 2

Standard Pitot Tube

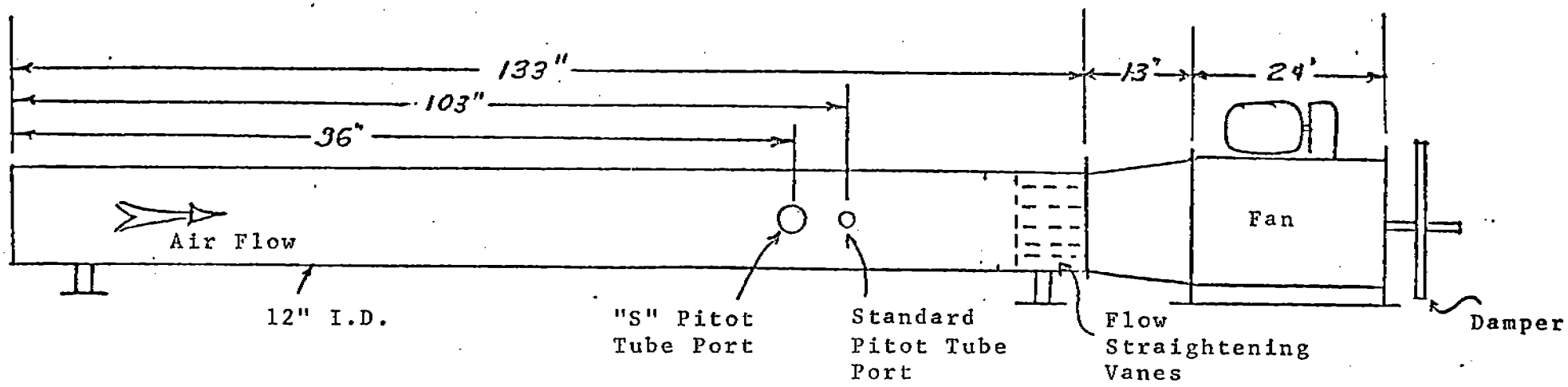


FIGURE 3

Airflow Demonstration and Calibration Duct and Fan

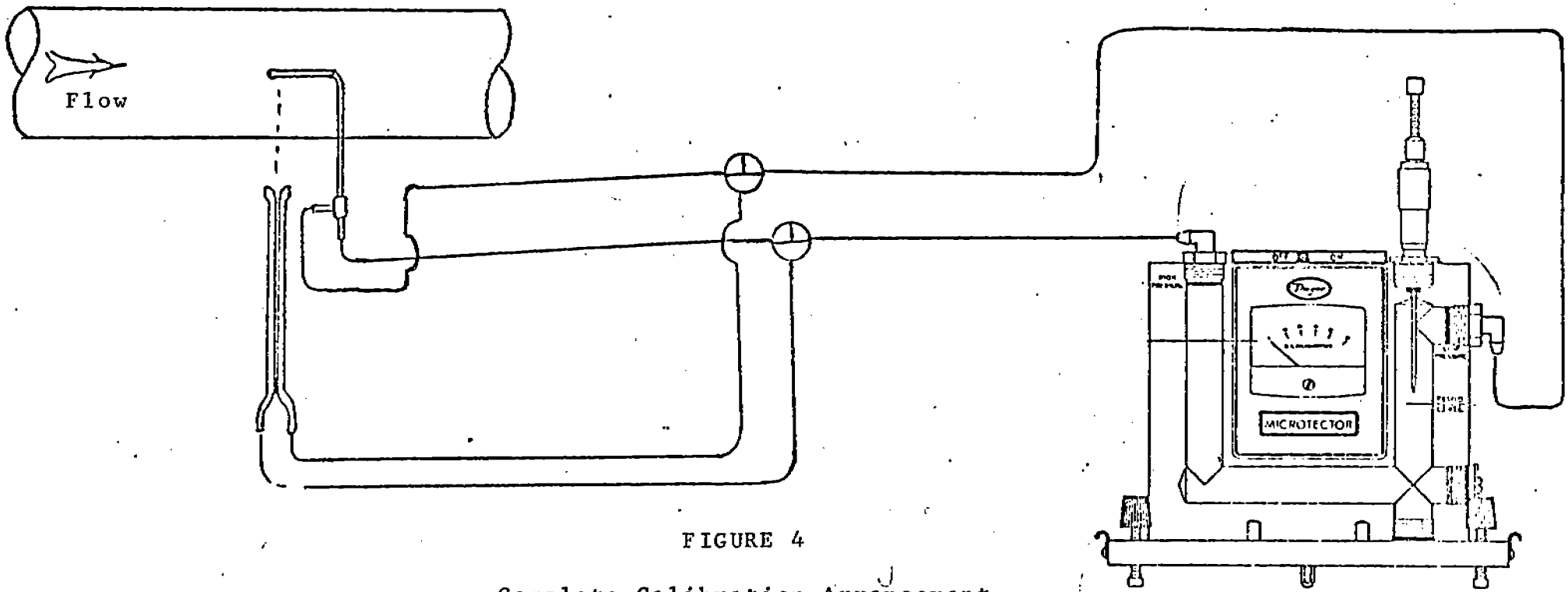


FIGURE 4

Complete Calibration Arrangement

ATTACHMENT A

PITOT TUBE CALIBRATION

Calibrator: _____ Date: _____

Standard Pitot Tube No.: _____

Pitot Tube Type _____ Pitot Tube No. _____

$$C_{p_{test}} = 0.99 \sqrt{\frac{\Delta p_{std}}{\Delta p_{test}}}$$

Anticipated Δp_{std}	Δp_{std}	A		B	
		Δp_{test}	$C_{p_{test}}$	Δp_{test}	$C_{p_{test}}$
0.02	0.____	0.____	0.____	0.____	0.____
0.04	0.____	0.____	0.____	0.____	0.____
0.06	0.____	0.____	0.____	0.____	0.____
0.08	0.____	0.____	0.____	0.____	0.____
0.10	0.____	0.____	0.____	0.____	0.____
0.12	0.____	0.____	0.____	0.____	0.____
0.16	0.____	0.____	0.____	0.____	0.____
0.20	0.____	0.____	0.____	0.____	0.____
0.30	0.____	0.____	0.____	0.____	0.____
0.50	0.____	0.____	0.____	0.____	0.____
0.70	0.____	0.____	0.____	0.____	0.____
0.80	0.____	0.____	0.____	0.____	0.____
Average					

METHOD OF TEMPERATURE SENSOR CALIBRATION

GEORGE D. CLAYTON & ASSOCIATES

1.0 SCOPE

1.1 This method covers the equipment and operational procedure necessary for the calibration of any temperature sensor whether it be direct-reading or otherwise, which is used by Clayton & Associates personnel.

1.2 Potentiometers are preferred over other temperature sensors for the measurement of stack temperature.

1.3 Direct-reading (in °F or °C) potentiometers are preferred over millivolt readout potentiometers because the possibility of error is reduced since no conversion table is required.

1.4 All exact potentiometer calibration procedures shall conform to the manufacturer's stated procedure.

1.5 It should be noted that in-field use of a potentiometer requires addition of a thermocouple which shall be given sufficient time to come to steady-state with the stack gas temperature in accordance with the manufacturer's specifications.

2.0 SUMMARY OF PROCEDURE

2.1 At Clayton & Associates, all potentiometers (and other temperature sensors) are calibrated in our engineering laboratory versus a secondary potentiometer (Pyrotest, Model 9-B, Serial No. 73090015) standard

which has been calibrated against a liquid-in-glass thermometer (Attachment A).

2.2 Calibration of each temperature sensor is done prior to and following each sampling study.

3.0 APPARATUS

3.1 Liquid-In-Glass Thermometer: Marked - No Maker 154049, Range -5 to +400°C in one degree (Attachment A).

3.2 Potentiometer: Pyrotest - Model 9-B - Serial No. 73090015.

4.0 PROCEDURE

4.1 The secondary potentiometer standard is utilized according to the procedures identified as "Changing Scale Plates," "Setting the Index," "Reading the Scales," "Adjusting the Galvanometer Zero," "Standardizing," and "Measuring Temperatures with Thermocouples" in the operating instructions for the Pyrotest Model 9-B.

4.2 The potentiometer to be calibrated is tested over the range of anticipated temperatures to be encountered.

4.3 A minimum of six (6) Pyrotest readings are made and recorded on the "Potentiometer Calibration" sheet (Attachment B).

4.4 The deviation of the test temperature sensor (potentiometer) versus the secondary standard potentiometer must be less than 1.5 percent of the minimum absolute temperature anticipated in-field to allow its use.

5.0 REFERENCES

1. Method 5 - Determination of Particulate Emissions from Stationary Sources, Final In-House Draft, 7/25/74, U.S. Environmental Protection Agency.

2. Method 2 - Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube), Final In-House Draft, 7/23/74, U.S. Environmental Protection Agency.

3. Method 1 - Sample and Velocity Traverses for Stationary Sources, Final In-House Draft, 7/18/74, U.S. Environmental Protection Agency.

4. Operating Instructions for the Pyrotest - Model 9-B, Serial No. 73090015.

ATTACHMENT A

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
INSTITUTE FOR BASIC STANDARDS
WASHINGTON, D.C. 20234

REPORT OF CALIBRATION

LIQUID-IN-GLASS THERMOMETER

TESTED FOR: GEORGE CLAYTON AND ASSOCIATES

MARKED: NO MAKER 154049
RANGE: -5 TO +400 DEGREES C IN 1 DEGREE

THERMOMETER READING	CORRECTION (IPTS-68)**
.03 C	-.03 C
100.00	.31
200.00	-.18
300.00	-.74

**ALL TEMPERATURES IN THIS REPORT ARE BASED ON THE INTERNATIONAL PRACTICAL TEMPERATURE SCALE OF 1968, IPTS-68. THIS TEMPERATURE SCALE WAS ADOPTED BY THE INTERNATIONAL COMMITTEE OF WEIGHTS AND MEASURES AT ITS MEETING IN OCTOBER, 1968, AND IS DESCRIBED IN "THE INTERNATIONAL PRACTICAL TEMPERATURE SCALE OF 1968," METROLOGIA, VOL. 5, NO. 2, 35 (APRIL 1969).

ESTIMATED UNCERTAINTIES IN THE ABOVE CORRECTIONS DO NOT EXCEED 1.0 DEGREE UP TO 300 DEGREES C .

FOR A DISCUSSION OF ACCURACIES ATTAINABLE WITH SUCH THERMOMETERS SEE NATIONAL BUREAU OF STANDARDS MONOGRAPH 90, CALIBRATION OF LIQUID-IN-GLASS THERMOMETERS.

IF THE CORRECTION IS + THE TRUE TEMPERATURE IS HIGHER THAN THE INDICATED TEMPERATURE; IF THE CORRECTION IS - THE TRUE TEMPERATURE IS LOWER THAN THE INDICATED TEMPERATURE. TO USE THE CORRECTIONS PROPERLY, REFERENCE SHOULD BE MADE TO THE NOTES GIVEN BELOW.

THE TABULATED CORRECTIONS APPLY PROVIDED THE ICE-POINT READING IS +0.03 C . IF THE ICE-POINT READING IS FOUND TO BE HIGHER (OR LOWER) THAN STATED, ALL OTHER READINGS WILL BE HIGHER (OR LOWER) BY THE SAME AMOUNT.

THIS THERMOMETER COMPLIES WITH THE ACCURACY REQUIREMENT OF THE APPLICABLE ASTM SPECIFICATION TO THE EXTENT OF THE TESTS MADE.

NOT TESTED OVER THE ENTIRE RANGE OF SCALE.

TEST NUMBER 209796
COMPLETED 2-11-74

THESE CORRECTIONS ARE APPLICABLE FOR 76 MM IMMERSION AND FOR TEMPERATURES OF THE EMERGENT MERCURY COLUMN AS GIVEN BELOW:

READING OF THERMOMETER	0	100	200	300 C
TEMPERATURE OF EMERGENT MERCURY	19	50	75	89 C.

FOR THE DIRECTOR,
INSTITUTE FOR BASIC STANDARDS

James F. Schooley, Jr.

HARMON H. PLUMB
CHIEF, TEMPERATURE SECTION
HEAT DIVISION

TEST NUMBER 209796
COMPLETED 2-11-74

ATTACHMENT B

POTENTIOMETER CALIBRATION

Instrument No.-Pyrotest 73090015 Minimite _____

Scale-Pyrotest _____ Minimite _____

Calibrator _____

Date _____

Cold Junction Temperature _____

Pyrotest Reading (°F)	Minimite Reading (°F)	Deviation (°F)
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
Average		

APPENDIX E

FIELD AND ANALYTICAL DATA

SAMPLING SUMMARY SHEET

Plant J. M. Brenner Company Location Lancaster, Pennsylvania

Sampled source Outlet A

Run	Date	N_p	P_m	P_b	$\propto$	$\propto V_m$	T_m	$V_{m_{std}}$	V_w	$V_{w_{gas}}$	%M	M_d
1	11-19-74	20	0.67	29.78	1.006	54.565	74	53.80	11.5	0.545	1.00	0.9900
2	11-21-74	20	3.60	29.01	0.998	247.66	42	254.9	23.9	1.133	0.44	0.9956
3	11-22-74	20	3.63	29.64	0.998	250.631	46	261.4	5.4	0.256	0.10	0.9990

Run	MW_d	MW	P_{st}	P_s	C_p	$\sqrt{\Delta P_s \times (T_s+460)}^c$	V_s	T_s	T_t	D_n	%I
1	(29)	28.89	-0.14	29.64	0.820	34.76	4988	66	120	0.125	106.4
2	(29)	28.95	-0.15	28.86	0.820	35.33	5132	38	240	0.195	97.3
3	(29)	28.99	-0.13	29.51	0.820	35.60	5111	44	240	0.195	98.9

$$V_{m_{std}} = \frac{17.45 \times V_m \left(P_b + \frac{P_m}{13.6}\right)}{(T_m + 460)}$$

$$\% M = \frac{100 \times V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}}$$

$$V_{w_{gas}} = 0.0474 \times V_w$$

$$M_d = \frac{100 - \% M}{100}$$

$$MW_d = (\%CO_2 \times \tfrac{44}{100}) + (\%O_2 \times \tfrac{32}{100}) + [\%CO + \%N_2) \times \tfrac{28}{100}$$

$$MW = MW_d \times M_d + 18 (1 - M_d)$$

$$P_s = P_b \pm P_{st}$$

$$V_s = 5120.8 \times Cp \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{1.032 \times (T_s + 460) \times V_{m_{std}}}{V_s \times T_t \times P_s \times M_d \times (D_n)^2}$$

N_p Total No. of Sampling Points

P_m Average Orifice Pressure Drop, in. H_2O

P_b Barometric Pressure, in. Hg. Absolute

V_m Volume of Dry Gas at Meter Conditions, DCF

T_m Average Meter Temperature, °F

$V_{m_{std}}$ Volume of Dry Gas at STP, DSCF[a]

V_w Total H_2O Collected in Impingers and Silica Gel, ml

$V_{w_{gas}}$ Volume of Water Vapor Collected at STP, SCF[b]

% M % Moisture by Volume

M_d Mole Fraction of Dry Gas

$\% CO_2$ Volume % Dry

$\% O_2$ Volume % Dry

% CO Volume % Dry

$\% N_2$ Volume % Dry

MW_d Molecular Weight of Stack Gas, Dry Basis

MW Molecular Weight of Stack Gas, Wet Basis

P_{st} Static Pressure of Stack Gas, in. Hg

P_s Stack Gas Pressure, in. Hg Absolute

C_p Pitot Tube Coefficient

V_s Stack Gas Velocity at Stack Conditions, fpm.

T_s Average Stack Temperature °F

T_t Net Time of Test, Min.

D_n Sampling Nozzle Diameter, in.

% I Percent Isokinetic

$\propto$ Dry gas meter correction factor

[a] Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b] Standard conditions at 68°F, 29.92 in. Hg.

[c] $\sqrt{\Delta P_s \times (T_s + 460)}$ is determined by averaging the square root of the product of the velocity head (ΔPs) and the absolute stack temperature from each sampling point.

SAMPLING SUMMARY SHEET

Plant J. M. Brenner Company Location Lancaster, Pennsylvania

Sampled source Outlet B

Run	Date	N_p	P_m	P_b	α	αV_m	T_m	$V_{m_{std}}$	V_w	$V_{w_{gas}}$	%M	M_d
1	11-19-74	20	2.10	29.78	0.982	102.825	60	104.1	8.2	0.389	0.38	0.9962
2	11-21-74	20	2.74	29.01	0.982	233.037	43	238.8	14.8	0.702	0.30	0.9970
3	11-22-74	20	2.49	29.64	0.982	220.299	46	229.1	3.5	0.166	0.08	0.9992

Run	MW_d	MW	P_{st}	P_s	C_p	$\sqrt{\Delta P_s \times (T_s+460)}^c$	V_s	T_s	T_t	D_n	%I
1	(29)	28.98	-0.02	29.76	0.823	28.89	4146	62	120	0.193	102.0
2	(29)	28.97	-0.08	28.93	0.823	31.47	4581	50	240	0.193	106.4
3	(29)	28.99	-0.05	29.59	0.823	30.31	4361	51	240	0.193	104.8

$$V_{m_{std}} = \frac{17.65 \times V_m \left(P_b + \frac{P_m}{13.6}\right)}{(T_m + 460)}$$

$$\%\,H = \frac{100 \times V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}}$$

$$V_{w_{gas}} = 0.0474 \times V_w$$

$$M_d = \frac{100 - \%\,H}{100}$$

$$MW_d = (\%CO_2 \times \tfrac{44}{100}) + (\%O_2 \times \tfrac{32}{100}) + [\%CO + \%N_2) \times \tfrac{28}{100}$$

$$MW = MW_d \times M_d + 18\,(1 - M_d)$$

$$P_s = P_b \pm P_{st}$$

$$V_s = 5120.8 \times Cp \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{1.032 \times (T_s + 460) \times V_{m_{std}}}{V_s \times T_t \times P_s \times M_d \times (D_n)^2}$$

N_p Total No. of Sampling Points

P_m Average Orifice Pressure Drop, in. H_2O

P_b Barometric Pressure, in. Hg. Absolute

V_m Volume of Dry Gas at Meter Conditions, DCF

T_m Average Meter Temperature, °F

$V_{m_{std}}$ Volume of Dry Gas at STP, DSCF

V_w Total H_2O Collected in Impingers and Silica Gel, ml

$V_{w_{gas}}$ Volume of Water Vapor Collected at STP, SCF

% H Moisture by Volume

M_d Mole Fraction of Dry Gas

% CO_2 Volume % Dry

% O_2 Volume % Dry

% CO Volume % Dry

% N_2 Volume % Dry

MW_d Molecular Weight of Stack Gas, Dry Basis

MW Molecular Weight of Stack Gas, Wet Basis

P_{st} Static Pressure of Stack Gas, in. Hg

P_s Stack Gas Pressure, in. Hg Absolute

C_p Pitot Tube Coefficient

V_s Stack Gas Velocity at Stack Conditions, fpm.

T_s Average Stack Temperature °F

T_t Net Time of Test, Min.

D_n Sampling Nozzle Diameter, in.

% I Percent Isokinetic

α Dry gas meter correction factor

[a] Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b] Standard conditions at 68°F, 29.92 in. Hg.

[c] $\sqrt{\Delta P_s \times (T_s + 460)}$ is determined by averaging the square root of the product of the velocity head (ΔP_s) and the absolute stack temperature from each sampling point.

SAMPLING SUMMARY SHEET

Plant J. M. Brenner Company Location Lancaster, Pennsylvania

Sampled source Inlet C

Run	Date	N_p	P_m	P_b	α	αV_m	T_m	$V_{m_{std}}$	V_w	$V_{w_{gas}}$	%M	M_d
1	11-21-74	8	2.15	29.01	1.002	87.020	40	89.58	11.5	0.55	0.63	0.9937
2	11-22-74	8	2.13	29.64	1.002	86.921	42	91.05	10.4	0.493	0.56	0.9944

Run	MW_d	MW	P_{st}	P_s	C_p	$\sqrt{\Delta P_s \times (T_s+460)}^c$	V_s	T_s	T_t	D_n	%I
1	(29)	28.93	-0.52	28.49	0.825	15.30	2251	40	114	0.25	101.8
2	(29)	28.94	-0.52	29.12	0.825	15.31	2228	42	121	0.25	96.7

$$V_{m_{std}} = \frac{17.65 \times V_m \left(P_b + \frac{P_m}{13.6}\right)}{(T_m + 460)}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}}$$

$$V_{w_{gas}} = 0.0474 \times V_w$$

$$M_d = \frac{100 - \%M}{100}$$

$$MW_d = (\%CO_2 \times \tfrac{44}{100}) + (\%O_2 \times \tfrac{32}{100}) + (\%CO + \%N_2) \times \tfrac{28}{100}$$

$$MW = MW_d \times M_d + 18 (1 - M_d)$$

$$P_s = P_b \pm P_{st}$$

$$V_s = 5120.8 \times C_p \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{1.032 \times (T_s + 460) \times V_{m_{std}}}{V_s \times T_t \times P_s \times M_d \times (D_n)^2}$$

N_p Total No. of Sampling Points

P_m Average Orifice Pressure Drop, in. H_2O

P_b Barometric Pressure, in. Hg. Absolute

V_m Volume of Dry Gas at Meter Conditions, DCF

T_m Average Meter Temperature, °F

$V_{m_{std}}$ Volume of Dry Gas at STP, DSCF[a]

V_w Total H_2O Collected in Impingers and Silica Gel, ml

$V_{w_{gas}}$ Volume of Water Vapor Collected at STP, SCF[b]

%M % Moisture by Volume

M_d Mole Fraction of Dry Gas

$\%CO_2$ Volume % Dry

$\%O_2$ Volume % Dry

%CO Volume % Dry

$\%N_2$ Volume % Dry

MW_d Molecular Weight of Stack Gas, Dry Basis

MW Molecular Weight of Stack Gas, Wet Basis

P_{st} Static Pressure of Stack Gas, in. Hg

P_s Stack Gas Pressure, in. Hg Absolute

C_p Pitot Tube Coefficient

V_s Stack Gas Velocity at Stack Conditions, fpm.

T_s Average Stack Temperature °F

T_t Net Time of Test, Min.

D_n Sampling Nozzle Diameter, in.

%I Percent Isokinetic

α Dry gas meter correction factor

[a] Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b] Standard conditions at 68°F, 29.92 in. Hg.

[c] $\sqrt{\Delta P_s \times (T_s + 460)}$ is determined by averaging the square root of the product of the velocity head (ΔP_s) and the absolute stack temperature from each sampling point.

SAMPLING SUMMARY SHEET

Plant J. M. Brenner Company Location Lancaster, Pennsylvania

Sampled source Inlet D

Run	Date	N_p	P_m	P_b	α	αV_m	T_m	$V_{m_{std}}$	V_w	$V_{w_{gas}}$	%M	M_d
1	11-21-74	36	2.17	29.01	1.012	86.006	40	88.54	22.5	1.067	1.23	0.9877
2	11-22-74	36	2.0	29.64	1.012	80.987	41	84.97	19.7	0.934	1.14	0.9886

Run	MW_d	MW	P_{st}	P_s	C_p	$\sqrt{\Delta P_s \times (T_s+460)}^c$	V_s	T_s	T_t	D_n	%I
1	(29)	28.86	-0.56	28.45	0.832	29.47	4382	37	108	0.188	96.6
2	(29)	28.87	-0.56	29.08	0.832	28.24	4152	41	108	0.188	96.4

$$V_{m_{std}} = \frac{17.65 \times V_m \left(P_b + \frac{P_m}{13.6}\right)}{(T_m + 460)}$$

$$\%H = \frac{100 \times V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}}$$

$$V_{w_{gas}} = 0.0474 \times V_w$$

$$M_d = \frac{100 - \%H}{100}$$

$$MW_d = (\%CO_2 \times \tfrac{44}{100}) + (\%O_2 \times \tfrac{32}{100}) + [\%CO + \%N_2) \times \tfrac{28}{100}$$

$$MW = MW_d \times M_d + 18 (1 - M_d)$$

$$P_s = P_b \pm P_{st}$$

$$V_s = 5120.8 \times Cp \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{1.032 \times (T_s + 460) \times V_{m_{std}}}{V_s \times T_t \times P_s \times M_d \times (D_n)^2}$$

N_p Total No. of Sampling Points

P_m Average Orifice Pressure Drop, in. H_2O

P_b Barometric Pressure, in. Hg. Absolute

V_m Volume of Dry Gas at Meter Conditions, DCF

T_m Average Meter Temperature, °F

$V_{m_{std}}$ Volume of Dry Gas at STP, DSCF[a]

V_w Total H_2O Collected in Impingers and Silica Gel, ml

$V_{w_{gas}}$ Volume of Water Vapor Collected at STP, SCF[b]

%M % Moisture by Volume

M_d Mole Fraction of Dry Gas

$\%CO_2$ Volume % Dry

$\%O_2$ Volume % Dry

%CO Volume % Dry

$\%N_2$ Volume % Dry

MW_d Molecular Weight of Stack Gas, Dry Basis

MW Molecular Weight of Stack Gas, Wet Basis

P_{st} Static Pressure of Stack Gas, in. Hg

P_s Stack Gas Pressure, in. Hg Absolute

C_p Pitot Tube Coefficient

V_s Stack Gas Velocity at Stack Conditions, fpm.

T_s Average Stack Temperature °F

T_t Net Time of Test, Min.

D_n Sampling Nozzle Diameter, in.

%I Percent Isokinetic

α Dry gas meter correction factor

[a] Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b] Standard conditions at 68°F, 29.92 in. Hg.

[c] $\sqrt{\Delta P_s \times (T_s + 460)}$ is determined by averaging the square root of the product of the velocity head (ΔP_s) and the absolute stack temperature from each sampling point.

SAMPLING SUMMARY SHEET

Plant J. M. Brenner Company Location Lancaster, Pennsylvania

Sampled source Inlet E

Run	Date	N_p	P_m	P_b	α	αV_m	T_m	$V_{m_{std}}$	V_w	$V_{w_{gas}}$	%M	M_d
1	11-21-74	8	5.88	29.01	1.006	153.842	48	157.3	10.2	0.483	0.31	0.9969
2	11-22-74	8	2.40	29.64	1.006	93.211	52	95.79	15.7	0.744	0.79	0.9921

Run	MW_d	MW	P_{st}	P_s	C_p	$\sqrt{\Delta P_s \times (T_s+460)}^c$	V_s	T_s	T_t	D_n	%I
1	(29)	28.97	-0.66	28.35	0.812	46.38	6729	45	125	0.188	97.6
2	(29)	28.91	-0.66	28.98	0.812	38.26	5496	45	120	0.125	168.5

$$V_{m_{std}} = \frac{17.65 \times V_m \left(P_b + \frac{P_m}{13.6}\right)}{(T_m + 460)}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}}$$

$$V_{w_{gas}} = 0.0474 \times V_w$$

$$M_d = \frac{100 - \%M}{100}$$

$$MW_d = (\%CO_2 \times \tfrac{44}{100}) + (\%O_2 \times \tfrac{32}{100}) + [\%CO + \%N_2) \times \tfrac{28}{100}$$

$$MW = MW_d \times M_d + 18 (1 - M_d)$$

$$P_s = P_b \pm P_{st}$$

$$V_s = 5128.8 \times Cp \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{1.032 \times (T_s + 460) \times V_{m_{std}}}{V_s \times T_t \times P_s \times M_d \times (D_n)^2}$$

N_p Total No. of Sampling Points

P_m Average Orifice Pressure Drop, in. H_2O

P_b Barometric Pressure, in. Hg. Absolute

V_m Volume of Dry Gas at Meter Conditions, DCF

T_m Average Meter Temperature, °F

$V_{m_{std}}$ Volume of Dry Gas at STP, DSCF[a]

V_w Total H_2O Collected in Impingers and Silica Gel, ml

$V_{w_{gas}}$ Volume of Water Vapor Collected at STP, SCF[b]

%M Moisture by Volume

M_d Mole Fraction of Dry Gas

$\%CO_2$ Volume % Dry

$\%O_2$ Volume % Dry

%CO Volume % Dry

$\%N_2$ Volume % Dry

MW_d Molecular Weight of Stack Gas, Dry Basis

MW Molecular Weight of Stack Gas, Wet Basis

P_{st} Static Pressure of Stack Gas, in. Hg

P_s Stack Gas Pressure, in. Hg Absolute

C_p Pitot Tube Coefficient

V_s Stack Gas Velocity at Stack Conditions, fpm.

T_s Average Stack Temperature °F

T_t Net Time of Test, Min.

D_n Sampling Nozzle Diameter, in.

%I Percent Isokinetic

α Dry gas meter correction factor

[a] Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b] Standard conditions at 68°F, 29.92 in. Hg.

[c] $\sqrt{\Delta P_s \times (T_s + 460)}$ is determined by averaging the square root of the product of the velocity head (ΔP_s) and the absolute stack temperature from each sampling point.

GEORGE D. CLAYTON & ASSOCIATES
SAMPLING TRAIN DATA

Company: EPA
Source Designation: A
Date: 11/19/77
Test Number: P-1
Field Person: RGill
Filter Number: 72461
Desiccant Number:
Barometric Pressure("Hg): 29.78
Stack Static Pressure("H_2O): -1.9
Flame Appearance: < 10% opacity

Meter Box No.: RAC-1 (1.006)
Sample Box No.: 1
Filter Heater Setting: 250°
Probe Heater Setting: 51
Assumed Moisture(%): 1%
Condensate Volume(ml):
Nozzle Diameter(in.): 1/2
Meter Correction Factor: 1

Q: m = 0.29 H

Traverse Point No.	Time 1421	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp.(°F) Inlet	Dry Gas Meter Temp.(°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
A-1	0	~~2.7~~	67	667.050	63	58	.78	250	49	< 1
A-2	3	2.7	67	668.93	65	59	.78	250	48	< 1
B-2	6	2.7	67	669.85	67	60	.78	250	48	< 1
B-1	9	2.7	67	671.25	67	60	.78	250	49	< 1
C-1	12	2.3	67	672.66	69	61	.67	250	50	< 1
C-2	15	2.35	67	674.97	71	62	.69	250	50	< 1
D-2	18	2.5	67	675.28	73	63	0.72	250	50	< 1
D-1	21	2.5	67	676.67	75	64	0.72	250	50	< 1
E-1	24	2.7	67	678.03	76	65	0.71	250	55	
E-2	27	2.7	67	679.54	77	68	0.78	250	55	< 1
F-1	30	2.5	67	680.969	75	67	0.72	250	56	< 1
F-2	33	2.5	67	682.35	75	67	0.72	250	56	< 1
G-1	36	2.2	67	683.76	77	68	0.64	250	56	< 1
G-2	39	2.2	67	685.11	78	68	0.64	250	56	< 1
H-1	42	2.24	67	686.44	79	70	0.65	250	57	< 1
H-2	45	2.3	67	687.76	79	70	0.67	250	57	< 1
I-2	48	2.35	67	689.11	80	70	.68	250	58	< 1
I-1	51	2.35	67	690.5	81	71	.68	250	58	< 1
AVERAGE (TOTAL)				( )						

GEORGE D. CLAYTON & ASSOCIATES
SAMPLING TRAIN DATA

P

Company: EPA
Source Designation: A, J. M. Brenner Co. Source "A"
Date: 11/19/74
Test Number: P-1
Field Person: R. Kellam
Filter Number: 72461
Desiccant Number:
Barometric Pressure("Hg): 29.80
Stack Static Pressure("H_2O): -1.9
Plume Appearance: < 10% Op.

Meter Box No.: RAC-1
Sample Box No.: 1
Filter Heater Setting: 250
Probe Heater Setting: 51
Assumed Moisture(%): 19
Condensate Volume(ml):
Nozzle Diameter(in.): .29
Meter Correction Factor:

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
C 1	54	2.3	67	691.88	82	71	.67	250	59	<1
1	57	2.3	67	693.26	82	72	.67	250	59	<1
B 5	60	2.55	67	694.63	82	72	.74	250	59	<1
5	63	2.55	67	696.04	83	72	.74	250	59	<1
4	66	2.15	66	697.48	83	73	.62	250	59	<1
4	69	2.15	66	698.81	83	73	.62	250	59	<1
B 3	72	2.1	66	700.13	83	73	.61	250	59	<1
3	75	2.05	66	701.45	82	73	.59	250	59	<1
B 2	78	2.1	65	702.75	82	73	.64	250	59	<1
2	81	2.2	65	704.10	82	73	.64	250	59	<1
A 1	84	2.2	65	705.46	82	73	.64	250	59	<1
1	87	2.2	65	706.81	83	73	.64	250	60	<1
A 5	90	2.65	65	708.16	83	73	.77	250	60	<1
5	93	2.65	65	709.62	83	73	.77	250	60	<1
A 4	96	2.3	65	711.08	83	74	.67	250	60	<1
4	99	2.3	65	712.46	83	74	.67	250	60	<1
A 3	102	2.05	65	713.85	83	74	.59	250	60	<1
3	105	2.05	65	715.15	83	74	.59	250	60	<1
AVERAGE (TOTAL)				( )						

GEORGE D. CLAYTON & ASSOCIATES
SAMPLING TRAIN DATA

Company: EPA

Source Designation: At J. M. Brennan Co. source "A"

Date: 11/19/74

Test Number: P-1

Field Person: R. Keller

Filter Number: 72961

Desiccant Number:

Barometric Pressure("Hg): 29.78

Stack Static Pressure("H_2O): -1.9

Plume Appearance:

Meter Box No.: RAC-1

Sample Box No.: 1

Filter Heater Setting: 250

Probe Heater Setting: 51

Assumed Moisture(%): 13 *

Condensate Volume(ml):

Nozzle Diameter(in.): 1/8

Meter Correction Factor:

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp.(°F) Inlet	Dry Gas Meter Temp.(°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
A 2	108	1.85	65	716.44	83	75	.54	250	60	<1
2	111	1.85	65	717.67	83	75	.54	250	60	<1
A 1	114	1.65	65	718.91	83	75	.45	250	60	<1
1	117	1.55	65	720.068	83	75	.45	250	60	<1
	120			721.290						
end	1623									
AVERAGE (TOTAL)			66	(1319.565)	79	70	.47	250	57	<1

1.006 (59.24)

GEORGE D. CLAYTON & ASSOCIATES
SAMPLING TRAIN DATA

Company: EPA
Source Designation: A
Date: 11/21/74 — Meter Box No.: MAC-2 (1.995)
Test Number: P-2 page 1 — Sample Box No.: 1
Field Person: R. Keller — Filter Heater Setting: 250-550
Filter Number: 72443 NBS # 5 — Probe Heater Setting: 60
Desiccant Number: — Assumed Moisture(%): 19%
Barometric Pressure("Hg): 29.01 — Condensate Volume(ml):
Stack Static Pressure("H_2O): -2.0 — Nozzle Diameter(in.): 3/8 → 0.375
Plume Appearance: — Meter Correction Factor:

Pre-test leak rate: 0.015 cu ft/min at 15" Hg
Final leak rate: 0.005 cu ft/min at 15" Hg

Traverse Point No.	Time 12:10	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
A 5	0	3.0	38	864.427	40	40	4.44	232	40	4.0
5	3	2.85	38	867.70	40	40	4.2	232	41	4.0
A 4	6	2.35	38	871.16	40	40	3.5	232	41	3.5
4	9	2.35	38	874.11	40	40	3.5	232	41	3.5
3	12	2.1	38	877.16	42	40	3.1	230	41	3.0
3	15	2.1	38	880.07	42	40	3.1	230	39	3.0
A 2	18	1.9	38	882.19	42	40	2.8	225	39	3.0
2	21	1.9	38	885.77	42	40	2.8	225	39	3.0
A 1	24	1.5	38	888.41	42	40	2.2	210	39	2.5
1	27	1.5	38	891.4	42	40	2.2	210	38	2.5
1	30	1.55	38	893.37	42	40	2.3	210	38	2.5
1	33	1.55	38	895.60	41	40	2.3	200	44	2.5
A 2	36	1.95	38	897.54	41	40	2.9	190	44	3.0
2	39	1.95	38	900.60	41	40	2.9	195	44	3.0
A 3	42	2.15	36	903.41	42	40	3.2	197	47	3.0
3	45	2.1	36	906.32	42	40	3.1	197	48	3.0
A 4	48	2.5	36	909.23	43	40	3.7	210	49	4.0
4	51	2.5	36	912.35	43	40	3.7	212	50	4.0
AVERAGE (TOTAL)				( )						

GEORGE D. CLAYTON & ASSOCIATES
SAMPLING TRAIN DATA

Company: EPA

Source Designation: A

Date: 11/21/77

Test Number: P-2 page 2

Field Person: R. Keller

Filter Number:

Desiccant Number:

Barometric Pressure("Hg):

Stack Static Pressure("H_2O):

Plume Appearance:

Meter Box No.:

Sample Box No.:

Filter Heater Setting: 550

Probe Heater Setting:

Assumed Moisture(%):

Condensate Volume(ml):

Nozzle Diameter(in.):

Meter Correction Factor:

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
A 5	54	2.85	36	915.51	44	40	4.2	208	51	4.0
5	57	2.85	36	918.55	44	40	4.2	208	52	4.0
B 5	30	2.85	36	922.20	44	40	4.2	207	52	4.0
5	33	2.8	36	925.55	44	40	4.1	207	52	4.0
B 4	36	2.40	36	928.86	44	40	3.6	208	52	3.5
4	39	2.4	36	932.2	44	40	3.6	208	52	3.5
B 3	42	2.15	36	935.11	44	40	3.2	214	51	3.5
3	45	2.15	36	938.03	44	40	3.2	214	50	3.5
B 2	48	2.15	36	940.97	44	40	3.2	215	50	3.5
2	51	2.15	36	943.93	44	40	3.2	215	50	3.5
B 1	54	1.9	36	946.84	43	40	2.8	220	50	3.0
1	57	1.9	35	949.67	43	40	2.8	220	50	3.0
1	60	1.9	35	952.47	43	40	2.8	219	50	3.0
1	63	1.95	35	955.26	42	40	2.9	220	50	3.0
B 2	66	2.15	35	958.09	42	40	3.2	221	50	3.5
2	69	2.15	35	961.05	42	40	3.2	223	50	3.5
B 3	72	2.15	35	964.0	42	40	3.2	225	52	3.5
3	75	2.15	35	966.96	42	40	3.2	227	52	3.5
AVERAGE (TOTAL)				( )						

* Add 30 minutes to this and subsequent times.

PARTICULATE SAMPLING TRAIN DATA

Company: EPA

Source Designation: A

Date: 11/21/74

Test Number: P-1-5

Field Person: R Hall

Filter Number:

Barometric Pressure ("Hg):

Stack Static Pressure ("H_2O):

Plume Appearance:

Stack Diameter:

Meter Box No.:

Sample Box No.:

Filter Heater Setting:

Probe Heater Setting:

Assumed Moisture(%):

Condensate Volume(ml):

Nozzle Diameter(in.):

$\Delta m = 1.43$ H

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
B 4	78	2.3	35	969.92	43	40	3.4	228	50	3.5
4	81	2.35	35	972.97	43	40	3.5	232	50	3.5
B 5	84	2.55	35	976.05	42	40	4.2	245	47	4.0
5	87	2.55	35	979.35	42	40	4.2	243	52	4.0
C 5	90	2.55	35	982.72	42	40	4.2	245	52	4.0
5	93	2.55	35	986.04	42	40	4.2	245	52	4.0
C 4	96	2.5	35	989.37	42	40	3.7	252	53	4.0
4	99	2.45	35	992.54	42	40	3.6	250	53	4.0
C 3	102	2.35	35	995.71	43	40	3.5	248	53	4.0
3	105	2.45	35	998.75	43	40	3.6	245	53	4.0
C 2	108	2.40	35	001.80	44	40	3.6	250	53	4.0
2	111	2.40	35	005.03	44	40	3.6	250	53	4.0
C 1	114	2.6	35	008.16	44	40	3.8	253	53	4.0
1	117	2.6	35	011.43	44	40	3.8	253	53	4.0
1	120	2.6	35	014.61	45	40	3.8	253	55	4.0
1	123	2.45	35	017.79	45	40	3.6	253	55	4.0
C 2	126	2.45	35	020.92	45	40	3.6	253	52	4.0
2	129	2.55	35	024.05	46	40	3.8	253	53	4.0
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

mpany: EPA
ource Designation: A
Date: 11/21/74
Test Number: 1-2-3-4
Field Person: R Kellar
Filter Number:
Barometric Pressure ("Hg):
Stack Static Pressure ("H_2O):
Plume Appearance:
Stack Diameter:

Meter Box No.:
Sample Box No.:
Filter Heater Setting:
Probe Heater Setting:
Assumed Moisture(%):
Condensate Volume(ml):
Nozzle Diameter(in.):

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
C 3	132	2.35	42	027.8	47	41	3.5	255	50	3.5
3	135	2.35	42	030.9	47	41	3.5	255	51	3.5
C 4	138	2.4	41	034.0	46	41	3.5	255	51	3.5
4	141	2.4	41	037.3	46	41	3.5	255	51	3.5
C 5	144	2.65	41	039.7	46	41	3.9	255	51	4.0
5	147	2.65	41	043.2	46	41	3.9	255	51	4.0
D 5	150	2.85	41	046.3	46	41	4.2	255	51	4.0
5	153	2.9	42	049.55	46	41	4.3	255	51	4.0
D 4	156	2.7	42	053.2	46	41	4.0	251	51	4.0
4	159	2.7	43	056.3	46	41	4.0	250	51	4.0
D 3	162	2.6	43	059.53	46	41	3.8	250	51	4.0
3	165	2.6	43	062.73	46	41	3.8	248	51	4.0
D 2	168	2.65	43	065.93	45	41	3.9	248	50	4.0
2	171	2.65	43	069.18	45	41	3.9	245	50	4.0
D 1	174	2.8	43	072.41	45	41	4.1	245	50	4.0
1	177	2.8	43	075.73	45	41	4.1	253	51	4.0
1	180	2.75	43	079.06	45	41	4.1	258	51	4.0
1	183	2.8	43	082.3	45	41	4.1	259	51	4.0
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: EPA

Source Designation: A

Date: 11/21/74

Test Number: 1-2 p.5

Field Person: P. Killer

Filter Number:

Barometric Pressure ("Hg):

Stack Static Pressure ("H_2O):

Plume Appearance:

Stack Diameter:

Meter Box No.:

Sample Box No.:

Filter Heater Setting:

Probe Heater Setting:

Assumed Moisture(%):

Condensate Volume(ml):

Nozzle Diameter(in.):

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
D 2	186	2.75	44	085.71	45	41	4.1	259	50	4.0
2	189	2.75	44	088.63	45	41	4.1	260	50	4.0
D 3	192	2.7	44	092.35	45	41	4.0	260	50	4.0
3	195	2.7	44	095.6	45	41	4.0	260	50	4.0
D 4	198	2.8	44	099.1	45	41	4.2	260	50	4.0
4	201	2.8	44	1023	45	41	4.2	260	50	4.0
D 5	204	3.0	44	105.8	45	41	4.4	260	50	4.0
5	207	3.0	44	109.1	43	41	4.4	260	50	4.0
1144	16:20			1112.558	44					
AVERAGE (TOTAL)			38	(248.157)	44	40	3.60			
			*	*	*	*	*			

44 4

PARTICULATE SAMPLING TRAIN DATA

Company: EPA

Source Designation: A

Date: 11/22/74

Test Number: P-3

Field Person: Rickle

Filter Number: 72464

Barometric Pressure ("Hg): 29.64

Stack Static Pressure ("H_2O): _____

Plume Appearance: _____

Stack Diameter: 16 x 13.25

Meter Box No.: MAC-2 (0.995)

Sample Box No.: 1

Filter Heater Setting: _____

Probe Heater Setting: _____

Assumed Moisture(%): 12

Condensate Volume(ml): _____

Nozzle Diameter(in.): 0.195 (2a)

Pitot leak rate
0.005 cu ft/min at 15" Hg

Traverse Point No.	Time 0903	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp.(°F) Inlet	Dry Gas Meter Temp.(°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
A 5	0	2.7	43	118.384	39	39	4.0	265	41	3.0
5	3	2.7	43	122.02 (3.6)	40	39	4.0	240	43	3.0
A 4	6	2.8	43	125.26 (3.2)	42	39	4.2	240	47	3.0
4	9	2.5	43	128.54 (3.3)	43	39	4.2	240	50	3.0
A 3	12	2.05	43	131.55 (3.0)	44	40	3.0	240	53	2.5
3	15	2.05	43	134.76 (3.2)	44	40	3.0	240	53	2.5
A 2	18	1.8	43	137.52 (2.8)	44	40	2.65	240	53	2.0
2	21	1.5	43	140.20 (2.7)	44	40	2.65	240	53	2.0
A 1	24	1.5	43	142.57 (2.4)	44	40	2.2	240	53	2.0
1	27	1.5	43	145.32	45	40	2.2	250	55	2.0
1	30	1.5	43	147.77	45	41	2.2	250	55	2.0
1	33	1.5	43	150.3	45	41	2.2	253	56	2.0
A 2	36	1.8	43	152.76	45	41	2.65	253	57	2.0
2	39	1.5	43	155.35 (2.6)	46	41	2.65	253	57	2.0
A 3	42	2.05	43	158.93 (3.6)	46	41	3.0	253	57	2.5
3	45	2.05	43	162. (3.1)	46	42	3.0	253	57	2.5
A 4	48	2.15	43	166.60 (4.6)	46	42	3.2	253	57	2.5
4	51	2.15	43	167.53	46	42	3.2	250	58	2.5
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: _____

Source Designation: _____

Date: _____ Meter Box No.: _____

Test Number: P-3 page 2 Sample Box No.: _____

Field Person: R Keller Filter Heater Setting: _____

Filter Number: _____ Probe Heater Setting: _____

Barometric Pressure ("Hg): _____ Assumed Moisture(%): _____

Stack Static Pressure "H_2O): _____ Condensate Volume(ml): _____

Plume Appearance: _____ Nozzle Diameter(in.): _____

Stack Diameter: _____

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
A 5	54	2.55	43	170.15	47	42	3.75	252	60	3.0
5	57	2.55	43	173.61	47	42	3.75	252	60	3.0
4 5		2.55	43	176.76	47	42	3.75	252	60	3.0
B 5	60	2.75	43	179.90	49	43	4.0	253	63	3.0
5	63	2.8	43	183.86	49	43	4.1	253	63	3.0
B 4	66	2.25	43	186.45	50	43	3.3	255	63	2.5
4	69	2.25	43	189.47	50	43	3.3	255	64	2.5
B 3	72	2.1	43	192.47	50	43	3.1	250	64	2.5
3	75	2.1	43	195.36	49	43	3.1	242	62	2.5
B 2	78	2.2	43	198.273	44	43	3.2	268	53	2.5
2	81	2.2	43	201.21	44	43	3.2	262	54	2.5
B 1	84	2.15	44	204.15	45	43	3.2	253	56	2.5
1	87	2.15	44	207.09	45	43	3.2	252	57	2.5
1	90	2.15	44	209.99	45	43	3.2	253	57	2.5
1	93	2.15	44	212.89	46	43	3.2	253	57	2.5
B 2	96	2.20	44	215.80	46	43	3.2	253	61	2.5
2	99	2.25	44	218.73	46	43	3.3	254	63	2.5
B 3	102	2.15	44	221.72	46	43	3.2	253	63	2.5
3	105	2.15	44	224.64	48	43	3.2	253	63	2.5
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: EPA

Source Designation: 1

Date: 11/27/74

Test Number: R-3 page 2

Field Person: R Kelly

Filter Number:

Barometric Pressure ("Hg): 29.73

Stack Static Pressure ("H_2O):

Plume Appearance:

Stack Diameter:

Meter Box No.:

Sample Box No.:

Filter Heater Setting:

Probe Heater Setting:

Assumed Moisture(%):

Condensate Volume(ml):

Nozzle Diameter(in.):

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
B 4	108	2.15	44	227.55	48	44	3.2	245	62	3.5
4	111	2.15	44	230.46	48	44	3.2	245	62	3.5
B 5	114	2.15	44	233.38	48	44	3.6	255	62	3.5
5	117	2.15	44	236.7	48	44	3.6	230	62	3.5
C 5	120	2.7	46	239.575	47	44	4.0	252	57	3.8
5	123	2.7	44	242.52	47	44	4.0	264	60	3.8
C 4	126	2.6	43	245.633	42	38	3.8	262	49	3.0
4	129	2.6	43	249.26	43	38	3.8	249	50	3.0
C 3	132	2.6	43	252.42	43	38	3.8	262	53	3.0
3	135	2.6	43	255.58	45	43	3.8	250	57	3.0
C 2	138	2.55	43	258.74	47	43	3.75	244	60	3.0
2	141	2.55	43	261.85	48	43	3.75	247	62	3.0
C 1	144	2.8	43	264.98	50	44	4.1	237	64	3.0
1	147	2.8	43	268.26	51	44	4.1	239	64	3.0
1	150	2.75	43	271.60	52	44	4.05	220	64	3.0
1	153	2.8	43	274.97	51	45	4.1	247	64	3.0
C 2	156	2.6	43	278.2	50	45	3.8	238	63	3.0
2	159	2.6	43	281.35	50	45	3.8	235	63	3.0
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: EPA

Source Designation: A

Date: 11/22/77

Test Number: 1-3 page 4

Field Person: [illegible]

Filter Number: _____

Barometric Pressure ("Hg): _____

Stack Static Pressure ("H_2O): _____

Plume Appearance: _____

Stack Diameter: _____

Meter Box No.: _____

Sample Box No.: _____

Filter Heater Setting: _____

Probe Heater Setting: _____

Assumed Moisture(%): _____

Condensate Volume(ml): _____

Nozzle Diameter(in.): _____

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
C 3	162	2.55	43	284.52	50	45	3.75	250	62	3.0
3	165	2.55	43	287.68	50	45	3.75	242	62	3.0
C 4	168	2.55	43	290.83	50	45	3.75	235	61	3.0
4	171	2.55	43	293.97	50	45	3.75	247	61	3.0
C 5	174	3.05	43	297.13	50	45	4.5	256	60	3.5
5	177	3.05	45	300.60	52	45	4.5	250	63	3.5
D 5	180	3.15	45	304.04	52	46	4.6	248	63	3.5
5	183	3.15	46	307.54	52	46	4.6	235	63	3.5
D 4	186	2.95	46	311.01	52	46	4.3	233	63	3.5
4	189	2.90	46	314.40	52	47	4.25	220	62	3.5
D 3	192	2.8	46	317.73	52	47	4.10	228	62	3.5
3	195	2.8	46	321.1	52	47	4.1	240	62	3.5
D 2	198	2.8	46	324.3	52	47	4.1	245	62	3.5
2	201	2.8	46	327.61	52	47	4.1	237	62	3.5
D 1	204	2.6	46	330.89	53	48	3.8	230	61	3.5
1	~~207~~ 207	2.55	46	334.07	53	48	3.75	240	61	3.5
D 1	210	2.55	46	337.20	51	47	3.75	240	59	3.6
1	213	2.6	46	340.35	51	47	3.8	264	58	3.5
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: EPA

Source Designation: A

Date: 11/22/74

Test Number: 1-3 page 5

Field Person: R. Klein

Filter Number:

Barometric Pressure ("Hg):

Stack Static Pressure ("H_2O):

Plume Appearance:

Stack Diameter:

Meter Box No.:

Sample Box No.:

Filter Heater Setting:

Probe Heater Setting:

Assumed Moisture(%):

Condensate Volume(ml):

Nozzle Diameter(in.):

Sp - 1.8

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
D 2	216	2.8	46	343.52	51	47	4.1	235	58	3.0
2	219	2.9	46	346.80	50	47	4.1	237	57	3.0
D 3	222	2.75	46	350.07	50	47	4.05	237	57	3.0
3	225	2.7	46	353.32	50	47	4.05	223	58	3.0
D 4	228	2.55	46	356.55	51	47	4.2	241	59	3.0
4	231	2.55	46	359.87	53	47	4.2	243	61	3.0
D 5	234	3.15	46	363.17	53	47	4.6	229	61	3.5
5	237	3.15	46	366.60	54	48	4.6	257	62	3.5
(1350)	240			370.017						
AVERAGE (TOTAL) (91)			44	(251.133)	48	44	3.63			

GEORGE D. CLAYTON & ASSOCIATES
SAMPLING TRAIN DATA

Company: JM BRENNER - EPA TASK 4
Source Designation: OUTLET B
Date: 11/10/94
Test Number: PARTICULATE 1
Field Person: RBK
Filter Number: 72445
~~Desiccant Number:~~ 20%
Barometric Pressure("Hg): 29.82
Stack Static Pressure("H_2O): -0.2-1.1
Plume Appearance:
Meter Box No.: MAC-3 (0.992)
Sample Box No.: MAC-3
Filter Heater Setting: 250
Probe Heater Setting: 250
Assumed Moisture(%): 1
Condensate Volume(ml):
Nozzle Diameter(in.): 3/16

$\Delta H = 1.30 \left(\frac{\Delta H}{T_s}\right) H$

Traverse Point No.	Time (~2.2)	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
A1	0	1.2	62	450.47	52	52	1.53	290	56	5.0
A1	3	1.3	62	452.67	54	53	1.66	240	50	5.0
A2	6	1.3	62	455.0	54	53	1.66	265	50	5.0
A2	9	1.3	62	457.33	54	53	1.66	265	50	5.0
A3	12	1.3	63	459.68	56	54	1.66	260	56	5.0
A3	15	1.3	63	462.00	58	54	1.66	250	58	5.0
A4	18	1.6	63	464.31	59	54	2.29	265	62	8.0
A4	21	1.5	63	466.94	60	54	1.92	249	66	6.5
A5	24	2.1	63	469.56	62	54	2.71	265	70	10.0
A5	27	2.1	63	472.42	63	54	2.70	240	72	10.0
B1	30	1.4	63	475.50	65	55	1.81	260	73	7.0
B1	33	1.5	64	478.20	62	56	1.93	245	70	7.0
B2	36	1.4	64	480.73	62	56	1.80	265	70	7.0
B2	39	1.3	64	483.22	64	56	1.68	260	71	5.5
B3	42	1.3	64	485.71	64	57	1.68	265	74	6.0
B3	45	1.3	64	488.01	64	57	1.68	240	73	6.0
B4	48	1.6	63	490.40	65	58	2.07	265	73	7.5
B4	51	1.6	63	492.90	66	58	2.08	250	73	7.5
AVERAGE (TOTAL)										

GEORGE D. CLAYTON & ASSOCIATES
SAMPLING TRAIN DATA

Company: J.M. Brenner EPA TASK 4-10
Source Designation: Outlet B
Date: 11/19/74
Test Number: Particulate 1
Field Person: PBK
Filter Number: 72445
~~Desiccant Number:~~ 2504
Barometric Pressure("Hg): 29
Stack Static Pressure("H_2O): -0.7 in
Plume Appearance:

Meter Box No.: MAC-3
Sample Box No.: MAC-3
Filter Heater Setting: 250
Probe Heater Setting: 250
Assumed Moisture(%): 1
Condensate Volume(ml):
Nozzle Diameter(in.): 3/16 micrometer (0.193)

$\Delta m = 1.30 \left(\frac{T_{a+1}}{T_s}\right) H$

Pg 2

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
B 5	54	2.1	63	495.51	66	58	2.72	265	74	9.0
B 5	57	2.0	63	498.30	68	58	2.60	245	74	10.0
C 1	60	1.3	63	501.28	68	58	1.69	265	74	7.0
C 1	63	1.3	63	503.75	68	58	1.69	255	74	7.0
C 2	66	1.5	60	506.11	66	58	1.96	265	70	8.0
C 2	69	1.5	60	508.62	66	59	1.96	245	70	7.0
C 3	72	1.5	62	511.27	66	59	1.95	265	70	7.0
C 3	75	1.5	62	513.78	66	59	1.95	250	70	7.0
C 4	78	1.6	62	516.36	66	60	2.08	230	70	8.0
C 4	81	1.6	62	518.81	67	60	2.08	200	70	8.0
C 5	84	2.1	62	521.48	67	60	2.74	225	70	10.0
C 5	87	2.1	62	524.48	68	60	2.74	200	70	10.0
D 1	90	1.3	62	527.51	68	60	1.70	225	70	5.0
D 1	93	1.3	62	529.81	68	60	1.70	200	70	6.0
D 2	96	1.7	62	532.41	67	60	2.22	225	70	8.0
D 2	99	1.7	62	535.00	68	60	2.22	210	70	8.0
D 3	102	1.9	62	537.70	68	60	2.48	200	72	10.0
D 3	105	1.9	62	540.50	69	60	2.48	170	72	9.0
AVERAGE (TOTAL)				( )						

GEORGE D. CLAYTON & ASSOCIATES
SAMPLING TRAIN DATA

Company: JM Brenner - EPA Task 4
Source Designation: Outlet B
Date: 11/19/79
Test Number: Particle 1
Field Person: RBK
Filter Number: 72495
Desiccant Number:
Barometric Pressure("Hg):
Stack Static Pressure("H_2O): -0.75
Plume Appearance:

Meter Box No.: MAC 3
Sample Box No.: MAC 5
Filter Heater Setting: 250
Probe Heater Setting: 250
Assumed Moisture(%): 1
Condensate Volume(ml):
Nozzle Diameter(in.): 5/16

Pg 3

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp.(°F) Inlet	Dry Gas Meter Temp.(°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
D4	108	1.9	62	543.36	70	60	2.48	150	72	9.0
D4	111	1.9	62	545.90	70	60	2.48	140	74	9.0
D5	114	2.2	62	549.18	70	60	2.88	100	75	10.0
D5	117	2.2	62	552.19	71	60	2.88	150	75	10.0
	120			555.189						
						60.5				
			62		64	57	2.10			

PARTICULATE SAMPLING TRAIN DATA

Company: EPA TASK 4 BRONER
Source Designation: CRUCES
Date: 11/21/74
Test Number: Particulate 2
Field Person: RSK
Filter Number: 92446
Barometric Pressure ("Hg):
Stack Static Pressure ("H_2O): -0.4
Plume Appearance:
Stack Diameter: 10" x 13 3/8"

Meter Box No.: MAC 3 (0.95)
Sample Box No.: MAC 3
Filter Heater Setting: 250
Probe Heater Setting: 250
Assumed Moisture(%): 1
Condensate Volume(ml):
Nozzle Diameter(in.): 0.193 (3/16)

$\Delta rm = 1.45 \left(\frac{T_m}{T_s}\right) H$

Traverse Point No.	Time 12:5	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
A 1	0	1.5	50	555 310	38	38	2.12	250	40	1.5
A1	3	1.5	50	557.8	40	40	2.17	250	40	1.5
A2	6	1.5	50	560.3	40	40	2.13	270	40	1.5
A2	9	1.6	50	562.9	40	40	2.25	270	40	1.5
A3	12	1.5	50	565.6	40	40	2.13	270	40	1.5
A3	15	1.5	50	568.4	42	40	2.14	270	44	1.5
A4	18	1.6	50	571.0	43	40	2.56	270	47	1.5
A4	21	1.6	50	573.8	44	40	2.57	265	47	1.5
A5	24	2.2	50	575.5	44	40	3.14	265	47	1.5
A5	27	2.2	50	579.9	44	40	3.14	265	017	1.5
A5	30	2.2	50	583.0	46	40	3.10	250	48	2.0
A5	33	2.2	50	586.2	46	40	3.10	255	48	2.5
A4	36	1.9	50	589.3	46	40	2.72	255	018	2.5
A4	39	1.9	50	592.3	46	40	2.72	255	50	2.5
A3	42	1.6	50	595.3	47	40	2.28	260	50	2.0
A3	45	1.6	50	598.1	47	40	2.25	260	50	2.0
A2	48	1.4	50	600.8	46	40	2.06	250	50	2.0
A2	51	1.4	50	603.4	96	40	2.00	250	50	2.0
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

[redacted]mpany: _____

ource Designation: _____

Date: _____ Meter Box No.: _____

Test Number: P-2 Sample Box No.: _____

Field Person: Rex Filter Heater Setting: _____

Filter Number: _____ Probe Heater Setting: _____

Barometric Pressure ("Hg): _____ Assumed Moisture(%): _____

Stack Static Pressure ("H_2O): _____ Condensate Volume(ml): _____

Plume Appearance: _____ Nozzle Diameter(in.): _____

Stack Diameter: _____

$\Delta H = 1.45 \left(\frac{\Delta p}{T_s}\right) H$ Pg 2

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
A1	54	1.1	50	606.0	46	40	1.57	250	50	1.0
A1	57	1.1	50	608.4	46	40	1.57	250	50	1.0
B1	60	1.6	50	610.8	45	40	2.29	250	50	2.0
B1	63	1.6	50	613.4	45	40	2.29	260	50	2.0
B2	66	1.8	50	616.2	46	40	2.58	270	50	2.5
B2	69	1.9	50	618.8	46	40	2.72	280	50	2.5
B3	72	1.9	50	621.9	46	40	2.72	280	50	3.0
B3	75	1.8	50	625.1	46	40	2.58	275	50	3.0
B4	78	2.0	50	627.8	46	40	2.87	275	50	3.0
B4	81	1.9	50	630.7	46	40	2.73	275	50	3.0
B5	84	2.5	50	633.7	46	40	3.57	270	50	5.0
B5	87	2.5	50	637.0	46	40	3.57	270	50	5.0
B5	90	2.5	50	640.5	46	40	3.57	270	50	5.0
B5	93	2.6	50	643.8	46	40	3.72	270	50	5.0
B4	96	1.8	50	647.2	45	40	2.58	250	50	3.5
B4	99	1.8	50	650.3	48	40	2.58	250	50	3.5
B3	102	1.8	50	653.4	48	40	2.58	250	50	3.0
B3	105	1.8	50	656.5	48	40	2.58	250	50	3.0
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: _____

Source Designation: _____

Date: _____ Meter Box No.: _____

Test Number: D-2 Sample Box No.: _____

Field Person: Ruy Filter Heater Setting: _____

Filter Number: _____ Probe Heater Setting: _____

Barometric Pressure ("Hg): _____ Assumed Moisture(%): _____

Stack Static Pressure ("H_2O): _____ Condensate Volume(ml): _____

Plume Appearance: _____ Nozzle Diameter(in.): _____

Stack Diameter: _____

Pg 3

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp.(°F) Inlet	Dry Gas Meter Temp.(°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
B2	108	1.7	50	659.3	46	40	2.43	230	50	3.0
B2	111	1.8	50	662.1	46	40	2.57	235	50	3.0
B1	114	1.4	50	665.0	46	40	2.00	250	50	2.0
B1	117	1.4	50	667.9	46	40	2.00	250	50	2.0
C1	120	2.0	50	670.2	46	40	2.86	250	50	4.0
C1	123	2.0	50	673.1	46	40	2.86	250	50	4.0
C2	126	2.1	50	676.1	46	40	3.00	250	50	4.0
C2	129	2.1	50	679.1	46	40	3.00	250	50	4.0
C3	132	2.1	50	682.3	46	40	3.00	250	50	4.0
C3	135	2.1	50	685.5	46	40	3.00	250	50	4.0
C4	138	1.9	50	688.6	46	40	2.72	250	50	3.5
C4	141	2.0	50	691.6	46	40	2.85	250	50	3.5
C5	144	2.4	50	694.6	46	40	3.43	250	50	5.0
C5	147	2.4	50	697.7	46	40	3.43	250	50	5.0
C5	150	2.4	50	701.3	46	40	3.43	250	50	5.0
C5	153	2.4	50	704.8	46	40	3.43	250	50	5.0
C4	156	1.8	50	707.7	46	40	2.57	250	50	3.5
C4	159	1.8	50	710.7	46	40	2.57	250	50	3.5
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: _____

Source Designation: _____

Date: _____

Test Number: P-2

Field Person: Ewy

Filter Number: _____

Barometric Pressure ("Hg): _____

Stack Static Pressure ("H_2O): _____

Plume Appearance: _____

Stack Diameter: _____

Meter Box No.: _____

Sample Box No.: _____

Filter Heater Setting: _____

Probe Heater Setting: _____

Assumed Moisture(%): _____

Condensate Volume(ml): _____

Nozzle Diameter(in.): _____

$\Delta m = 1.45$ $\frac{1}{16}$ = .094

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
C3	162	1.8	50	713.6	48	41	2.58	270	52	3.5
C3	165	1.8	50	716.5	48	41	2.58	270	52	3.5
C2	168	1.7	50	719.1	48	41	2.62	270	54	3
C2	171	1.8	50	722.2	48	41	2.58	270	54	4.0
C1	174	1.9	50	725.2	48	41	2.72	270	54	4.0
C1	177	1.9	50	728.3	48	41	2.72	270	54	4.0
D1	180	1.8	50	731.2	48	41	2.58	270	56	4.0
D1	183	1.8	50	734.1	48	41	2.58	270	57	4.0
D2	186	2.1	50	737.1	48	41	3.00	270	57	4.0
D2	189	2.1	50	740.1	48	41	3.00	270	57	4.0
D3	192	2.0	50	743.2	48	41	2.85	270	57	4.0
D3	195	2.0	50	746.3	48	41	2.85	270	57	4.0
D4	198	2.6	50	749.0	48	41	2.61	270	57	5.0
D4	201	2.1	50	752.2	48	41	3.00	270	57	5.0
D5	204	2.3	50	755.5	48	41	3.28	270	57	4.0
D5	207	2.3	50	758.6	48	41	3.20	270	57	4.0
D5	210	2.3	50	761.8	48	41	3.20	270	57	4.0
D5	213	2.3	50	765.1	48	41	3.20	270	57	4.0
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: _____

Source Designation: D OUTLET F

Date: _____ Meter Box No.: _____

Test Number: P-2 Sample Box No.: _____

Field Person: Rmax Filter Heater Setting: _____

Filter Number: _____ Probe Heater Setting: _____

Barometric Pressure ("Hg): _____ Assumed Moisture(%): _____

Stack Static Pressure ("H_2O): _____ Condensate Volume(ml): _____

Plume Appearance: _____ Nozzle Diameter(in.): _____

Stack Diameter: _____

$\Delta H = 1.45 \left(\frac{T_m}{T_s}\right) H$ PS

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
D4	216	2.0	50	768.3	48	41	2.87	270	58	5.0
D4	219	2.0	50	771.4	48	41	2.87	270	58	5.0
D3	222	2.0	50	774.4	48	41	2.87	270	58	5.0
D3	225	2.0	50	777.5	48	41	2.87	270	58	5.0
D2	228	2.1	50	780.5	48	41	3.02	270	58	5.0
D2	231	2.1	50	783.6	48	41	3.02	270	58	5.0
D1	234	1.8	50	786.8	48	41	2.58	270	58	5.0
D1	237	1.8	50	789.7	48	41	2.58	270	58	5.0
	240			792						
						43				
AVERAGE (TOTAL)			50	(237.309	46	40	2.74			

792.619

PARTICULATE SAMPLING TRAIN DATA

Company:
Source Designation: CR-HC+B
Date: 1/22/74
Test Number: P-3
Field Person: RBK
Filter Number: 72152
Barometric Pressure ("Hg): 29.61
Stack Static Pressure ("H_2O):
Plume Appearance:
Stack Diameter:

Meter Box No.: MAC 3
Sample Box No.: MAC 3
Filter Heater Setting: 250
Probe Heater Setting: 250
Assumed Moisture(%): 1
Condensate Volume(ml):
Nozzle Diameter(in.): 0.193

pg 2

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
A1	54	1.3	50	842.7	48	41	1.86	240	50	2.0
A1	57	1.3	50	846.0	48	41	1.86	260	50	2.0
B1	60	1.7	50	847.8	48	41	2.46	270	50	3.0
B1	63	1.7	50	850.2	48	41	2.46	270	50	3.0
B2	66	1.7	50	853.0	48	41	2.46	270	50	3.0
B2	69	1.6	50	855.8	50	42	2.31	280	50	3.0
B3	72	1.5	50	858.5	50	42	2.16	240	50	2.5
B3	75	1.5	50	861.2	50	42	2.16	250	50	2.5
B4	78	1.7	50	863.8	50	42	2.45	270	50	3.0
B4	81	1.6	50	866.6	50	42	2.31	240	56	3.0
B5	84	2.2	50	869.4	50	42	3.16	260	57	4.5
B5	87	2.1	50	872.3	46	42	3.00	230	58	4.5
B5	90	2.1	50	875.6	46	42	3.00	245	56	4.5
B5	93	2.1	50	878.6	46	42	3.00	245	56	4.5
B4	96	1.7	50	881.7	48	42	2.44	230	57	3.0
B4	99	1.7	50	884.4	48	42	2.44	230	57	3.0
B3	102	1.4	50	887.3	48	42	2.01	260	57	2.0
B3	105	1.4	50	889.8	48	42	2.01	260	57	2.0
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: ECA TASK 406 J.M. Brenner
Source Designation: Brenner Outlet B
Date: 11/22/74 Meter Box No.: MAC 2
Test Number: P-3 Sample Box No.: MAC 2
Field Person: RBK Filter Heater Setting: 250
Filter Number: Probe Heater Setting: 250
Barometric Pressure ("Hg): 29.64 Assumed Moisture(%):
Stack Static Pressure ("H_2O): Condensate Volume(ml):
Plume Appearance: Nozzle Diameter(in.): 0.193
Stack Diameter: 10" x 13 1/8"

ΔH = 1.45 (1.31) (Tm/Ts) H pg 3

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
B2	108	~~2.20~~ 1.5	50	892.3	48	42	2.16	250	58	2.5
B2	111	1.5	54	894.9	48	42	2.14	250	58	2.5
B1	114	1.4	54	897.6	48	42	2.00	250	58	2.5
B1	117	1.4	54	900.2	48	42	2.00	250	62	2.5
C1	120	1.5	54	902.7	48	42	2.14	240	64	2.5
C1	123	1.5	54	905.3	50	43	2.15	250	65	2.5
C2	126	1.6	54	908.0	48	44	2.28	250	65	2.5
C2	129	1.6	54	910.6	48	44	2.28	250	65	2.5
C3	132	1.7	50	913.3	48	44	2.45	230	65	2.5
C3	135	1.7	50	916.0	48	44	2.45	240	65	2.5
C4	138	1.9	50	918.9	48	44	2.64	270	65	3.0
C4	141	1.9	50	921.7	48	44	2.64	245	65	3.0
C5	144	2.5	50	924.7	42	42	3.25	260	52	5.0
C5	147	2.4	50	927.9	42	42	3.10	250	54	5.0
C5	150	2.4	50	930.9	44	42	3.10	250	56	5.0
C5	153	2.4	50	934.1	46	42	3.10	250	59	5.0
C4	156	1.9	50	937.2	48	42	2.46	250	60	4.0
C4	159	1.9	50	940.1	48	42	2.46	250	60	4.0
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: EPA TASK Arco JAI BRUNER

Source Designation: OUTLET B

Date: 11/22/74

Test Number: D-3

Field Person: RBK

Filter Number: 72452

Barometric Pressure ("Hg): 29.64

Stack Static Pressure ("H_2O): _____

Plume Appearance: _____

Stack Diameter: 16" x 13 3/8"

Meter Box No.: MAC 3

Sample Box No.: MAC 3

Filter Heater Setting: 250

Probe Heater Setting: 250

Assumed Moisture(%): _____

Condensate Volume(ml): _____

Nozzle Diameter(in.): 0.195

$\Delta M = 1.31 \left(\frac{T_m}{T_s}\right)$ H PST

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
C3	162	1.8	50	943.0	50	42	2.34	265	60	3.0
C3	165	1.8	50	945.6	50	42	2.34	250	60	3.0
C2	168	1.9	50	948.3	50	42	2.48	260	60	3.0
C2	171	1.9	50	951.0	50	44	2.48	255	60	3.0
C1	174	2.1	50	953.9	50	44	2.73	255	60	3.0
C1	177	2.1	50	956.8	50	44	2.73	255	60	3.0
D1	180	1.8	50	959.8	50	44	2.32	250	60	3.0
D1	183	1.6	50	962.5	50	44	2.08	250	60	2.5
D2	186	2.0	52	965.1	50	44	2.59	250	60	4.0
D2	189	2.0	52	967.9	50	44	2.59	250	60	4.0
D3	192	2.0	52	970.8	50	44	2.59	250	60	4.0
D3	195	2.1	52	973.5	50	44	2.59	250	60	4.0
D4	198	2.1	52	976.5	54	45	2.74	250	60	4.0
D4	201	2.1	52	979.4	54	45	2.74	250	60	4.0
D5	204	2.5	52	982.3	54	45	3.28	240	60	5.0
D5	207	2.5	52	985.4	54	45	3.28	265	60	5.0
D5	210	2.5	52	988.6	56	47	3.28	265	60	5.0
D5	213	2.5	52	991.8	56	47	3.28	265	60	4.0
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: EPA TASK 4+6 JM Brenner
Source Designation: Outlet B
Date: 11/2/94
Test Number: P-3
Field Person: RBK
Filter Number: 72452
Barometric Pressure ("Hg): 29.64
Stack Static Pressure ("H_2O): -0.60
Plume Appearance:
Stack Diameter: 16" x 13"

Meter Box No.: MAC 3
Sample Box No.: MAC 3
Filter Heater Setting: 250
Probe Heater Setting: 250
Assumed Moisture(%): 1
Condensate Volume(ml):
Nozzle Diameter(in.): 0.193

pg 5

$\Delta H = 1.31 \left[\frac{T_m}{T_s}\right] H$

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
D4	2:16	2.1	52	994.9	56	47	2.75	250	62	3.5
D4	2:19	2.1	52	997.9	56	47	2.75	250	62	3.5
D3	2:22	2.0	52	1000.8	56	48	2.62	250	62	3.5
D3	2:25	2.0	52	1003.7	56	48	2.62	250	62	3.5
D2	2:28	2.0	52	1006.6	56	48	2.62	250	62	3.5
D2	2:31	2.0	52	1009.4	56	48	2.62	250	62	3.5
D1	2:34	1.5	52	1012.3	56	48	1.96	250	62	3.5
D1	2:37	1.5	52	1015.1	56	48	1.96	250	62	3.5
	2:40			1017.4						
						46				
AVERAGE (TOTAL)			51	(224.337)	49	42	2.49			

PARTICULATE SAMPLING TRAIN DATA

Company: BRENNER

Source Designation: #1 Inlet - [illegible]

Date: 11/22/74 | Meter Box No.:

Test Number: P-2 | Sample Box No.:

Field Person: TAL RCM | Filter Heater Setting:

Filter Number: 72459 | Probe Heater Setting:

Barometric Pressure ("Hg): | Assumed Moisture(%):

Stack Static Pressure ("H_2O): -7.1 | Condensate Volume(ml):

Plume Appearance: | Nozzle Diameter(in.):

Stack Diameter:

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
B-4	1030	0.48	43	427.222	42	42	2.2	240	42	3.3
B-4	1032	0.48	43	428.6	42	42	2.2	240	42	3.3
B-4	1037	0.48	43	432.4	43	41	2.2	240	46	3.3
B-3	1042	0.48	44	436.1	44	42	2.2	240	50	3.5
B-3	1047	0.47	44	439.9	44	42	2.15	240	50	3.5
B-3	1052	0.47	44	443.5	45	42	2.15	240	51	3.5
B-2	1057	0.47	44	447.2	46	43	2.15	240	51	3.5
B-2	1103 (1102)	0.44	44	450.9	46	43	2.00	240	51	3.3
B-2	1108	0.44	44	454.5	46	43	2.00	240	51	3.3
B-1	1113	0.44	44	457.9	46	43	2.00	240	50	3.3
B-1	1118	0.46	44	461.5	46	43	2.10	240	50	3.3
B-1	1123	0.46	44	465.2	46	43	2.1	240	50	3.3
	1128			468.866						
		LEAK TEST: AFTER				0.006 cfm				
AVERAGE (TOTAL)		(36)	42	(86.748)	43	41	2.13			

15.31

GEORGE D. CLAYTON & ASSOCIATES
SAMPLING TRAIN DATA

Company: EPA Brunner Stop Lancaster PA
Source Designation: Inlet - D
Date: 11/21/14
Test Number: P-2
Field Person: F-C
Filter Number:
Desiccant Number:
Barometric Pressure("Hg): 29.01
Stack Static Pressure("H_2O): -7.6
Plume Appearance: Clr
Meter Box No.: MHC-1 (1.016)
Sample Box No.: mm - MHC 5
Filter Heater Setting: 10
Probe Heater Setting: —
Assumed Moisture(%): 1
Condensate Volume(ml):
Nozzle Diameter(in.): 3/16
Meter Correction Factor: 1.231 H

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
A-18	12:02	0.98	40	597.376	--	40	1.2	250	38	5.0
17	3	.94	40	598.2		40	1.15	250	38	5.0
16	6	.92	38	600.2		40	1.2	250	39	5.0
15	9	.95	38	602.6		40	1.15	250	39	5.0
14	12	.90	38	604.3		40	1.1	250	39	5.0
13	15	1.00	38	606.0		40	1.2	250	39	5.0
12	3	1.1	38	607.6		40	1.3	250	39	5.0
11	6	1.05	38	609.2		40	1.3	250	41	5.0
10	9	1.4	38	611.6		40	1.3	250	42	5.0
9	12	1.4	37	6133		40	1.7	250	43	5.2
8	15	1.9	37	6154		40	2.3	250	43	6.0
7	3	1.6	35	617.5		40	2.0	250	43	6.0
6	6	1.7	36	620.3		40	2.1	250	43	6.0
5	9	2.4	36	622.4		40	3.0	250	43	7.0
4	12	2.4	36	2252		40	3.0	250	43	7.0
3	15	2.4	36	228.4		40	3.0	250	44	7.0
2		2.4	36	630.7		40	3.0	250	44	7.0
1		2.4	35	633.7		40	3.0	250	44	7.0
AVERAGE (TOTAL)				( )						

GEORGE D. CLAYTON & ASSOCIATES
SAMPLING TRAIN DATA

Company: EPA Brenner Stone Quarry Lancaster Pennsylvania
Source Designation: Outlet D
Date: P-3 11/22/74 Meter Box No.: MBC-1 (1.016)
Test Number: P-3 page-1 Sample Box No.:
Field Person: RLC Filter Heater Setting: 100
Filter Number: Probe Heater Setting: —
Desiccant Number: [redacted] Assumed Moisture(%): 1
Barometric Pressure("Hg): 29.64 Condensate Volume(ml):
Stack Static Pressure("H_2O): Nozzle Diameter(in.): 3/16
Plume Appearance: Meter Correction Factor:

Traverse Point No.	Time 9:01	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
C-9	0	2.1	41	687.020		39	2.6	250	39	5.0
8	3	2.2	41	689.6		39	2.7	250	39	5.0
7	6	2.2	41	692.1		39	2.7	250	39	5.0
6	9	2.3	41	694.6		39	2.85	250	39	5.5
5	12	2.4	41	697.5		39	2.9	250	39	5.5
4	15	2.4	41	700.2		39	2.9	250	39	5.5
3	2	2.5	41	702.9		39	3.1	250	39	5.5
2	6	2.5	41	705.6		39	3.1	250	39	5.5
1	9	2.5	41	708.4		40	3.1	250	39	5.5
10	12	2.1	41	711.2		40	2.5	250	39	5.0
11	15	2.1	41	714.0		40	2.5	250	39	5.0
12	3	2.0	41	716.4		40	2.4	250	39	4.5
13	6	1.9	41	718.9		40	2.4	250	39	4.5
14	9	1.9	41	721.0		40	2.4	250	39	4.5
15	12	1.9	41	725.2		40	2.4	250	39	4.5
16	15	1.9	41	727.6		40	2.4	250	39	4.5
17	3	1.9	41	727.8		40	2.4	250	39	4.5
18	6	1.9	41	730.2		41	2.4	250	39	5.0
AVERAGE ~~(TOTAL)~~ end of port				(732.626)						

GEORGE D. CLAYTON & ASSOCIATES
SAMPLING TRAIN DATA

Company: EPA Lancaster Pa
Source Designation: Inlet
Date: 11/22/74
Test Number: P-3 (run 2)
Field Person: EC
Filter Number: 27441
Desiccant Number:
Barometric Pressure("Hg):
Stack Static Pressure("H_2O):
Plume Appearance:

Meter Box No.:
Sample Box No.:
Filter Heater Setting:
Probe Heater Setting:
Assumed Moisture(%):
Condensate Volume(ml):
Nozzle Diameter(in.):
Meter Correction Factor:

1.231 ?

Traverse Point No.	Time (min)	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp.(°F) Inlet	Dry Gas Meter Temp.(°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
10	3	0.95	41	732.636		41	1.1	250	39	4.0
11	3	0.97	41	733.9		41	1.1	250	39	4.0
12	6	0.99	41	736.1		41	1.1	250	39	4.0
13	9	0.91	41	738.3		41	1.1	250	39	4.0
14	12	0.83	41	740.2		42	1.0	250	39	4.0
15	15	0.81	41	741.9		42	1.0	250	39	4.5
16	3	0.80	41	743.2		42	1.0	250	39	4.5
17	6	0.75	41	745.0		42	0.95	250	39	4.5
18	9	0.70	41	746.9		42	0.9	250	39	4.5
1	12	1.5	42	748.4		42	1.8	250	39	4.0
9	15	1.6	42	749.6		42	1.9	250	39	5.0
7	3	1.5	42	751.1		42	1.8	250	39	5.0
6	6	1.4	43	754.2		43	1.7	250	40	5.0
5	9	1.4	43	756.5		43	1.7	250	40	5.0
4	12	1.5	43	758.5		43	1.85	250	40	5.0
3	15	1.3	43	760.5		43	1.6	250	41	5.0
2	3	1.3	43	762.8		43	1.6	250	41	5.0
1	6	1.3	43	765.0		43	1.6	250	41	5.0
AVERAGE (TOTAL)	90	1.16	41	767.053	—	41	2.0			

28.24 (80.027)

PARTICULATE SAMPLING TRAIN DATA

Company: Brenner

Source Designation: 102 FT E. 45°

Date: 11-21-76

Test Number: P-1

Field Person: C-115

Filter Number: 724-10

Barometric Pressure ("Hg):

Stack Static Pressure ("H_2O):

Plume Appearance:

Stack Diameter: 18"ϕ

Meter Box No.: 1617C (1.006)

Sample Box No.: 1617C

Filter Heater Setting:

Probe Heater Setting: 700

Assumed Moisture(%):

Condensate Volume(ml):

Nozzle Diameter(in.): 3/16"

$(D^4 \times 1.41)H$

Traverse Point No.	Time (2:10)	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
1-1	0	4.8	45°	720.41	50	40	6.8	140	45°	14
2	5	4.7	45°	727.0	50	40	6.6	120	45°	14
3	10	4.0	45°	732.5	50	40	5.7	120	45°	14
4	15	4.1	45°	738.4	50	40	5.8	140	50°	14
4	20	4.0	45°	745.6	50	40	5.7	140	50°	14
3	25	3.7	45°	750.5	50	40	5.2	140	50°	14
2	30	3.5	45°	755.7	50	43	5.0	140	50°	14
1	35	3.1	45°	761.1	50	48	4.4	140	50°	14
1	40	5.7	45°	766.6	50	50	7.5	120	50°	14
2	45	5.2	45°	772.1	50	50	7.4	125	50°	14
3	50	4.1	45°	778.1	50	50	5.8	130	50°	14
4	55	4.1	45°	784.5	50	50	5.8	140	50°	14
	60			789.6						
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: _____

Source Designation: _____

Date: _____ Meter Box No.: _____

Test Number: _____ Sample Box No.: _____

Field Person: _____ Filter Heater Setting: _____

Filter Number: 72490 Probe Heater Setting: _____

Barometric Pressure ("Hg): _____ Assumed Moisture(%): _____

Stack Static Pressure ("H_2O): _____ Condensate Volume(ml): _____

Plume Appearance: _____ Nozzle Diameter(in.): _____

Stack Diameter: _____

Traverse Point No.	Time 4.5	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp.(°F) Inlet	Dry Gas Meter Temp.(°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
E 1	0	4.1	45	789.6	50	40	4.7	140	50	14
2	5	4.0	45	795.0	50	40	5.7	140	50	14
3	10	4.2	45	801.8	50	40	6.1	140	50	14
4	15	4.5	45	808.7	50	40	6.4	140	50	14
A	20	4.6	45	814.0	50	46	6.5	140	50	14
3	25	4.2	45	[illegible]	50	46	6.1	140	50	14
2	30	4.2	45	827.1	50	46	6.1	140	50	14
1	35	4.2	45	832.6	50	46	6.1	140	50	14
1	40	4.2	45	942.4	50	46	6.1	140	50	14
2	45	3.1	45	847.8	50	46	5.2	140	50	14
3	50	4.1	45	853.1	50	50	5.8	140	50	14
4	55	4.4	45	858.8	50	50	3.2	140	50	14
	60									
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: _____

Source Designation: _____

Date: 11-2-1-74 | Meter Box No.: _____

Test Number: 1 | Sample Box No.: _____

Field Person: C-[illegible]S | Filter Heater Setting: _____

Filter Number: _____ | Probe Heater Setting: _____

Barometric Pressure ("Hg): _____ | Assumed Moisture(%): _____

Stack Static Pressure ("H_2O): _____ | Condensate Volume(ml): _____

Plume Appearance: _____ | Nozzle Diameter(in.): _____

Stack Diameter: _____

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp.(°F) Inlet	Dry Gas Meter Temp.(°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
E1	[illegible]	5.1	45	8604.2	50	50	7.2	250	50	14
2	5			8734.01						
3	10									
4	15									
4	20									
3	25									
2	30									
1	35									
1	40									
2	45									
3	50									
4	55									
4	60									
TP										
[illegible]										
AVERAGE (TOTAL)	(75)	45		(152.924)	50	45	5.88			

46.38

PARTICULATE SAMPLING TRAIN DATA

Company: Brenner

Source Designation: Inlet E

Date: 11-22-74

Test Number: P-3

Field Person: GMS

Filter Number: 72442

Barometric Pressure ("Hg): 29.64

Stack Static Pressure ("H_2O): -9"

Plume Appearance:

Stack Diameter: 18" ϕ

Meter Box No.: RAC (1.666)

Sample Box No.: RAC

Filter Heater Setting:

Probe Heater Setting:

Assumed Moisture(%):

Condensate Volume(ml):

Nozzle Diameter(in.): 1/2" (.285 (H))

Traverse Point No.	Time 8:58	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp. (°F) Inlet	Dry Gas Meter Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
1-1	0	4.7	45°	874.420	40	40	1.34	200	45°	0.0
2	5	3.5	45°	877.4	50	42	1.0	200	45°	1.0
3	10	4.0	45°	880.2	50	42	1.14	200	45°	1.0
4	15	4.3	45°	882.9	56	44	2.3	200	45°	1.0
4	20	4.5	45°	887.1	56	44	2.8	200	45°	1.5
3	25	4.4	45°	891.3	58	44	2.6	200	45°	1.0
2	30	4.4	45	895.1	59	47	2.6	200	45°	1.0
1	35	4.9	45°	899.4	64	50	1.4	200	45°	1.0
1	40	5.5	45°	903.3	64	50	1.57	200	45°	1.0
2	45	3.9	45°	906.6	65	50	1.11	200	45°	1.0
3	50	4.3	45°	909.6	66	52	2.3	200	45°	1.5
4	55	3.0 (3.2)	45°	913.3	66	52	0.91	200	45°	1.0
	60			916.557						
AVERAGE (TOTAL)				( )						

PARTICULATE SAMPLING TRAIN DATA

Company: _____

Source Designation: _____

Date: 11-22-74 | Meter Box No.: KAC

Test Number: F-3 | Sample Box No.: KAC

Field Person: C-MS | Filter Heater Setting: _____

Filter Number: _____ | Probe Heater Setting: _____

Barometric Pressure ("Hg): _____ | Assumed Moisture(%): _____

Stack Static Pressure ("H_2O): _____ | Condensate Volume(ml): _____

Plume Appearance: _____ | Nozzle Diameter(in.): _____

Stack Diameter: 18" ϕ

.285(H)

Traverse Point No.	Time	Velocity Pressure ("H_2O)	Stack Temp. (°F)	Dry Gas Meter Volume (ft^3)	Dry Gas Meter Temp.(°F) Inlet	Dry Gas Meter Temp.(°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp. (°F)	Last Impinger Gas Temp. (°F)	Sampling Train Static Pressure ("Hg)
E-1	0	3.5	45°	916.557	50	48	1.0	200	45°	1.0
2	5	1.1	45°	919.2	50	48	3.0	200	45°	1.5
3	10	1.1	45°	92.2.1	50	48	3.0	200	45°	1.5
4	15	1.5	45	925.4	50	48	4.0	200	45°	1.5
4	20	1.5	45°	932.1	50	48	4.1	200	45°	2.0
3	25	1.4	45°	937.1	55	50	4.0	200	45°	2.5
2	30	1.4	45°	942.1	55	50	4.0	200	45°	2.5
1	35	3.5	45°	947.3	55°	51°	1.0	200	45°	1.0
1	40	3.7	45°	950.4	55°	51°	1.05	200	45°	1.0
2	45	1.2	45°	952.9	55°	51°	3.41	200	45°	1.0
3	50	1.3	45°	957.1	55°	51°	3.7	200	45°	2.0
4	55	1.5	45	962.1	55°	51°	4.1	200	45	2.0
	60			967.075						
AVERAGE (TOTAL) (24)			45	(92.655)	55	48	2.40			

38.26

PARTICULATE DATA

Company J. M. Brenner Company Lancaster, Pa.

Source Designation OUTLET A

Field Person RGK

Test Number	Fraction	Final* Weight (gm.)	Tare Weight (gm.)	Weight of* Particulate (gm.)
1	110 mm filter	0.65814	0.66130	-0.00316
	Beaker with acetone probe washings	96.6552	96.6449	0.0103
	Beaker with impinger contents (aqueous/organic)	96.4528	96.4555	-0.0027
		90.4005	90.3865	0.0140
2	110 mm filter	0.66241	0.65905	0.00336
	Beaker with acetone probe washings	86.2074	86.1989	0.0085
	Beaker with impinger contents (aqueous/organic)	102.2692	102.2665	0.0027
		102.5160	102.5081	0.0079
3	110 mm filter	0.68163	0.66630	0.01533
	Beaker with acetone probe washings	95.7251	95.6963	0.0288
	(aqueous/organic) Beaker with impinger contents	89.9694	89.9652	0.0042
		96.7272	96.7227	0.0045

* Corrected for blank

Note:
Negative weights have been considered zero for purposes of calculation.

Geo. D. Clayton & Assoc

PARTICULATE DATA

Company J. M. Brenner Company Lancaster, Pa.

Source Designation OUTLET B

Field Person RBK

Test Number	Fraction	Final* Weight (gm.)	Tare Weight (gm.)	Weight of* Particulate (gm.)
1	110 mm filter	0.663380	0.63172	0.03208
	Beaker with acetone probe washings	83.5143	83.5077	0.0066
	Beaker with impinger contents	97.0891	97.0764	0.0127
	(aqueous/organic)	98.8755	98.8696	0.0059
2	110 mm filter	0.633321	0.63362	-0.00041
	Beaker with acetone probe washings	97.5004	97.4999	0.0005
	Beaker with impinger contents	93.9005	93.8928	0.0077
	(aqueous/organic)	96.1995	96.1977	0.0018
3	110 mm filter	0.64567	0.64640	-0.00073
	Beaker with acetone probe washings	92.0099	92.0044	0.0055
	(aqueous/organic) Beaker with impinger contents	86.4440	86.4375	0.0065
		66.2190	66.2170	0.0020

* Corrected for blank

Note: Negative weights have been considered zero for purposes of calculation.

Geo. D. Clayton & Assoc

PARTICULATE DATA

Company J. M. Brenner Company Lancaster, Pa.

Source Designation Inlet C

Field Person RCM

Test Number	Fraction	Final* Weight (gm.)	Tare Weight (gm.)	Weight of* Particulate (gm.)
2	110 mm filter	1.05762	0.66835	0.38927
	Beaker with acetone probe washings	98.6925	97.9794	0.7131
	Beaker with impinger contents	95.3661	95.3536	0.0125
	(aqueous/organic)	89.7204	89.7115	0.0089
3	110 mm filter	1.25725	0.66485	0.59240
	Beaker with acetone probe washings	96.9101	96.0951	0.8150
	Beaker with impinger contents	96.1345	96.1233	0.0112
	(aqueous/organic)	98.6086	98.6034	0.0052
	110 mm filter			
	Beaker with acetone probe washings			
	Beaker with impinger contents			

* Corrected for blank

Note: Negative weights have been considered Zero for purposes of calculation.

Geo. D. Clayton & Assoc.

PARTICULATE DATA

Company J. M. Brenner Company Lancaster, Pa.

Source Designation INLET D

Field Person F-I C

Test Number	Fraction	Final* Weight (gm.)	Tare Weight (gm.)	Weight of* Particulate (gm.)
2	110 mm filter	0.66651	0.66523	0.00128
	Beaker with acetone probe washings	91.1132	91.1085	0.0047
	Beaker with impinger contents (aqueous/organic)	102.1361	102.1238	0.0123
		89.0576	89.0570	0.0006
3	110 mm filter	0.85428	0.66021	0.19407
	Beaker with acetone probe washings	113.9670	100.5259	13.4411
	Beaker with impinger contents (aqueous/organic)	82.6990	82.6845	0.0145
		82.8258	82.8208	0.0050
	110 mm filter			
	Beaker with acetone probe washings			
	Beaker with impinger contents			

* Corrected for blank

Note: Negative weights have been considered zero for purposes of calculation.

Geo. D. Clayton & Assoc.

PARTICULATE DATA

Company J. M. Brenner Company Lancaster, Pa.

Source Designation INLET E

Field Person GMS

Test Number	Fraction	Final* Weight (gm.)	Tare Weight (gm.)	Weight of* Particulate (gm.)
2	110 mm filter	0.87636	0.66486	0.21150
	Beaker with acetone probe washings	90.3901	89.8677	0.5224
	Beaker with impinger contents	97.0870	97.0799	0.0071
	(aqueous/organic)	97.1249	97.1240	0.0009
3	110 mm filter	0.70447	0.66741	0.03706
	Beaker with acetone probe washings	95.5789	93.6797	1.8992
	Beaker with impinger contents	95.8376	95.8291	0.0085
	(aqueous/organic)	95.8413	95.8414	-0.0001
	110 mm filter			
	Beaker with acetone probe washings			
	Beaker with impinger contents			

* Corrected for blank

Note: Negative weights have been considered zero for purposes of calculation.

Geo. D. Clayton & Assoc.

VOLUME OF CONDENSATE COLLECTED

ompany J. M. Brenner Co., Lancaster, Pa.

Source Designation Outlet A

ield Person RGK

Test Number	Fraction	Initial Volume or Weight	Final Volume or Weight	Liquid Collected (ml)
1	First Impinger	100	75	-25
	Second Impinger	100	120	20
	Third Impinger	0	3	3
	Silica Gel	200	213.5	13.5
	Total			11.5
2	First Impinger	100	29	-71
	Second Impinger	100	133	33
	Third Impinger	0	13	13
	Silica Gel	200	248.9	48.9
	Total			23.9
3	First Impinger	100	93	-7
	Second Impinger	100	50	-50
	Third Impinger	0	15	15
	Silica Gel	200	247.4	47.4
	Total			5.4

VOLUME OF CONDENSATE COLLECTED

Company J. M. Brenner Co., Lancaster, Pa.

Source Designation Outlet B

Field Person RBK

Test Number	Fraction	Initial Volume or Weight	Final Volume or Weight	Liquid Collected (ml)
1	First Impinger	100	71	-29
	Second Impinger	100	108	8
	Third Impinger	0	2	2
	Silica Gel	200	227.2	27.2
	Total			8.2
2	First Impinger	100	70	-30
	Second Impinger	100	95	-5
	Third Impinger	0	9	9
	Silica Gel	200	240.8	40.8
	Total			14.8
3	First Impinger	100	46	-54
	Second Impinger	100	98	-2
	Third Impinger	0	4	4
	Silica Gel	200	240.5	40.5
	Total			3.5*

* Estimated loss due to spillage: 15 ml

VOLUME OF CONDENSATE COLLECTED

Company J. M. Brenner Co., Lancaster, Pa.

Source Designation Inlet C

Field Person RCM

Test Number	Fraction	Initial Volume or Weight	Final Volume or Weight	Liquid Collected (ml)
2	First Impinger	100	87	-13
	Second Impinger	100	104	4
	Third Impinger	0	1	1
	Silica Gel	200	219.5	19.5
	Total			11.5
3	First Impinger	100	84	-16
	Second Impinger	100	102	2
	Third Impinger	0	1	1
	Silica Gel	200	223.4	23.4
	Total			10.4
	First Impinger			
	Second Impinger			
	Third Impinger			
	Silica Gel			
	Total			

VOLUME OF CONDENSATE COLLECTED

Company J. M. Brenner Co., Lancaster, Pa.

Source Designation Inlet D

Field Person FIC

Test Number	Fraction	Initial Volume or Weight	Final Volume or Weight	Liquid Collected (ml)
2	First Impinger	100	103	3
	Second Impinger	100	101	1
	Third Impinger	0	2	2
	Silica Gel	200	216.5	16.5
	Total			22.5
3	First Impinger	100	90	-10
	Second Impinger	100	108	8
	Third Impinger	0	0	0
	Silica Gel	200	221.7	21.7
	Total			19.7
	First Impinger			
	Second Impinger			
	Third Impinger			
	Silica Gel			
	Total			

VOLUME OF CONDENSATE COLLECTED

Company J. M. Brenner Co., Lancaster, Pa.

Source Designation Inlet E

Field Person GMS

Test Number	Fraction	Initial Volume or Weight	Final Volume or Weight	Liquid Collected (ml)
2	First Impinger	100	66	-34
	Second Impinger	100	107	7
	Third Impinger	0	8	8
	Silica Gel	200	229.2	29.2
	Total			10.2
3	First Impinger	100	84	-16
	Second Impinger	100	106	6
	Third Impinger	0	1	1
	Silica Gel	200	224.7	24.7
	Total			15.7
	First Impinger			
	Second Impinger			
	Third Impinger			
	Silica Gel			
	Total			

LABORATORY ANALYSIS REPORT

Lab. Nos. 82788-82800 Sheet No. 1 of 6

☐ Continued From Previous Sheet ☒ Emergency (Needed: 12-3-74

Project USEPA T6 Sampling Date 11/18-22/74

Job No. 3014 Log-in Date 11-26-74

Investigators RJP, FIC, Keller, Knox, Sexton, Mascy, Loch

Sample Source: ☒ Stack ☐ Community ☐ Ind. Hyg. ☐ Process ☐ Water

Identity, Volume and Concentration of Collection Media: 110 MM Type A Filters

Major Components NOT Listed Below:

Other Comments: Follow EPA stipulated procedures

Analyses Requested: Total Wt.

Estimated Concen.:

Analyst: m. fegan

Date Completed: 12-10-74

Lab. No.	Field Description: Stack or Site No.	Test No. & Date	Fraction Identification	Total Original Volume of Sample	Analyses Completed (2) Detm'n: weight Units: (g)	Blank Corrected
82788	BLANK:	11-19	#72447		-0.00008	
89	Outlet A	11-19	#72461		-0.00316 ✓	
90	outlet B	11-19	#72445		0.03208 ✓	
91	BLANK	11-21	#72468		0.00096 ←	
92	outlet A	11-21	#72443		0.00432 ✓	
93	outlet B	11-21	#72446		-0.00041 ✓	
94	C Inlet	11-21	#72460		0.39023 ✓	
95	D Inlet	11-21	#72463		0.00224 ✓	
96	E Inlet	11-21	#72440		0.21246 ✓	
97	BLANK	11-22	#72453		0.00421 ← ✓	
98	outlet A	11-22	#72464		0.01954 ✓	
99	outlet B	11-22	#72452		-0.00073 ✓	
82800	C Inlet	11-22	#72441		0.59661 ✓	✓

☐ Additional analyses on next sheet for samples listed above

☒ Additional samples on next sheet for analyses listed above

Approved and forwarded: [signature] Date: 12-10-74

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LABORATORY ANALYSIS REPORT

Lab. Nos. 82801-2 Sheet No. 2 of 6

☐ Continued From Previous Sheet ☒ Emergency (Needed: 12-3-74)

Project USEPA T6 Sampling Date 11/18-22/74

Job No. 3014 Log-in Date 11-26-74

Investigators RJP, etc.

Sample Source: ☒ Stack ☐ Community ☐ Ind. Hyg. ☐ Process ☐ Water

Identity, Volume and Concentration of Collection Media: 110 mm Type A Filter

Major Components NOT Listed Below:

Other Comments: Follow EPA stipulated procedures

Analyses Requested: Total wt.

Estimated Concen.:

Analyst: m. Regan

Date Completed: 12-10-74

Lab. No.	Field Description: Stack or Site No.	Test No. & Date	Fraction Identification	Total Original Volume of Sample	Analyses Completed (2) Determ.: weight Units: (g)	Blank Corrected
	BLANK:					
82801	Dinlet	11-22	#72459		0.19828	
02	Einlet	11-22	#72442		0.04127	

☐ Additional analyses on next sheet for samples listed above

☐ Additional samples on next sheet for analyses listed above

Approved and forwarded: [signature] Date: 12-10-74

LABORATORY ANALYSIS REPORT

Lab. Nos. 82805-13 Sheet No. 3 of 6

☐ Continued From Previous Sheet ☒ Emergency (Needed: 12-3-74)

Project USEPA T6

Job No. 3014 Sampling Date 11/18-22/74

Investigators RJPeta Log-in Date 11/26/74

Sample Source: ☒ Stack ☐ Community ☐ Ind. Hyg. ☐ Process ☐ Water

Identity, Volume and Concentration of Collection Media: Acetone

Major Components NOT Listed Below:

Other Comments: FOLLOW EPA STIPULATED PROCEDURES

Analyses Requested: Total wt

Estimated Concen.:

Analyst:

Date Completed:

Lab. No.	Field Description: Stack or Site No.	Test No. & Date	Fraction Identification	Total Original Volume of Sample	Analyses Completed Detm'n: Units:	Blank Corrected?
82803	BLANK:	11-19	Bottle A-2	193 mL		
04	outlet A	11-19	Particulate 1	98		
05	outlet B	11-19	Particulate 1	120		
06	BLANK	11-22	Bottle A-1	82		
07	outlet A	11-22	Particulate 2	130		
08	outlet B	11-22	Particulate 2	100		
09	inlet C	11-22	P-3	324		
82810	inlet D	11-22	P-3	414		
11	E inlet	11-22	P-3	435		
12	BLANK	11-21	Bottle A-2	218		
13	A outlet	11-21	P-2	140		
14	B outlet	11-21	P-2	130		
15	C inlet	11-21	P-2	310		

☐ Additional analyses on next sheet for samples listed above

☒ Additional samples on next sheet for analyses listed above

Approved and forwarded: Hoover Date: 12-10-74

LABORATORY ANALYSIS REPORT

b. Nos. 82816-17 Sheet No. 4 of 6

[X] Continued From Previous Sheet [X] Emergency (Needed: 12-3-74)

oject USEPA T6 Sampling Date 11/18-26/74

Job No. 3014 Log-in Date 11/26/74

vestigators RJP etc

ample Source: [X] Stack [ ] Community [ ] Ind. Hyg. [ ] Process [ ] Water

entity, Volume and Concentration of Collection Media: Acetone

ajor Components NOT Listed Below:

ther Comments: FOLLOW EPA STIPULATED PROCEDURES

nalyses Requested: Total wt.

stimated Concen.:

Analyst: Fegan, Nemeth, Schneider

ate Completed: 12-10-74

Lab. No.	Field Description: Stack or Site No.	Field Description: Test No. & Date	Field Description: Fraction Identification	Total Original Volume of Sample	Analyses Completed Detm'n: Units:	Blank Corrected
	BLANK:				(2)	
82816	D Inlet	11-21	P-2	184	0.0014 ✓	
17	E Inlet	11-21	P-2	176	0.0045 ✓	

[ ] Additional analyses on next sheet for samples listed above

[ ] Additional samples on next sheet for analyses listed above

Approved and forwarded: _______ Date: 12-10-74

LABORATORY ANALYSIS REPORT

Lab. Nos. 82818-30 Sheet No. 5 of 6

☐ Continued From Previous Sheet ☒ Emergency (Needed: 12-3-74

Project USEPA T6 Sampling Date 11/18-22/74

Job No. 3014 Log-in Date 11/26-74

Investigators RJPetc

Sample Source: ☒ Stack ☐ Community ☐ Ind. Hyg. ☐ Process ☐ Wate

Identity, Volume and Concentration of Collection Media: distilled H_2O

Major Components NOT Listed Below:

Other Comments: Follow EPA STIPULATED procedures

Analyses Requested: organic wt. part. wt

Estimated Concen.:

Analyst:

Date Completed:

Lab. No.	Field Description: Stack or Site No.	Test No. & Date	Fraction Identification	Total Original Volume of Sample	Analyses Completed Detm'n: / Units:		Blank Correcte
					particulate wt.	organic wt	
82818	BLANK:	11-19	DI H_2O	134	✓	✓	
19	Outlet A	11-19	Particulate 1	255 o	✓	✓	
20	Outlet B	11-19	Particulate 2	285 o	✓	✓	
21	BLANK	11-22	DI H_2O-3	116 o	✓	✓	
22	Outlet A	11-22	P-3	198 o	✓	✓	
23	Outlet B	11-22	P-3	186 o	✓	✓	
24	C Inlet	11-22	P-3	242 o	✓	✓	
82825	D Inlet	11-22	P-3	211-6	✓	✓	
26	E Inlet	11-22	P-3	255 o	✓		0.0005
27	BLANK	11-21	DI H_2O-5	86 o	✓	✓	
28	A Outlet	11-21	P-2	226 o	✓	✓	
29	B Outlet	11-21	P-2	214 o	✓	✓	
30	C Inlet	11-21	P-2	270 o	✓	✓	

☐ Additional analyses on next sheet for samples listed above

☐ Additional samples on next sheet for analyses listed above

Approved and forwarded: H Cuick Date: 12-10-74

qd

LABORATORY ANALYSIS REPORT

Lab. Nos. 82831-32 Sheet No. 6 of 6

☒ Continued From Previous Sheet ☒ Emergency (Needed: 12-3-74)

Project USEPA T6 Sampling Date 11/18-22/74

Job No. 3014 Log-in Date 11/26/74

Investigators R&D etc.

Sample Source: ☒ Stack ☐ Community ☐ Ind. Hyg. ☐ Process ☐ Water

Identity, Volume and Concentration of Collection Media: distilled H_2O

Major Components NOT Listed Below:

Other Comments: Follow EPA STIPULATED procedures

Analyses Requested: organic wt part. wt.

Estimated Concen.:

Analyst:

Date Completed: 12-10-74

Lab. No.	Field Description: Stack or Site No.	Test No. & Date	Fraction Identification	Total Original Volume of Sample	Analyses Completed Detm'n: Units:		Blank Corrected
	BLANK:				~~[illegible]~~ particulate	organic wt.	
82831	D Cyclone	10-21	P-2	2420	[illegible]	[illegible]	
32	E Cyclone	10-24	P-2	2110	[illegible]	[illegible]	

☐ Additional analyses on next sheet for samples listed above

☐ Additional samples on next sheet for analyses listed above

Approved and forwarded: Hayes Date: 12-10-74

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LABORATORY ANALYSIS REPORT

Lab. Nos. _____ Sheet No. _____

☐ Continued From Previous Sheet ☐ Emergency (Needed: _____)

Project EPA

Job No. _____ Sampling Date _____

Investigators _____ Log-in Date _____

Sample Source: ☐ Stack ☐ Community ☐ Ind. Hyg. ☐ Process ☐ Water

Identity, Volume and Concentration of Collection Media: Acetone - AR

Major Components NOT Listed Below: _____

Other Comments: _____

Analyses Requested: Particulate

Estimated Concen.:

Analyst: Teague

Date Completed: 11-18-74

Lab. No.	Field Description: Stack or Site No.	Field Description: Test No. & Date	Field Description: Fraction Identification	~~Total Original Volume of Sample~~	Analyses Completed Detm'n: Particulate Units: percent	Blank Corrected?
	~~BLANK:~~ Both Acetone	filtration		Beaker No.		
	A-1	"		21	<0.00025	
	"			24	<0.00025	
	↓			30	<0.00025	
	A-2			22	<0.00025	
	"			23	<0.00025	
	↓			28	<0.00025	
	A-3			29	<0.00025	
	"			37	<0.00025	
	↓			38	0.00025	
	A-4			27	<0.00025	
	"			31	<0.00025	
	↓			32	<0.00025	

☐ Additional analyses on next sheet for samples listed above

☐ Additional samples on next sheet for analyses listed above

Approved and forwarded: Hayes Date: 11-18-74

LABORATORY ANALYSIS REPORT

Lab. Nos. _____ Sheet No. _____

☐ Continued From Previous Sheet ☐ Emergency (Needed: _____)

Project EPA Sampling Date _____

Job No. _____ Log-in Date _____

Investigators _____

Sample Source: ☐ Stack ☐ Community ☐ Ind. Hyg. ☐ Process ☐ Water

Identity, Volume and Concentration of Collection Media: Acetone - AR

Major Components NOT Listed Below: _____

Other Comments: _____

Analyses Requested: Dichlorobenzene

Estimated Concen.:

Analyst: Fegan

Date Completed: 11-18-74

Lab. No.	Field Description: Stack or Site No.	Test No. & Date	Fraction Identification	~~Total~~ Original Volume of Sample	Analyses Completed Detm'n: Dichlorobenzene Units: percent	Blank Corrected?
	~~BLANK:~~ Reagent	Extraction		Beaker No.		
	A-5			33	0.00035	
	↓			34	0.00051	
				36	<0.00025	
	A-6			25	0.00051	
	↓			26	<0.00025	
				35	0.00076	

☐ Additional analyses on next sheet for samples listed above

☐ Additional samples on next sheet for analyses listed above

Approved and forwarded: Hayes Date: 11-18-74

LABORATORY ANALYSIS REPORT

Lab. Nos. _____ Sheet No. _____

☐ Continued From Previous Sheet ☐ Emergency (Needed: _____)

Project EPA - _____ Sampling Date _____

Job No. _____ Log-in Date _____

Investigators _____

Sample Source: ☐ Stack ☐ Community ☐ Ind. Hyg. ☐ Process ☐ Water

Identity, Volume and Concentration of ~~Collection~~ Media: Distilled Deionized H_2O

Major Components NOT Listed Below: _____

Other Comments: _____

Analyses Requested: Dissolved _____

Estimated Concen.: _____

Analyst: Tobey

Date Completed: 11-17-74

Lab. No.	Field Description: Stack or Site No.	Test No. & Date	Fraction Identification	~~Total Original Volume of Sample~~	Analyses Completed Detm'n: Dissolved Units: %	Blank Corrected
	~~BLANK:~~ Beaker	Northshore Air		Beaker No.		
	DD-H_2O-1			1	<0.00020	
	↓			4	<0.00020	
	↓			7	<0.00020	
	DD-H_2O-2			13	<0.00020	
	↓			14	<0.00020	
	↓			15	<0.00020	
	DD-H_2O-3			2	<0.00020	
	↓			5	<0.00020	
	↓			6	<0.00020	
	DD-H_2O-4			7	<0.00020	
	↓			12	<0.00020	
	↓			11	<0.00020	

☐ Additional analyses on next sheet for samples listed above

☐ Additional samples on next sheet for analyses listed above

Approved and forwarded: Harper Date: 11-18-74

LABORATORY ANALYSIS REPORT

Lab. Nos. _____ Sheet No. _____

☐ Continued From Previous Sheet ☐ Emergency (Needed: _____)

Project EIA

Job No. _____ Sampling Date _____

Investigators _____ Log-in Date _____

Sample Source: ☐ Stack ☐ Community ☐ Ind. Hyg. ☐ Process ☐ Water

Identity, Volume and Concentration of Collection Media: Distilled, Deionized H2O

Major Components NOT Listed Below: _____

Other Comments: _____

Analyses Requested: Pb, Cu, Zn, Cd

Estimated Concen.: _____

Analyst: _____

Date Completed: _____

Lab. No.	Field Description: Stack or Site No.	Field Description: Test No. & Date	Field Description: Fraction Identification	Total Original Volume of Sample	Analyses Completed Detm'n: Pb, Cu, Zn, Cd Units: ppm wt	Blank Corrected?
	~~BLANK:~~ Bottle			Beaker No.		
	DD-W-0-5			17	<0.00020	
	↓			18	<0.00020	
	↓			19	<0.00020	
	DD-W-0-6			9	<0.00020	
	↓			10	<0.00020	
	↓			11	<0.00020	

☐ Additional analyses on next sheet for samples listed above

☐ Additional samples on next sheet for analyses listed above

Approved and forwarded: Hayes Date: 11-18-74

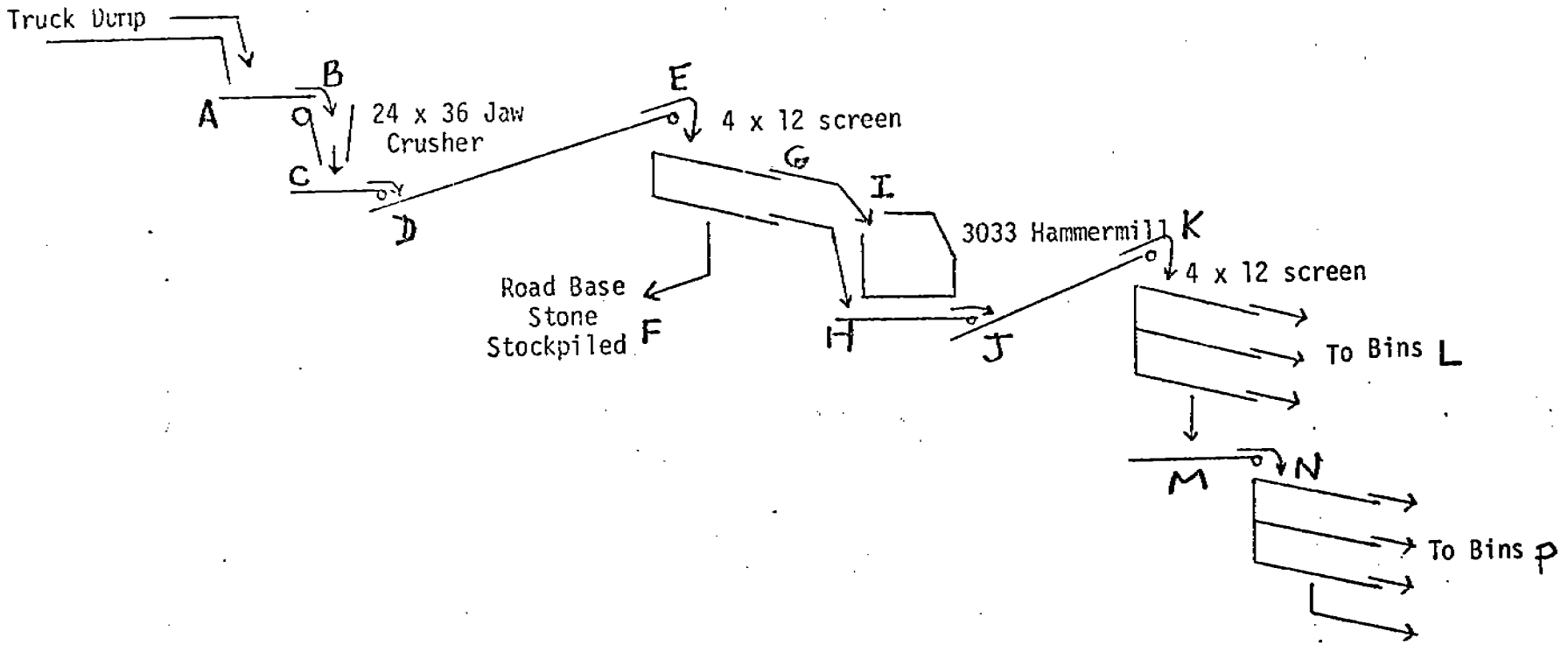


Figure 2. Flow Diagram

Brenner Stone Company

APPENDIX F

CALIBRATION DATA

GEORGE D. CLAYTON & ASSOCIATES
PITOT TUBE CALIBRATION

$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$

PITOT TUBE TYPE "S" PITOT TUBE NO. 101

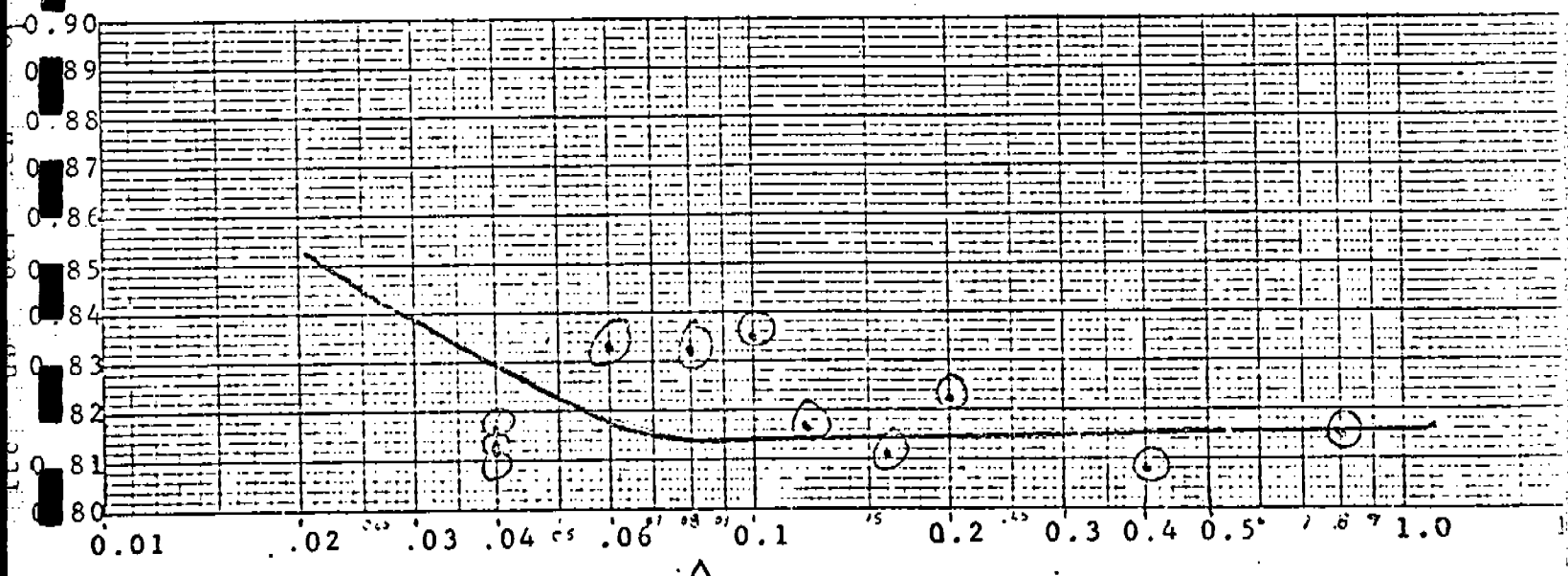
STANDARD PITOT TUBE NO. _____

CALIBRATED BY: R. KELLER

DATE: 11/18/74

CLIENT: EPA TASK 486 Lancaster, Pa.

ΔP_{std}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{pte}
0.02	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.__
0.04	0.019	0.028	0.816	0.031	0.046	0.813	0.037	0.055	0.81
0.06	0.033	0.055	0.767	0.063	0.089	0.833	0.___	0.___	0.__
0.08	0.054	0.060	0.939	0.077	0.102	0.832	0.___	0.___	0.__
0.10	0.091	0.128	0.835	0.___	0.___	0.___	0.___	0.___	0.__
0.12	0.047	0.069	0.817	0.___	0.___	0.___	0.___	0.___	0.__
0.16	0.106	0.158	0.811	0.___	0.___	0.___	0.___	0.___	0.__
0.20	0.169	0.245	0.822	0.___	0.___	0.___	0.___	0.___	0.__
0.40	0.269	0.404	0.808	0.___	0.___	0.___	0.___	0.___	0.__
0.50	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.__
0.70	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.__
0.80	0.632	0.932	0.815	0.___	0.___	0.___	0.___	0.___	0.__



GEO. D. CLAYTON & ASSOC

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PITOT TUBE CALIBRATION

PITOT TUBE TYPE S PITOT TUBE NO 101

$C_{p_{test}} = 0.99\sqrt{\frac{\Delta p_{std}}{\Delta p_{test}}}$

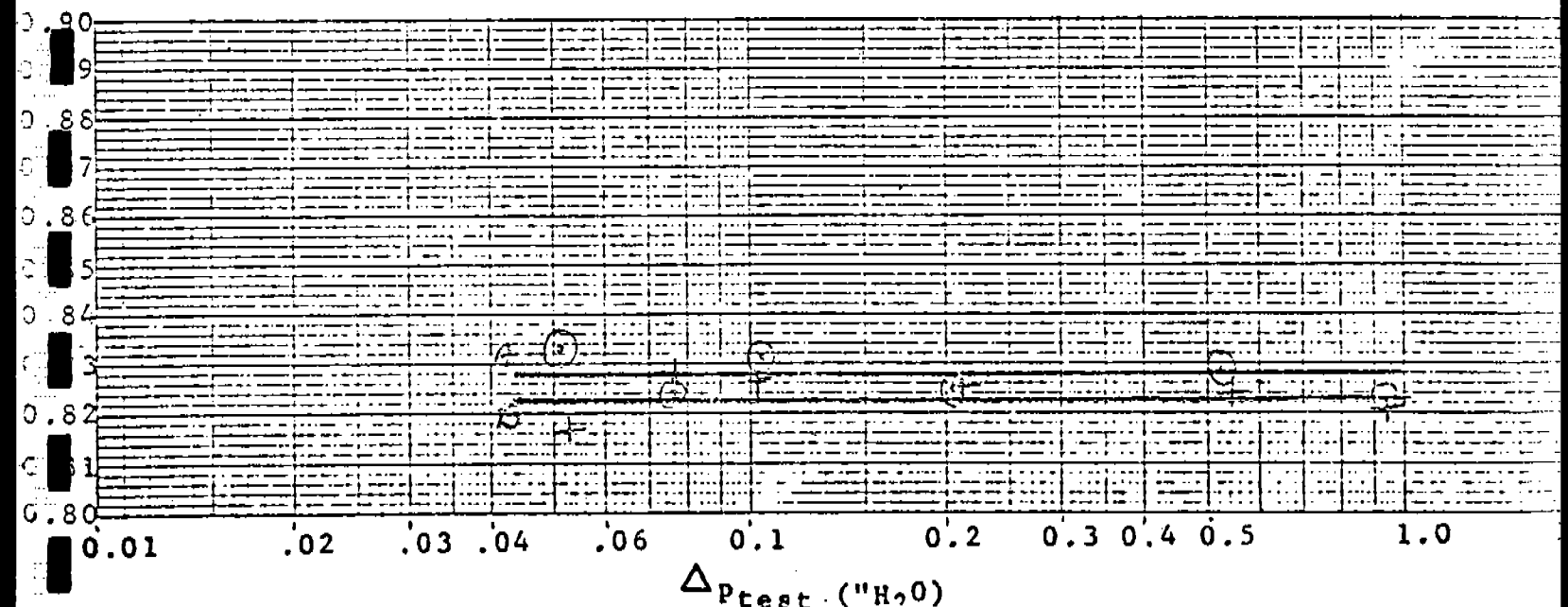
STANDARD TUBE NO.

CALIBRATED BY R Keller

DATE: 11/21/79

CLIENT: EPA

	side A ⊖			side B ⊕					
Δp_{std}	Δp_{std}	Δp_{test}	Cp_{test}	Δp_{std}	Δp_{test}	Cp_{test}	Δp_{std}	Δp_{test}	Cp_{test}
.02	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.04	0.0399	0.0506	0.833	0.0359	0.0526	0.817	0.	0.	0.
.06	0.	0.	0.	0.	0.	0.	0.	0.	0.
.08	0.0734	0.077	0.824	0.0734	0.0764	0.828	0.	0.	0.
0.10	0.	0.	0.	0.	0.	0.	0.	0.	0.
.12	0.0734	0.1034	0.831	0.0727	0.1046	0.826	0.	0.	0.
0.16	0.	0.	0.	0.	0.	0.	0.	0.	0.
.20	0.1452	0.2090	0.825	0.1452	0.2096	0.825	0.	0.	0.
.30	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.40	0.	0.	0.	0.	0.	0.	0.	0.	0.
.50	0.7626	0.5176	0.929	0.3626	0.523	0.924	0.	0.	0.
.60	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.70	0.	0.	0.	0.	0.	0.	0.	0.	0.
.80	0.	0.9357	0.223	0.6436	0.9432	0.821	0.	0.	0.
1.00	0.	0.	0.	0.	0.	0.	0.	0.	0.



GEORGE D. CLAYTON & ASSOCIATES
PITOT TUBE CALIBRATION

$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$

PITOT TUBE TYPE 'S' PITOT TUBE NO. 102

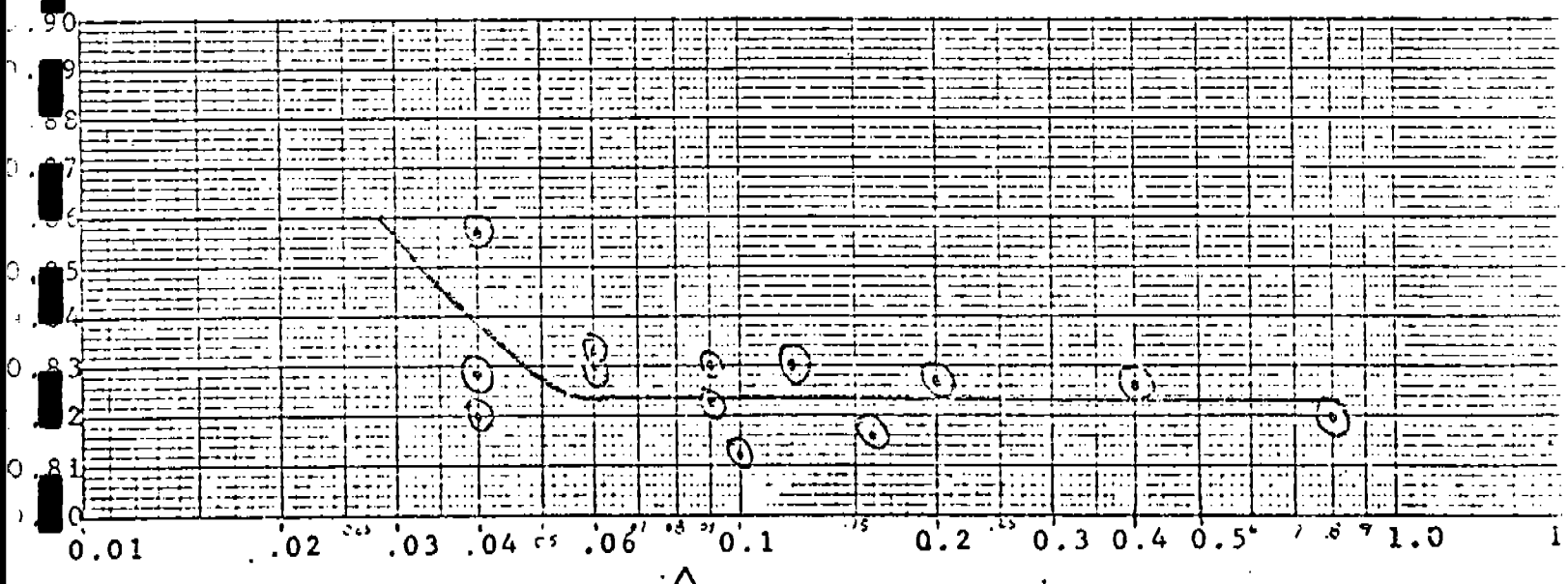
STANDARD PITOT TUBE NO. _____

CALIBRATED BY: R Keller

DATE: 11/18/74

CLIENT: EPA TASK 4+6 Lancaster, Pa.

P_{std}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{pte}
0.02	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.04	0.015	0.020	0.857	0.021	0.030	0.828	0.035	0.051	0.82
.06	0.058	0.082	0.833	0.038	0.054	0.830	0.___	0.___	0.___
0.08	0.038	0.054	0.830	0.058	0.084	0.823	0.___	0.___	0.___
.10	0.072	0.107	0.812	0.___	0.___	0.___	0.___	0.___	0.___
0.12	0.085	0.121	0.830	0.___	0.___	0.___	0.___	0.___	0.___
0.16	0.112	0.165	0.816	0.___	0.___	0.___	0.___	0.___	0.___
.20	0.141	0.202	0.827	0.___	0.___	0.___	0.___	0.___	0.___
0.40	0.292	0.419	0.826	0.___	0.___	0.___	0.___	0.___	0.___
.50	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.70	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.80	0.628	0.916	0.820	0.___	0.___	0.___	0.___	0.___	0.___



PITOT TUBE CALIBRATION

PITOT TUBE TYPE S PITOT TUBE NO 102

$C_{p_{test}} = 0.99\sqrt{\frac{\Delta p_{STD}}{\Delta p_{test}}}$

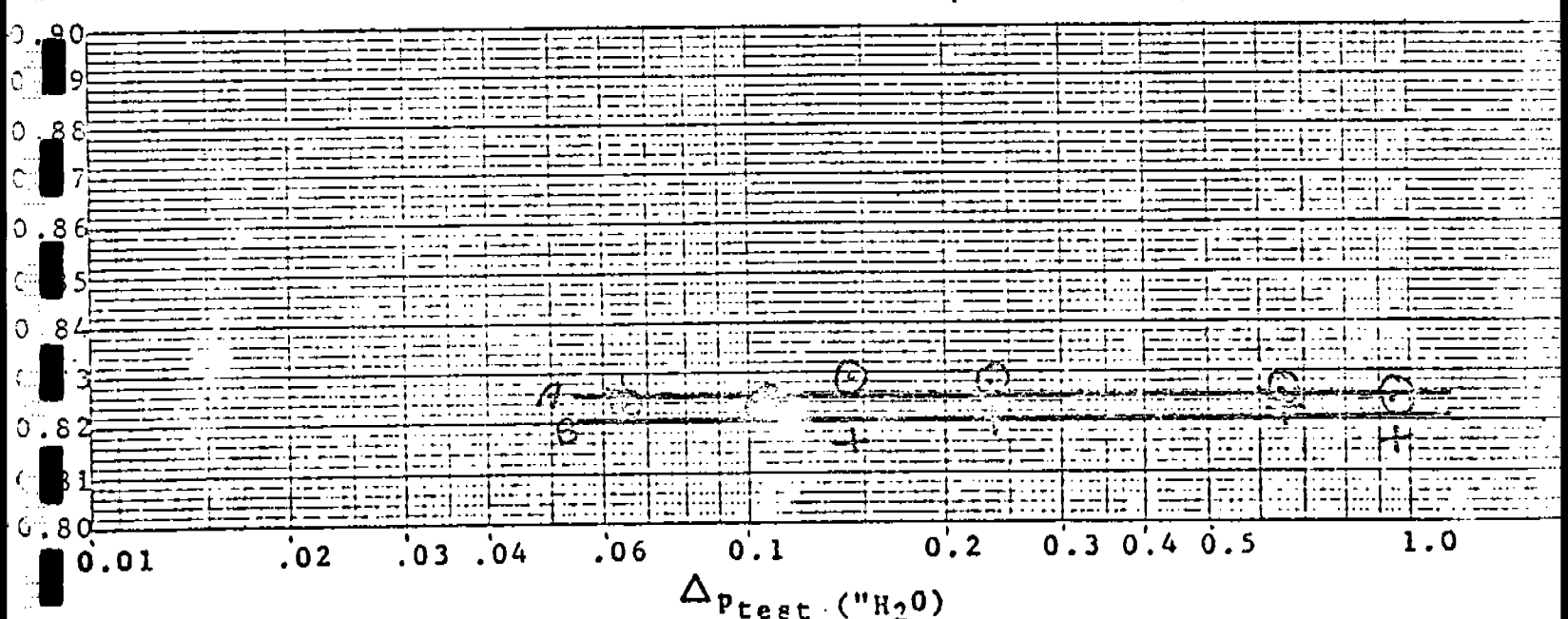
STANDARD TUBE NO.

CALIBRATED BY R Keller

DATE: 11/26/74

CLIENT: EPA

	side A ⊙			side B +					
P_{std}	Δp_{std}	Δp_{test}	$C_{p_{test}}$	Δp_{std}	Δp_{test}	$C_{p_{test}}$	Δp_{std}	Δp_{test}	$C_{p_{test}}$
.02	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.04	0.0448	0.0650	0.822	0.0448	0.0644	0.826	0.____	0.____	0.____
.06	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.08	0.0742	0.1074	0.823	0.0742	0.1076	0.822	0.____	0.____	0.____
.10	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.12	0.0990	0.1412	0.829	0.0990	0.1456	0.816	0.____	0.____	0.____
.16	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.20	0.1640	0.2346	0.828	0.1640	0.2384	0.821	0.____	0.____	0.____
.30	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.40	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.50	0.441	0.6328	0.826	0.4410	0.6400	0.822	0.____	0.____	0.____
.60	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.70	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.80	0.645	0.9314	0.824	0.645	0.9496	0.816	0.____	0.____	0.____
1.00	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____



GEORGE D. CLAYTON & ASSOCIATES
PITOT TUBE CALIBRATION

$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$

PITOT TUBE TYPE S PITOT TUBE NO. 103

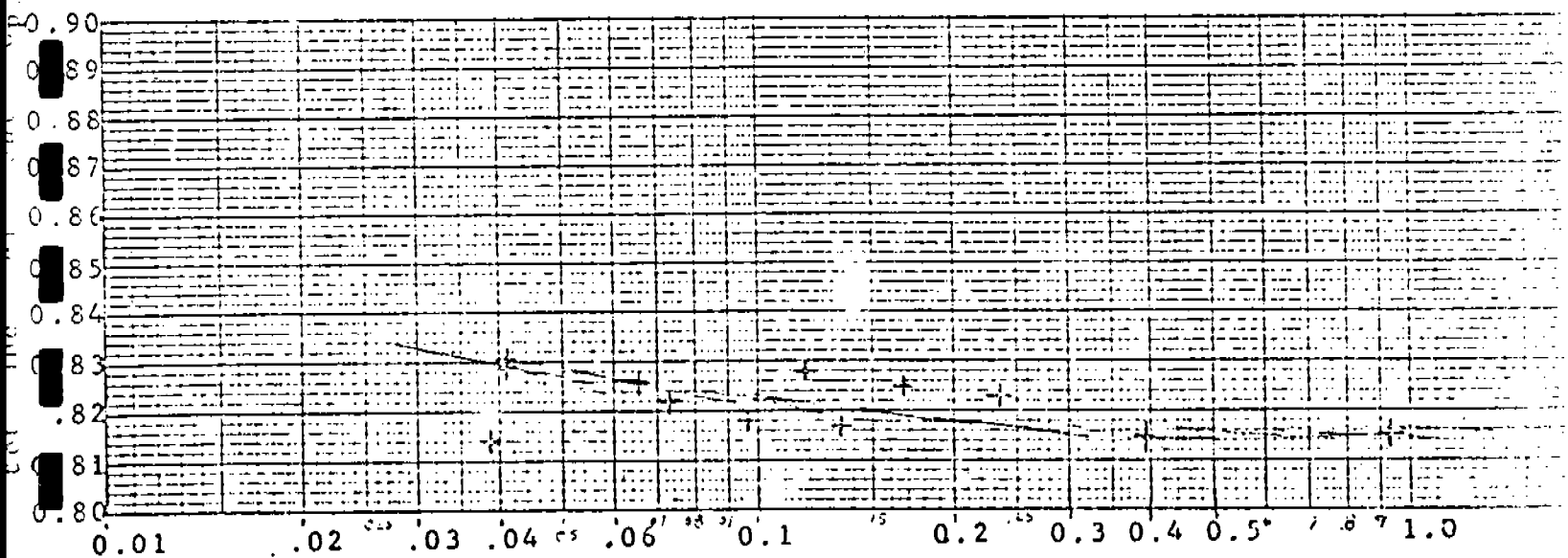
STANDARD PITOT TUBE NO. _____

CALIBRATED BY: R. Keller

DATE: 11/18/74

CLIENT: Not Used in Field

C_{pstd}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptest}
0.02	0.029	0.0414	0.829	0.___	0.___	0.___	0.___	0.___	0.___
0.04	0.0267	0.0394	0.814	0.6288	0.0410	0.830	0.___	0.___	0.___
0.06	0.046	0.066	0.826	0.050	0.073	0.822	0.___	0.___	0.___
0.08	0.065	0.096	0.818	0.084	0.119	0.828	0.___	0.___	0.___
0.10	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.12	0.091	0.134	0.817	0.___	0.___	0.___	0.___	0.___	0.___
0.16	0.116	0.168	0.825	0.___	0.___	0.___	0.___	0.___	0.___
0.20	0.162	0.234	0.823	0.___	0.___	0.___	0.___	0.___	0.___
0.30	0.268	0.395	0.815	0.___	0.___	0.___	0.___	0.___	0.___
0.50	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.70	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.80	0.630	0.928	0.815	0.___	0.___	0.___	0.___	0.___	0.___



PITOT TUBE CALIBRATION

PITOT TUBE TYPE S — PITOT TUBE NO 103

$C_{p_{test}} = 0.99\sqrt{\frac{\Delta p_{STD}}{\Delta p_{test}}}$

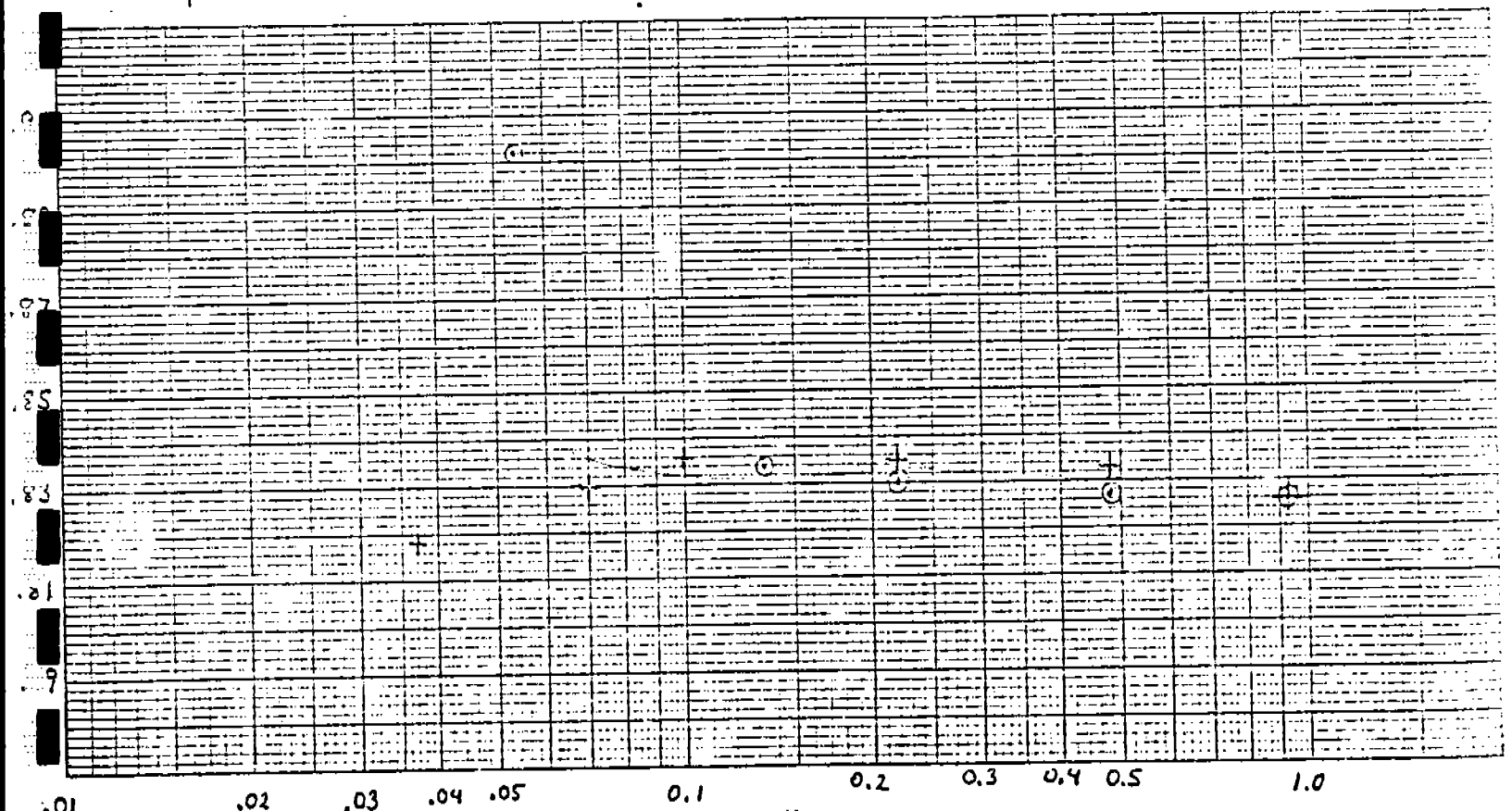
STANDARD TUBE NO. ...

CALIBRATED BY R. Keller

TE: 11/26/74

IENT: EPA

	side A ⊙			side B +					
p_{std}	Δp_{std}	Δp_{test}	$C_{p_{test}}$	Δp_{std}	Δp_{test}	$C_{p_{test}}$	Δp_{std}	Δp_{test}	$C_{p_{test}}$
.02	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
0.04	0.0205	0.0422	0.691	0.0254	0.0373	0.818	0.____	0.____	0.____
.06	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.08	0.0449	0.0541	0.902	0.0492	0.0700	0.830	0.____	0.____	0.____
0.10	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.12	0.0958	0.1351	0.834	0.0710	0.0995	0.836	0.____	0.____	0.____
0.16	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
0.20	0.1557	0.2217	0.830	0.1557	0.2189	0.835	0.____	0.____	0.____
.30	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
0.40	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.50	0.3371	0.4828	0.827	0.3371	0.4764	0.833	0.____	0.____	0.____
.60	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
0.70	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____
.80	0.6508	0.9342	0.826	0.6508	0.9345	0.826	0.____	0.____	0.____
1.00	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____	0.____



GEORGE D. CLAYTON & ASSOCIATES
PITOT TUBE CALIBRATION

$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$

PITOT TUBE TYPE S PITOT TUBE NO. #104

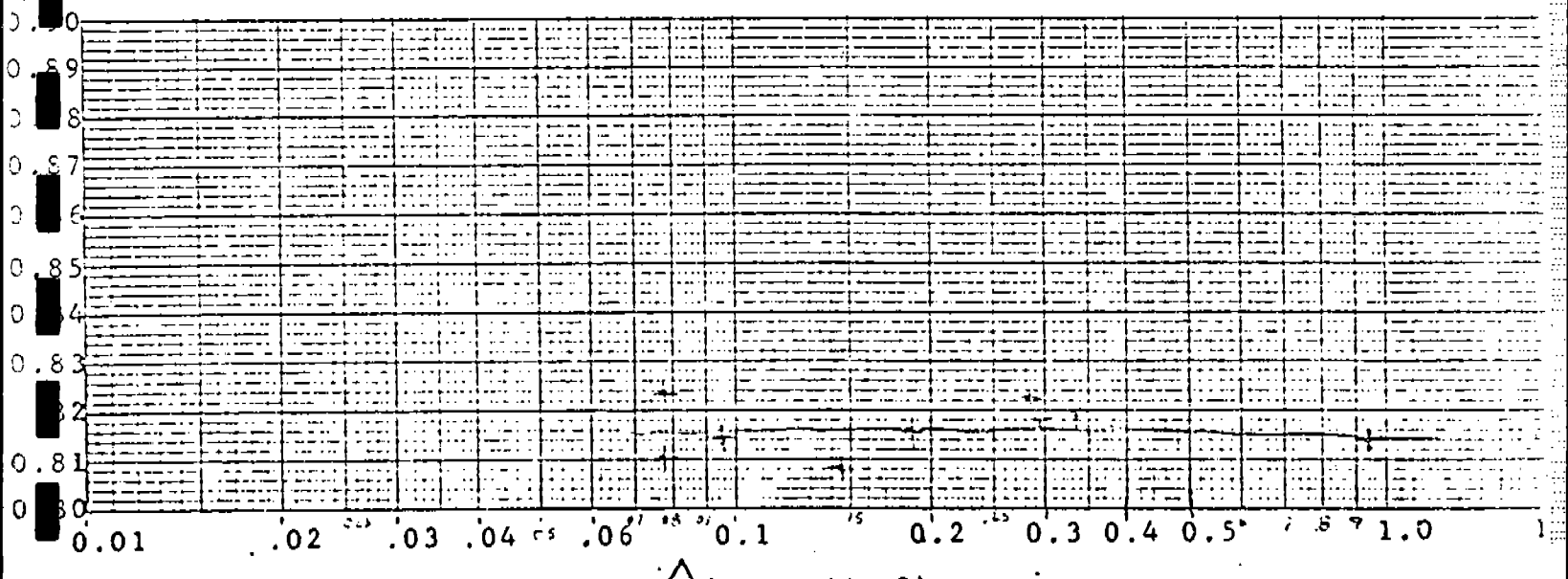
STANDARD PITOT TUBE NO. _____

CALIBRATED BY: R. Keller

DATE: 11/18/74

CLIENT:

ΔP_{std}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{pte}
0.02	0.[illegible]	0.[illegible]	0.___	0.02608	0.04385	0.763	0.___	0.___	0.___
.04	0.[illegible]	0.[illegible]	0.___	0.05916	0.07836	0.823	0.___	0.___	0.___
.06	0.___	0.___	0.___	0.05916	0.07836	0.810	0.___	0.___	0.___
.08	0.___	0.___	0.___	0.4134	0.28524	0.822	0.___	0.___	0.___
.10	0.___	0.___	0.___	0.12644	0.18664	0.815	0.___	0.___	0.___
0.12	0.___	0.___	0.___	0.227	0.332	0.819	0.___	0.___	0.___
.16	0.___	0.___	0.___	0.9732	0.14604	0.808	0.___	0.___	0.___
.20	0.___	0.___	0.___	0.19864	0.29152	0.818	0.___	0.___	0.___
0.30	0.___	0.___	0.___	0.63364	0.93706	0.814	0.___	0.___	0.___
.50	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.70	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.80	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___



ΔP_{test} ("H2O)

$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$

PITOT TUBE TYPE S PITOT TUBE NO. 104

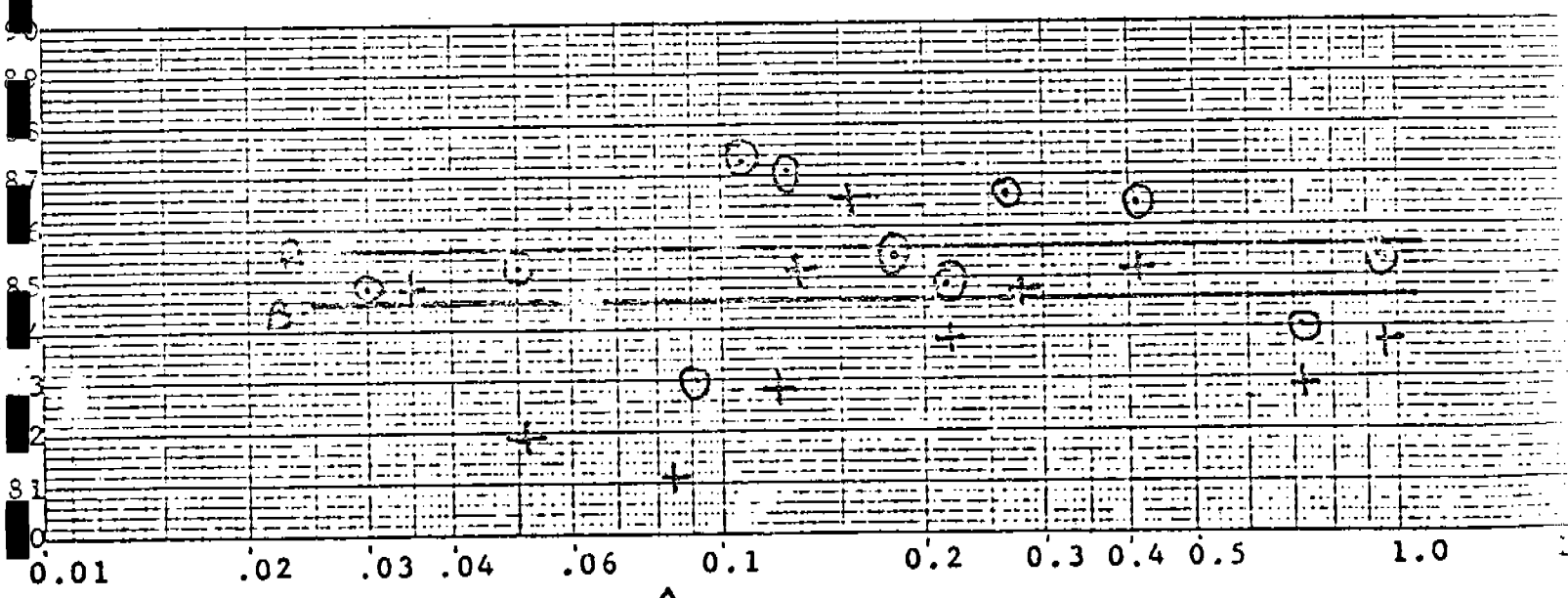
STANDARD PITOT TUBE NO. _____

BRATED BY: R.J. Griffin

12/11/74

NT:

	A o			Reverse Side B +					
sta	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptest}
2	0.022	0.030	0.848	0.022	0.030	0.848	0.___	0.___	0.___
4	0.037	0.050	0.852	0.037	0.054	0.819	0.___	0.___	0.___
0.06	0.057	0.081	0.830	0.057	0.085	0.811 828	0.___	0.___	0.___
8	0.084	0.108	0.873	0.084	0.120	0.828	0.___	0.___	0.___
10	0.096	0.124	0.871	0.096	0.130	0.851	0.___	0.___	0.___
0.12	0.116	0.156	0.854	0.116	0.152	0.865	0.___	0.___	0.___
16	0.159	0.216	0.849	0.159	0.222	0.838	0.___	0.___	0.___
20	0.202	0.264	0.866	0.202	0.276 414	0.847	0.___	0.___	0.___
0.30	0.306	0.402	0.864	0.306	0.___	0.851	0.___	0.___	0.___
50	0.512	0.712	0.840	0.512	0.730	0.829	0.___	0.___	0.___
70	0.690	0.930	0.853	0.690	0.966	0.837	0.___	0.___	0.___
80	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___



GEORGE D. CLAYTON & ASSOCIATES
PITOT TUBE CALIBRATION

$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$

PITOT TUBE TYPE S PITOT TUBE NO. #105

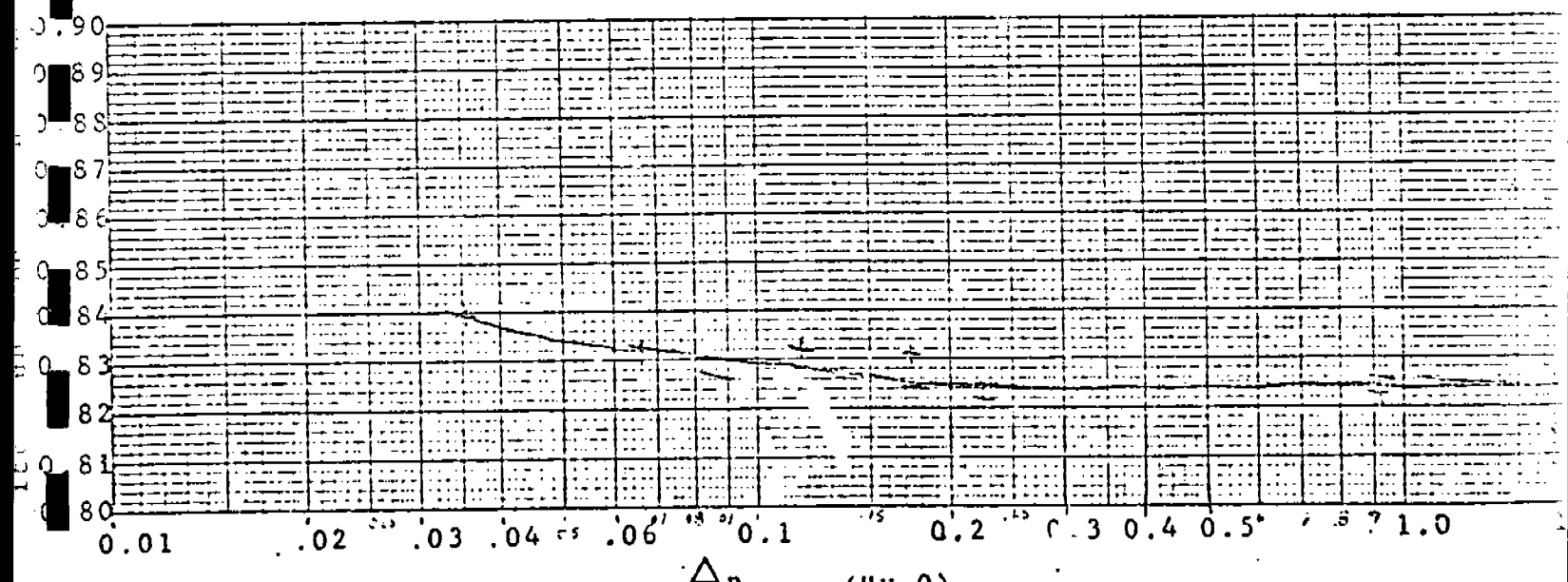
STANDARD PITOT TUBE NO. _____

CALIBRATED BY: R. Kell

DATE: 11/18/74

CLIENT:

ΔP_{std}	Δp_{std}	Δp_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{pte}
0.02	0.02528	0.03524	0.839	0.___	0.___	0.___	0.___	0.___	0.___
0.04	0.04816	0.06916	0.832	0.___	0.___	0.___	0.___	0.___	0.___
0.06	0.06872	0.11864	0.832	0.___	0.___	0.___	0.___	0.___	0.___
0.08	0.15852	0.22172	0.829	0.___	0.___	0.___	0.___	0.___	0.___
0.10	0.1218	0.173	0.831	0.___	0.___	0.___	0.___	0.___	0.___
0.12	0.16284	0.20896	0.823	0.___	0.___	0.___	0.___	0.___	0.___
0.16	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.20	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.30	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.50	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.70	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.80	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___



PITOT TUBE CALIBRATION

$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$

PITOT TUBE TYPE S PITOT TUBE NO. _____

STANDARD PITOT TUBE NO. 105

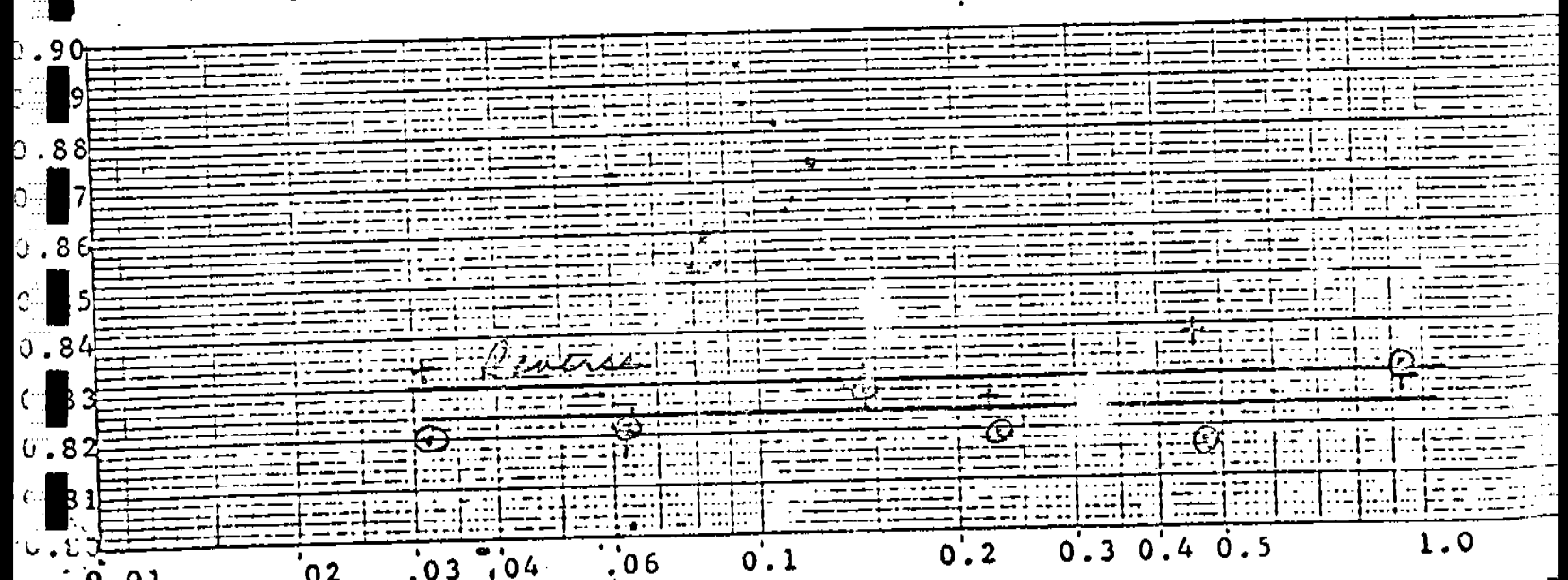
RATED BY: RJG & GMS

12/12/74

T: ①

+ Reversed

std	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{pte}
0.02	0.022	0.032	0.821	0.022	0.031	0.834	0.___	0.___	0.___
.04	0.044	0.064	0.821	0.044	0.064	0.821	0.___	0.___	0.___
.06	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.08	0.___	0.144	0.829	0.___	0.___	0.___	0.___	0.___	0.___
.10	0.101	0.___	0.___	0.101	0.144	0.829	0.___	0.___	0.___
.12	0.___	0.224	0.819	0.___	0.___	0.___	0.___	0.___	0.___
0.16	0.156	0.___	0.___	0.156	0.224	0.826	0.___	0.___	0.___
.20	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.30	0.324	0.476	0.817	0.324	0.452	0.838	0.___	0.___	0.___
.50	0.___	0.___	0.___	0.___	0.448	0.829	0.___	0.___	0.___
.70	0.664	0.942	0.831	0.664	0.___	0.___	0.___	0.___	0.___
0.80	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___



$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$

PITOT TUBE TYPE S PITOT TUBE NO. 106

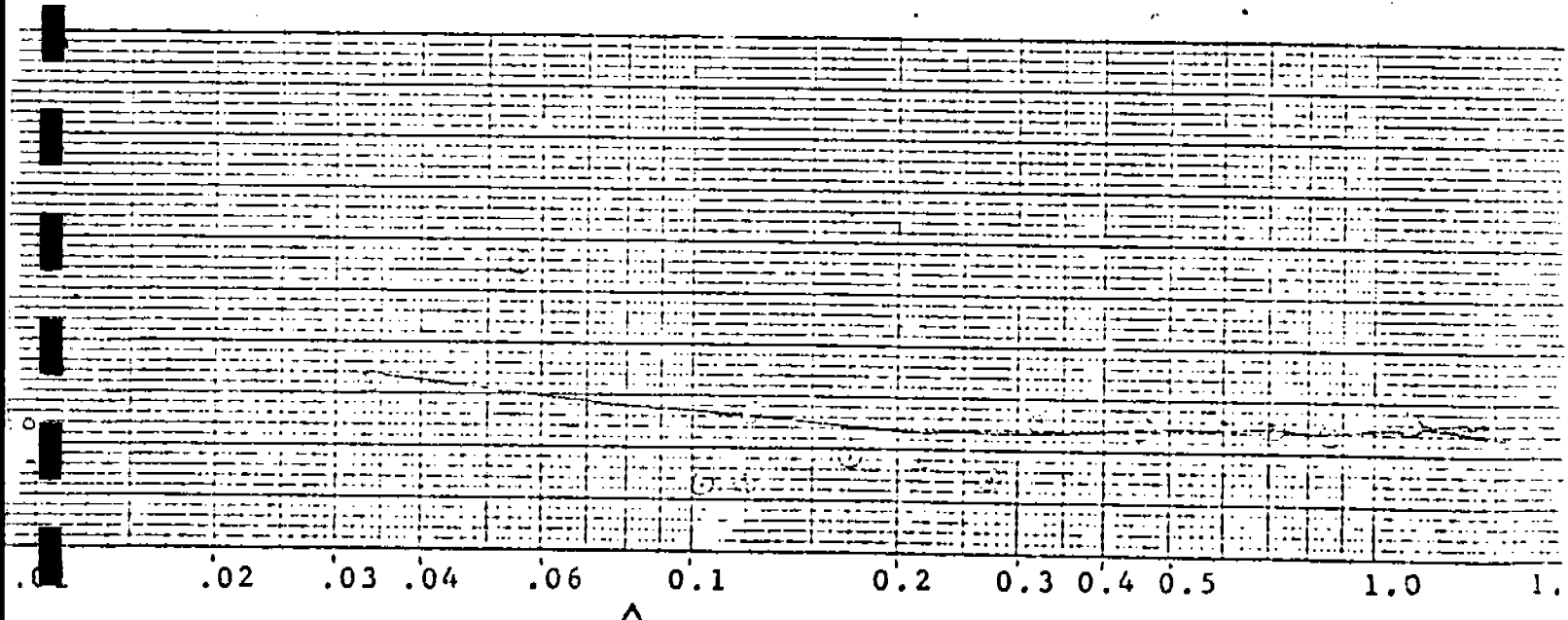
STANDARD PITOT TUBE NO. _____

[redacted]ATED BY: RSP

[redacted]BR 11/15

[redacted]NT:

t[redacted]	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{pte}
[redacted]2	0. 0224	0. 0334	0. 832	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
.04	0. ____ .1372	0. 1018	0. ____ .8126	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
[redacted]6	0. 0336	0. 0568	0. [illegible]	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
[redacted]8	0. 1714	0. 122	0. 1273	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
.10	0. ____	0. ____	0. ____ 818	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
[redacted]2	0. 1158	0. 1691	0. 2141	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
[redacted]6	0. 1498	0. 2196	0. 818	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
.20	0. 1872	0. 2766	0. 814	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
[redacted]0	0. 2312	0. 3322	0. 826	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
[redacted]50	0. 3152	0. 4536	0. 825	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
.70	0. 4234	0. 6096	0. 826	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
[redacted]8	0. 602	0. 8708	0. 823	0. ____	0. ____	0. ____	0. ____	0. ____	0. ____
	0.7202	1.0312	0.827						



$\Delta P_{[illegible]}$ (IN. O)

PITOT TUBE CALIBRATION

$$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$$

PITOT TUBE TYPE S PITOT TUBE NO. _____

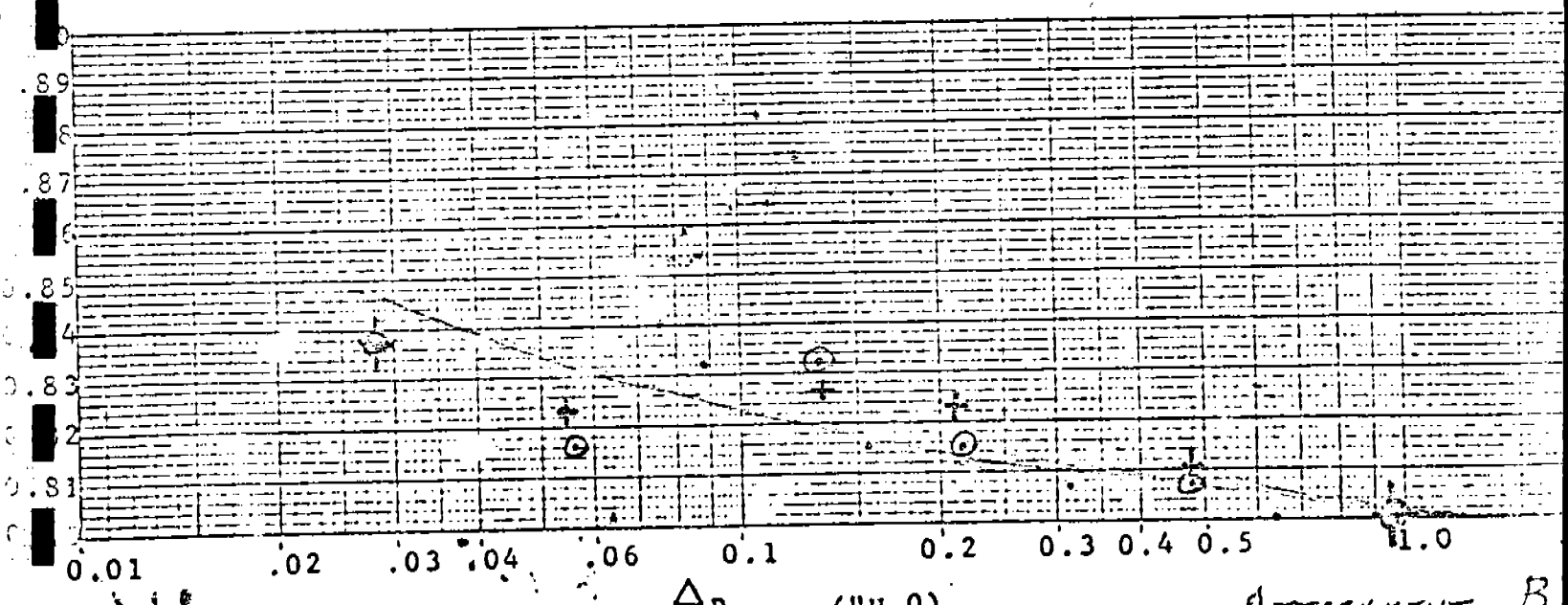
STANDARD PITOT TUBE NO. _____

CALIBRATED BY: STC-6GMS

12/12/74

ORIENT: ⊙ Ptot Annul +

P_{std}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptest}	ΔP_{std}	ΔP_{test}	C_{ptes}
.02	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.04	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.06	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.08	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.10	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.12	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.16	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.20	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.30	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.50	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
0.70	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___
.80	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___	0.___



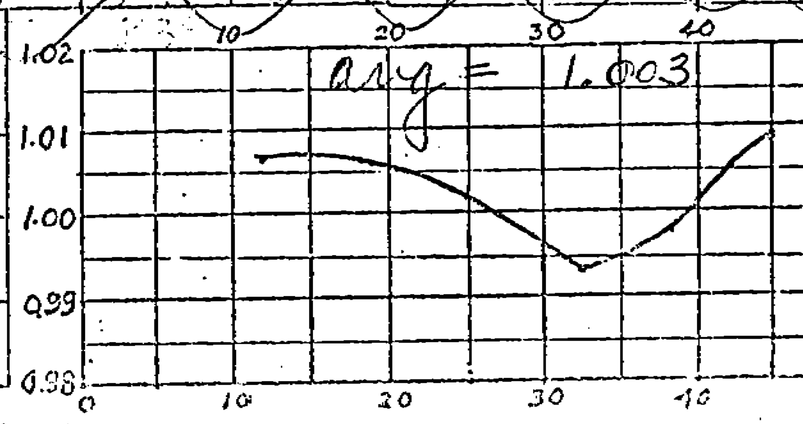
ATTACHMENT B

[redacted]

DATE	11/12/74	GAS METER NO.	[illegible]
BAROMETRIC PRESSURE	29.15 "Hg	FLOW METER NO.	
CALIBRATOR	[illegible]	CLIENT	EPA TASK 4 LANCASTER PA.
VACUUM GAGE NO.		TEMP. GAGE NO.	
RIG NO.	[illegible]		

Flowmeter Rate		Gas Volume Test Meter V_w	Gas Volume Field Meter V_d	Time Min θ	Test Meter Temp t_w	Test Meter Vacuum P_w		Field Meter Temp t_d	Field Meter Vacuum P_d	P_d	γ Gas Meter	γ Flow Meter	ΔH@
2% [illegible]	Stop	577.00	572.194	12.7		.001	(81)	[illegible]	77°		1.006	✓	
.5	Start	572.00	567.157	12.40	73	.05		85	75°	0.04			
	Final Avg	5 5.0	5.037										
8%	Stop	[illegible]	[illegible]	9.8		.004	(83)	5[illegible]	77		1.041 [illegible]	[illegible]	[illegible]
.0	Start	[illegible]	[illegible]	9.41	73.4	.05		86°	79°	0.07			
		5 5.0	4.879								1.0606		
5%	Stop	594.00	589.991	13.2		.006	[illegible]	92°	80°		1.065		
.0	Start	584.00	579.960	12.11	73.4	.08		90°	79	0.15			
		10 10	[illegible]										
2%	Stop	605.00	600.755	9.5		.007	(98)	95°	53°		.993	✓	
.0	Start	595.00	590.508	9.29	73.0	.10		93°	51°	0.29			
		10 10	10.247										
88%	Stop	616.00	611.550	7.8		.01	(95)	95°	53°		1.001	0.998	
.0	Start	606.00	601.707	7.50	73.0	.20		94°	52°	0.44			
		10 10	10.142										
5%	Stop	627.00	[illegible]	7.6	7	.02	(90)	97°	[illegible]	[illegible]	.9[illegible]	[illegible]	
.0	Start	617.00	[illegible]	7.38	[illegible]	.21		96					
		10 10	10.[illegible]										

Vacuum Gage Test		Mano. Reading	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0
		Gage Reading								



[redacted] ORC[redacted]YTC[redacted]AND [redacted]SOCIATES [redacted]

ATE T[redacted]

BAROMETRIC PRESSURE _____ "Hg

CALIBRATOR _____

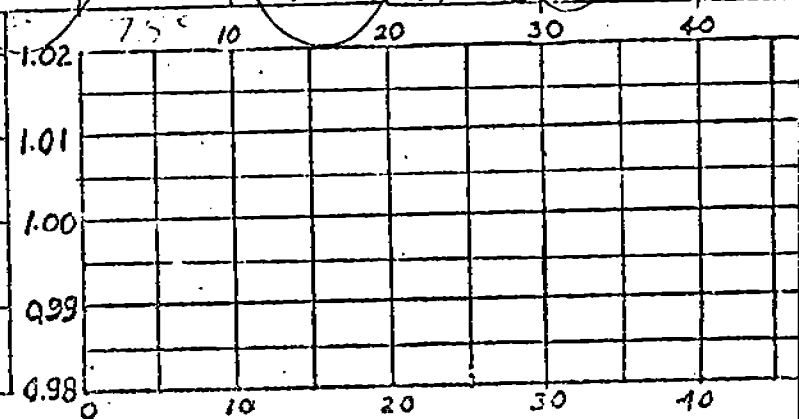
GAS METER NO. _____ VACUUM GAGE NO. _____

FLOW METER NO. _____ TEMP. GAGE NO. _____

CLIENT _____ RIG NO. _____

Flowmeter Rate		Gas Volume Test Meter Vw	Gas Volume Field Meter Vd	Time Min θ	Test Meter Temp tw	Test Meter Vacuum Pw		Field Meter Temp td	Field Meter Vacuum Pd		Gas Meter γ	Flow Meter γ	ΔH@
Vem													
12%	Stop												
ΔH 0.5	Start												
	Final Avg	5		9.2									
18%	Stop	[redacted]	[redacted]	[redacted]		.004	(71)	80	70	71°	.999	1.006	
1.0	Start	[redacted]	[redacted]	[redacted]	70	.05		70°	.5	0.01			
		5 5.0	4.963										
25%	Stop	[redacted]	[redacted]	27 13.2		.004	(78)	88°	13°		1.001	1.002	
2.0	Start	[redacted]	[redacted]	13.14	72	.00		80°	70	0.15			
		10 10.0	10.027										
32%	Stop												
4.0	Start												
		10											
38%	Stop												
6.0	Start												
		10											
45%	Stop	[redacted]	[redacted]			.02	(83)	72°	70	0.59	[redacted]	[redacted]	
8.0	Start	[redacted]	[redacted]	6.54	70.5°	.05		70	75°	10	20	30	40
		10 10.22	9.902										
		10											

Vacuum Gage Test		Mano. Reading	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	
		Gage Reading									



GEORGE D. CLAYTON AND ASSOCIATES

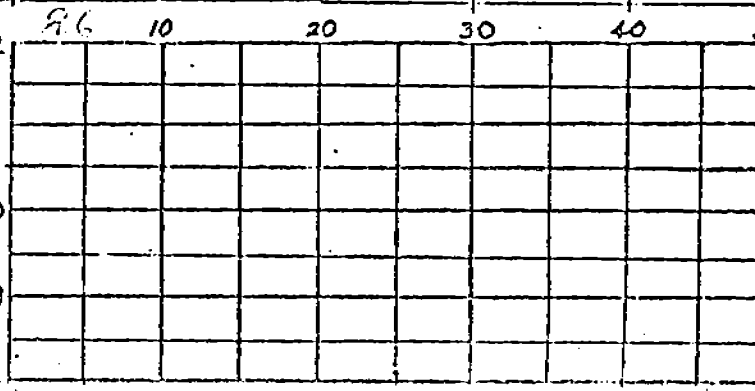
DATE _____ GAS METER NO. _____ VACUUM GAGE NO. _____

BAROMETRIC PRESSURE _____ "Hg FLOW METER NO. _____ TEMP. GAGE NO. _____

CALIBRATOR _____ CLIENT _____ RIG NO. _____

Flowmeter Rate		Gas Volume Test Meter V_w	Gas Volume Field Meter V_d	Time Min θ	Test Meter Temp t_w	Test Meter Vacuum P_w		Field Meter Temp t_d	Field Meter Vacuum P_d		γ Gas Meter	γ Flow Meter	$\Delta H@$
ITEM													
2%	Stop												
.5	Start												
	Final Avg	5											
8%	Stop												
.0	Start												
		5											
5%	Stop												
.0	Start												
		10											
2%	Stop												
.0	Start												
		10											
8%	Stop												
.0	Start												
		10											
5%	Stop	6.068	664.117	6.8		.02	(83)	86	76	.59	1.009		
.0	Start	6.053	654.180	6.47	71°	.21		83					
		10 10.0	9.926										

Vacuum Gage Test		Mano. Reading	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0
		Gage Reading								



$K_m = \frac{SR}{\sqrt{\frac{T_m \Delta m}{P_m G_m}}}$

$G_m = 1$

$\Delta m = \Delta H$

$P_m = P_b + P_w$

$T_m = 460 + t_w$

$SR = \frac{V_w}{MIN}$

RAC 1

11/12/79

$\frac{0.344}{\sqrt{\frac{(533)(0.5)}{(29.15)(1)}}} = 0.13031$

$\frac{0.543}{\sqrt{\frac{(530)(1.0)}{29.15}}} = 0.12734$

$\frac{0.758}{\sqrt{\frac{(532)(2)}{29.15}}} = 0.12546$

$\frac{1.053}{\sqrt{\frac{(533)(4)}{29.14}}} = 0.12311$

$\frac{1.280}{\sqrt{\frac{(533)(6)}{(29.14)}}} = 0.12238$

$\frac{1.471}{\sqrt{\frac{(531)(8)}{29.13}}} = 0.12181$

avg. $K_m = 0.12507$

new factor 1752

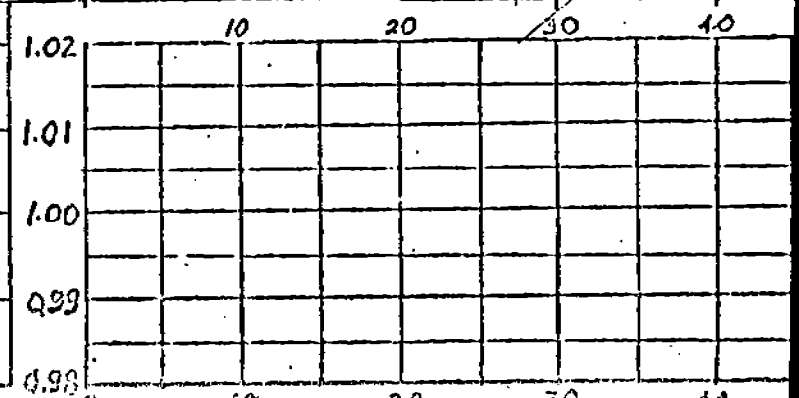
TE 11/25/74 GAS METER NO. #1-RAC VACUUM GAGE NO.

ROMETRIC PRESSURE 29.62 "Hg FLOW METER NO. TEMP. GAGE NO.

LIBRATOR GERALD HAWKINS CLIENT EPA-AFC RIG NO. #1 RAC

owmeter Rate		Gas Volume Test Meter Vm	Gas Volume Field Meter Vd	Time Min θ	Test Meter Temp Tm	Test Meter Vacuum Pm		Field Meter Temp Td	Field Meter Vacuum Pd		Gas Meter γ	Flow Meter γ	ΔH
	Stop	6700.00	977.920	-							1.014		
5	Start	6695.00	973.915	12.38	73°	.02		88°	75"				
	Final Avg	5 5.00	5.065							81.5			
	Stop	6705.00	984.028	-									
1.0	Start	6700.00	978.920	9.06	71	.05		94	80		1.006		
		5 5.04	5.108							87			
	Stop	6715.00	994.130										
2.0	Start	6705.00	984.028	13.04	73°	.06		102°	86°		1.004		
		10 10.00	10.302							94			
	Stop	6725.00	004.705										
3.0	Start	6715.00	994.330	10.73	72°	.08		110°	90°		1.007		
		10 10.00	10.375							100			
	Stop	6735.00	015.090										
4.0	Start	6725.00	004.705	7.88	72°	.12		114°	94		1.006		
		10 10.00	10.385							104			
	Stop	6745.13	025.403										
5.0	Start	6735.00	015.090	6.16	71°	.25		116	96°	105	1.021	1.0	10
		10 10.13	10.318										

Vacuum ge Test		Mano. Reading	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0
		Gage Reading								



RAC Train
11-25-74

K Factors

1	0.13462
2	0.13034
3	0.12783
4	0.12635
5	0.12223
6	0.12280
Avg	0.12736

$$\text{Factor} = \frac{27.40}{(K_m)^2} = \frac{27.40}{(0.12736)^2} = 1689$$

DE 11-15-94

GAS METER NO. MAC #1 — VACUUM GAGE NO.

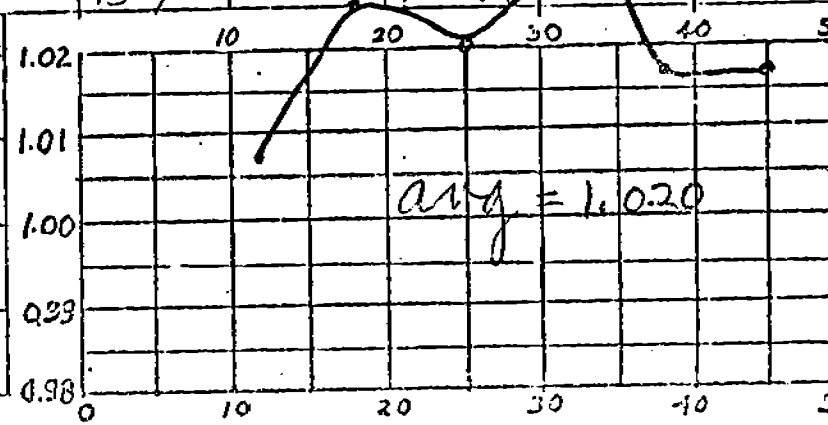
FLOW METER NO. — TEMP. GAGE NO.

BAROMETRIC PRESSURE 29.3 "Hg — CLIENT EPA MASK A. LANKASTER PA — RIG NO. MAC #1

CALIBRATOR CHUCK M. SAUCIER

Flowmeter Rate		Gas Volume Test Meter Vw	Gas Volume Field Meter Vd	Time Min θ	Test Meter Temp tw	Test Meter Vacuum Pw		Field Meter Temp td	Field Meter Vacuum Pd		Gamma Gas Meter	Gamma Flow Meter	ΔH@
.5%	Stop	6324.00	546.18	12.2		.004		71°			1.017		
.5	Start	6319.00	541.23	12.18	71°	.005		71°	.04				
	Final	5.00	4.965										
	Avg 5												
.5%	Stop	6557.00	552.01	8.8		.004		71°			1.025		
.0	Start	6552.00	547.14	9.41	72°	.005		71°	.07				
		5.00	4.858										
	5												
.5%	Stop	6341.00	562.751	12.6		.004		71°			1.026	✓	29.5
.0	Start	6332.00	552.779	12.38	70°	.005		71°	.15				11-16-94
		10.00	9.772										
	10												
2%	Stop	6552.00	573.246	10.2		.006		71°			1.034		
.0	Start	6542.00	563.612	10.11	70.4°	.008		71°	.22				
		10.00	9.634										
	10												
8%	Stop	6363.00	553.774	9.0		.01		71°			1.023	1.017	
.0	Start	6353.00	544.074	9.00	73°	.015		71°	.29				
		10.00	9.700										
	10												
5%	Stop	6374.00	574.316	8.0		.01		71°	.37		1.017		
.0	Start	6364.00	564.645	7.59	73°	.015		71°					
		10.00	9.671										
	10												

Vacuum Gage Test		Mano. Reading	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0
		Gage Reading								



MAC 1
11/15/74

$$\frac{0.410}{\sqrt{\frac{(531)\,0.5}{29.30}}} = 0.13620$$

$$\frac{0.568}{\sqrt{\frac{(532)(1)}{29.30}}} = 0.13330$$

$$\frac{0.794}{\sqrt{\frac{(530)(2)}{29.30}}} = 0.13201$$

$$\frac{0.980}{\sqrt{\frac{(530)(3)}{29.29}}} = 0.13301$$

$$\frac{1.111}{\sqrt{\frac{(533)(4)}{29.29}}} = 0.13022$$

$$\frac{1.250}{\sqrt{\frac{(533)(5)}{29.29}}} = 0.13105$$

avg. $K_m = 0.13263$

New factor = 1558

Nov. 25. 1978

PRESSURE 29.62 IN

GAS METER NO. [redacted] VACUUM GAGE NO.

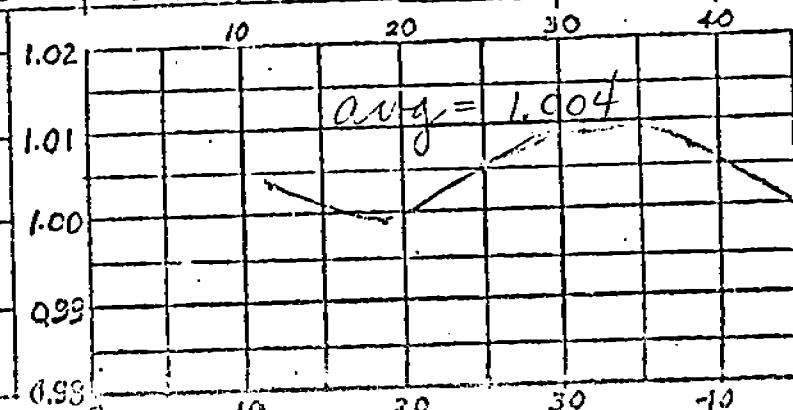
FLOW METER NO. TEMP. GAGE NO.

CLIENT RIG NO. [redacted]

[redacted]

Flowmeter Rate		Gas Volume Test Meter V_m	Gas Volume Field Meter V_f	Time Min θ	Test Meter Temp t_m	Test Meter Vacuum P_M		Field Meter Temp t_d	Field Meter Vacuum P_d		Gas Meter	Flow Meter	$\Delta H_@$
%	Stop	665.000	789.465	-		.002					1.004		
5	Start	664.500	784.500	12.50	76	.03		75°	.01				
	Final Avg	5.00 / 5	4.965										
8%	Stop	6655.00	794.465	-		.001					0.999		
.0	Start	665.0.00	789.465	8.90	75°	.05		76°	.07				
		5.00 / 5	5.000										
5%	Stop	6665.00	804.365			.006					1.005		
.0	Start	6655.00	794.165	12.58	76°	.08		76°	0.15				
		10.00 / 10	9.900										
2%	Stop	6675.00	814.252			.001					1.009		
.0	Start	6665.00	804.365	10.09	75°	.12		79°	0.22				
		10.00 / 10	9.887										
8%	Stop	6685.00	824.160			.01					1.007		
.0	Start	6675.00	814.252	9.00	74°	.15		78°	0.29				
		10.00 / 10	9.908										
5%	Stop	6695.00	834.165			.01		80°	0.37		1.000		
.0	Start	6685.00	824.160	8.09	73°	.18							
		10.00 / 10	10.005										

Vacuum Gage Test									
	Mano. Reading	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0
	Gage Reading								



11/25/74

$$\frac{5/12.5}{\sqrt{\frac{526 \cdot 0.5}{29.62}}} = 0.13298$$

$$\frac{5/8.9}{\sqrt{\frac{535}{29.62}}} = 0.13219$$

$$\frac{10/12.58}{\sqrt{\frac{536(2)}{29.61}}} = 0.13211$$

$$\frac{10/10.09}{\sqrt{\frac{535(3)}{29.61}}} = 0.13461$$

$$\frac{10/9}{\sqrt{\frac{535(4)}{29.61}}} = 0.13082$$

$$\frac{10/9.09}{\sqrt{\frac{535(4)}{29.61}}} = 0.13029$$

$\bar{w}_y = 0.13217$

1569 new factor

[illegible]E 11-[illegible]-74

[illegible]OMETRIC PRESSURE 29.5 "Hg

[illegible]IBRATOR [illegible] M. SANTELLA

GAS METER NO. [illegible] 2

FLOW METER NO.

CLIENT EPA TASK #4 [illegible]

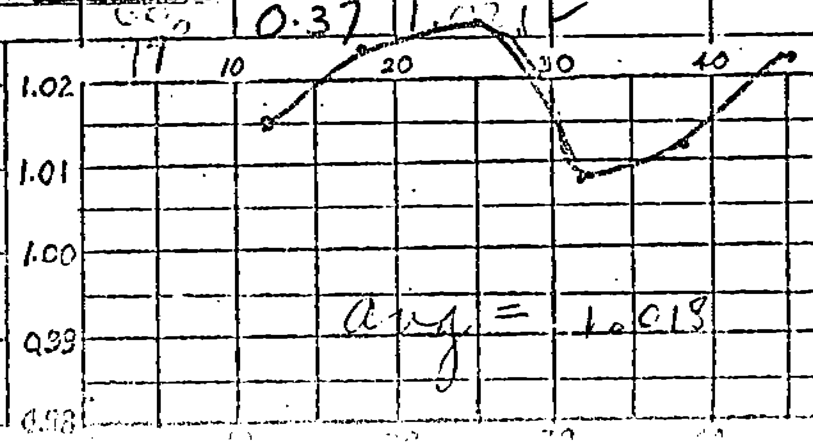
VACUUM GAGE NO.

TEMP. GAGE NO.

RIG NO. [illegible] #2

[illegible]meter Rate		Gas Volume Test Meter V_w	Gas Volume Field Meter V_d	Time Min θ	Test Meter Temp t_w	Test Meter Vacuum P_w		Field Meter Temp t_d	Field Meter Vacuum P_d	P_d	γ Gas Meter	γ Flow Meter	ΔH@
	Stop	[illegible]	507.[illegible]	11.[illegible]	72	.004	58	[illegible]	[illegible]	0.09	1.015		
	Start	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]				
	Final Avg	5 [illegible]	4.790										
	Stop	[illegible]	[illegible]	10.4	73	.005	[illegible]	[illegible]	[illegible]		[illegible]	1.023	
	Start	[illegible]	508.[illegible]	[illegible]	[illegible]	.01		[illegible]	54°	0.07			
		5 6.[illegible]	5.760										
	Stop	[illegible]	[illegible]	12.6	73	.007	70	72°	72°		1.027		
	Start	[illegible]	[illegible]	[illegible]	[illegible]	.09		[illegible]	[illegible]	0.15			
		10 10.[illegible]	9.8[illegible]										
	Stop	[illegible]	[illegible]	15.2		.009	[illegible]	73	66		1.008	✓	
	Start	[illegible]	[illegible]	15.[illegible]	72	.12		[illegible]	[illegible]	0.22			
		10 15.[illegible]	14.661										
	Stop	[illegible]	557.9[illegible]	11.8	72	.01	72	73°	77°		1.012		
	Start	[illegible]	[illegible]	11.4[illegible]	[illegible]	.15		73	66°	0.29			
		10 [illegible]	11.335										
	Stop	[illegible]	[illegible]	8.6		.01		74	[illegible]	0.37	1.0[illegible]	✓	
	Start	[illegible]	[illegible]	8.[illegible]	[illegible]	.15	73	7[illegible]	77				
		10 10.5[illegible]	10.188										

[illegible]acuum [illegible]e Test		Mano. Reading	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0
		Gage Reading								



Avg = 1.018

MAC 2
11/18/74

$$\frac{0.420}{\sqrt{\frac{(532)(0.5)}{29.50}}} = 0.13987$$

$$\frac{0.577}{\sqrt{\frac{(533)(1)}{29.50}}} = 0.13574$$

$$\frac{0.810}{\sqrt{\frac{(533)(2)}{29.49}}} = 0.13472$$

$$\frac{0.987}{\sqrt{\frac{532(3)}{29.49}}} = 0.13416$$

$$\frac{1.017}{\sqrt{\frac{(532)(4)}{29.49}}} = 0.11972$$

$$\frac{1.221}{\sqrt{\frac{(531)(5)}{29.49}}} = 0.12868$$

avg K_m = 0.13215

new factor = 1569

[redacted] Barometric Pressure Pb ("Hg) 27.83 [redacted] Orifice [redacted] Gas [redacted]

	Orifice Manometer Setting, Δm (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_{di} (°F)	Temperature: Dry Gas Meter Outlet t_{do} (°F)	Temperature: Dry Gas Meter Average t_d (°F)	Vacuum Wet Test Meter P_w (in. H_2O)	Time θ (min) 100 cf nominal	γ	K_m
Start	0.5	7215.00	407.700	91°	81°	70°	75.5	.05			
Stop		7220.00	412.775		83°	72°				0.976	0.13153
Average		(5) 5.00	5.075		82	71			12.52		
Start	1.0	7220.00	412.775	79°	84°	72°		.05			
Stop		7225.00	417.863		84°	72°				0.978	0.12991
Average		(5) 5.00	5.088				78		8.98		
Start	2.0	7225.00	417.863	77°	84°	74°		.08			
Stop		7235.00	428.070							0.975	0.12900
Average		(10) 10.00	10.207				79	[illegible]	12.81		
Start	3.0	7235.00	428.070	78°	89°	74°		.10			
Stop		7245.00	438.282							0.978	0.12839
Average		(10) 10.00	10.212				81.5	[illegible]	10.50		
Start	4.0	7245.00	438.282	76°	92°	76°		.12			
Stop		7255.00	448.512							0.980	0.12782
Average		(10) 10.00	10.230				84	[illegible]	9.15		
Start	5.0	7255.00	448.512	78°	96°	78°		.17			
Stop		7265.00	458.743							0.981	0.12734
Average		(10) 10.00	10.231				87	0.01	8.20		
									AVERAGE	0.979	0.12900

$$P_w = P_b - \frac{P_w}{13.6} \qquad P_d = P_b + \frac{\Delta m}{13.6} \qquad K_m = \frac{V_w}{\theta}\sqrt{\frac{P_w}{T_w \Delta m}}$$

$$\gamma = \frac{V_w P_w (t_d + 460)}{V_d P_d (t_w + 460)}$$

Factor in isokinetic equation $= \frac{27.40}{(K_m)^2} = \frac{27.40}{(0.12900)^2} =$ 1647

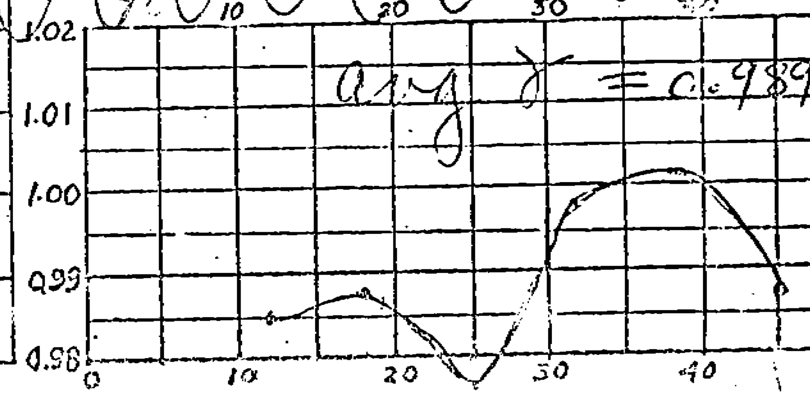
G.D. Clayton & Associates

GAS METER NO. [illegible] VACUUM GAGE NO.
FLOW METER NO. TEMP. GAGE NO.
CLIENT RIG NO. [illegible]

PRESSURE [illegible] "Hg

Flowmeter Rate		Gas Volume Test Meter V_w	Gas Volume Field Meter V_d	Time Min θ	Test Meter Temp t_m	Test Meter Vacuum P_m		Field Meter Temp t_d	Field Meter Vacuum P_d	Pd	γ Gas Meter	γ Flow Meter	ΔH@
2%	Stop	[illegible]	[illegible]			.004		[illegible]	[illegible]		.986	0.985	
ΔH .5	Start	[illegible]	[illegible]	11.0	70	.05		[illegible]	[illegible]	.04			
	Final Avg	5 5.00	5.022					65					
8%	Stop	[illegible]	[illegible]		70	.004		[illegible]	[illegible]		.988	0.988	
.0	Start	[illegible]	[illegible]	3.25	[illegible]	.05		[illegible]	[illegible]	.07			
		5 5.00	5.0					65					
5%	Stop	[illegible]	398.77		72	.004		66	66		.9752	0.975	
.0	Start	[illegible]	[illegible] 69	11.57	[illegible]	.06		[illegible]	[illegible]	.15			
		10 10.0	10.08					66					
2%	Stop	[illegible]	[illegible]		72	.007		67	67		1.000	0.998	✓
.0	Start	[illegible]	399.70	11.42	[illegible]	.10		66	66	0.22			
		10 10	11.71					66					
8%	Stop	6163	[illegible]			.009		67	67		1.000	1.001	
.0	Start	[illegible]	[illegible]	12.1	71	.12		67	67	0.29			
		10 14.3	14.041					67					
5%	Stop	[illegible]	[illegible]			.009				0.37	.957	X [illegible] .957	
.0	Start	[illegible]	[illegible]	[illegible]	71	[illegible]		70					
		10 [illegible]	11.4										

Vacuum Gage Test	Mano. Reading	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0
	Gage Reading								



GAS METER NO. _____ VACUUM GAGE NO. _____

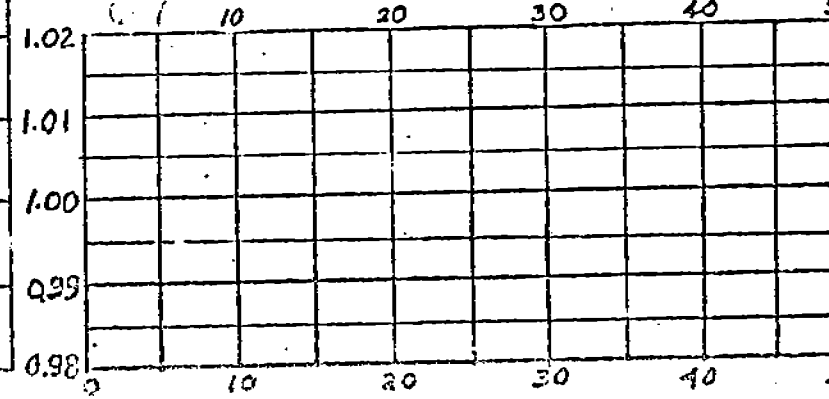
FLOW METER NO. _____ TEMP. GAGE NO. _____

ROMETRIC PRESSURE _____ "Hg CLIENT _____ RIG NO. _____

LIBRATOR _____

owmeter Rate		Gas Volume Test Meter	Gas Volume Field Meter	Time Min	Test Meter Temp	Test Meter Vacuum		Field Meter Temp	Field Meter Vacuum		γ Gas Meter	γ Flow Meter	$\Delta H@$
m		V_w	V_d	θ	t_w	P_w		t_d	P_d				
2%	Stop												
5	Start												
	Final Avg	5											
3%	Stop												
.0	Start												
		5											
5%	Stop												
.0	Start												
		10											
2%	Stop												
.0	Start												
		10											
8%	Stop												
.0	Start												
		10											
5%	Stop	illegible	illegible			.01							
5.0	Start	illegible	illegible	1735	71°	.15							
		10	9.941										

Vacuum age Test		Mano. Reading	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0
		Gage Reading								



MAC 3
11/14/74

$$\frac{0.427}{\sqrt{\frac{(530)0.5}{29.25}}} = 0.14186$$

$$\frac{0.595}{\sqrt{\frac{(530)(1)}{29.25}}} = 0.13978$$

$$\frac{0.840}{\sqrt{\frac{(530)(2)}{29.25}}} = 0.13927$$

$$\frac{1.026}{\sqrt{\frac{(532)(3)}{29.24}}} = 0.13887$$

$$\frac{1.172}{\sqrt{\frac{(531)(4)}{29.24}}} = 0.13751$$

$$\frac{1.316}{\sqrt{\frac{(531)(5)}{29.24}}} = 0.13811$$

avg. $K_n = 0.13923$

new factor = 1414

Barometric Pressure [redacted] "Hg [redacted] Calibration [redacted] Gas Meter Number [redacted]

	Orifice Manometer Setting, Δm (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_{di} (°F)	Temperature: Dry Gas Meter Outlet t_{do} (°F)	Temperature: Dry Gas Meter Average t_d (°F)	Vacuum Wet Test Meter p_w (in. H_2O)	Time θ (min)	γ	K_m
Start	0.5	7365.00	093.000	73°	78°	76°		.03			
Stop		7370.00	097.177							0.972	0.14479
Average		(5) 5.00	5.177				77		11:45		
Start	1.0	7370.00	097.677	73°	77°	75°		.05			
Stop		7375.00	102.333							0.973	0.14176
Average		(5) 5.00	5.156				76		8.27		
Start	2.0	7375.00	102.333	74°	78°	76°		.08			
Stop		7385.00	112.570							0.977	0.14011
Average		(10) 10.00	10.237				77		11.82		
Start	3.0	7385.00	112.570	74°	76°	76°		.10			
Stop		7395.00	122.780							0.976	0.13854
Average		(10) 10.00	[illegible]				76		9.76		
Start	4.0	7395.00	122.780	73°	80	76		.15			
Stop		7405.00	132.960							0.981	0.13953
Average		(10) 10.00	10.18				78		8.47		
Start	5.0	7405.00	132.960	73°	83°	76°		.15			
Stop		7416.00	144.196							0.978	0.13779
Average		(10) 11.00	11.236				79.5		8.37		
									AVERAGE	0.976	0.14022

$$P_w = P_b - \frac{p_w}{13.6} \qquad P_d = P_b + \frac{\Delta m}{13.6} \qquad K_m = \frac{V_w}{\theta}\sqrt{\frac{P_w}{T_w \Delta m}}$$

$$\gamma = \frac{V_w P_w (t_d + 460)}{V_d P_d (t_w + 460)}$$

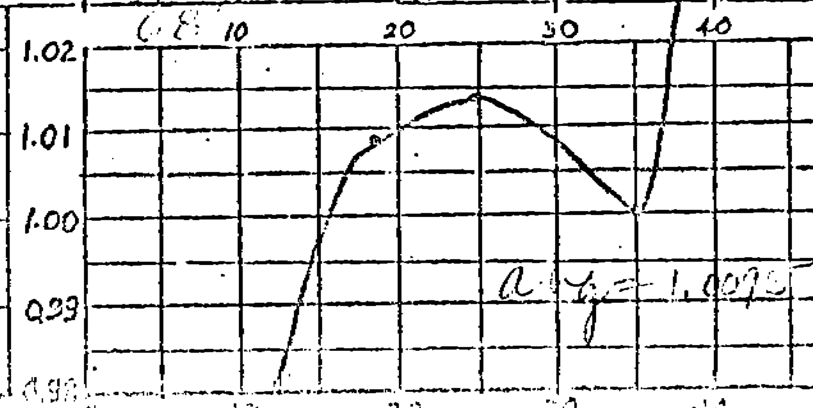
Factor in isokinetic equation $= \frac{27.40}{(\overline{K_m})^2} = \frac{27.40}{(\quad)^2} =$ 1394

GAS METER NO. [illegible]
FLOW METER NO.
CLIENT EPA [illegible]
VACUUM GAGE NO.
TEMP. GAGE NO.
RIG NO. [illegible]

BAROMETRIC PRESSURE 29.5 "Hg
CALIBRATOR [illegible] M. [illegible]

Meter Rate		Gas Volume Test Meter V_w	Gas Volume Field Meter V_d	Time Min	Test Meter Temp t_w	Test Meter Vacuum P_w		Field Meter Temp t_d	Field Meter Vacuum P_d	Pd	γ Gas Meter	γ Flow Meter	ΔH@
	Stop	[illegible]	[illegible]	[illegible]	72	.004	62	[illegible]	[illegible]		.981		
	Start	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	0.09			
	Final Avg	5 [illegible]	4.978										
	Stop	[illegible]	[illegible]	9.6	72	.004	64	[illegible]	64°		1.009		
	Start	[illegible]	114.1[illegible]	9.39		[illegible]		[illegible]	[illegible]	0.07			
		5 5.4	5.260										
	Stop	[illegible]	[illegible]	12.[illegible]	71	.007	66	67°	66°		1.018		
	Start	[illegible]	[illegible]	[illegible]		.10		[illegible]	64°	0.15			
		10 [illegible]	9.72[illegible]										
	Stop	[illegible]	[illegible]	11.8		.007	67	66°	67°		~~[illegible]~~	1.000	
	Start	[illegible]	[illegible]	[illegible]	71°	.10		[illegible]	66°	0.22			
		10 10.24	10.038										
	Stop	[illegible]	[illegible]	11.9	70	.009	68	68°	67°		1.027		
	Start	[illegible]	[illegible]	11.56		.10		[illegible]	67	0.29			
		10 10.19	11.072										
	Stop	[illegible]	[illegible]	9.8		.01	68	[illegible]	[illegible]	0.37	1.027		
	Start	[illegible]	[illegible]	[illegible]	[illegible]	.16		[illegible]	68				
		10 [illegible]	9.578										

Vacuum Gage Test		Mano. Reading	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0
		Gage Reading								



MAC4
11/18/74

$$\frac{0.407}{\sqrt{\frac{532(0.5)}{29.5}}} = 0.13554$$

$$\frac{0.562}{\sqrt{\frac{532(1)}{29.5}}} = 0.13234$$

$$\frac{0.800}{\sqrt{\frac{531(2)}{29.49}}} = 0.13331$$

$$\frac{0.868}{\sqrt{\frac{(531)(3)}{29.49}}} = 0.11810$$

$$\frac{1.021}{\sqrt{\frac{530(4)}{29.49}}} = 0.12042$$

$$\frac{1.020}{\sqrt{\frac{530(5)}{29.49}}} = 0.10760$$

avg Km = 0.12455

new factor = 1766

Barometric Pressure Pb [redacted] Hg [redacted]

	Orifice Manometer Setting, Δm (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_{di} (°F)	Temperature: Dry Gas Meter Outlet t_{do} (°F)	Temperature: Dry Gas Meter Average t_d (°F)	Vacuum Wet Test Meter p_w (in. H_2O)	Time θ (min)	γ	K_m
Start	0.5	7116.00	469 [illegible]	74	70	65		.05	15.22	0.994	1723
Stop		7121.00	474 70	74	71	70		.02			
Average		(5) 5.00	4.955								
Start	1.0	7122.00	475.[illegible]	74	73	76		.05	9.47	0.994	1771
Stop		7127.00	480 [illegible]	73	76	71		.05			
Average		(5) 5.00	5.[illegible]								
Start	2.0	7136.00	491 210	73	80	74		.05	13.60	0.994	1824
Stop		7146.00	501 904	73	84	76		.05			
Average		(10) 10.00	10.[illegible]								
Start	3.0	7149.00	503 [illegible]	73	83	76		0.10	11.28	0.996	1886
Stop		7159.00	513 [illegible]	74	86	78		0.10			
Average		(10) 10.00	10.[illegible]								
Start	4.0	7160.00	514.[illegible]	74	85	78		0.11	9.85	0.994	1870
Stop		7170.00	524.[illegible]	73	89	74		0.11			
Average		(10) 10.00	10.[illegible]								
Start	5.0	7186.00	550.554	73	85	82		0.11	9.57	0.991	1950
Stop		7196.00	560 743	73	91	83		0.11			
Average		(10) 10.00	10.189								
								AVERAGE		0.994	1841

$$P_w = P_b - \frac{P_w}{13.6} \qquad P_d = P_b + \frac{\Delta m}{13.6} \qquad K_m = \frac{V_w}{\theta}\sqrt{\frac{P_w}{T_w \Delta m}}$$

$$\gamma = \frac{V_w P_w (t_d + 460)}{V_d P_d (t_w + 460)}$$

Factor in isokinetic equation = $\frac{27.40}{(\bar{K}_m)^2} = \frac{27.40}{(\quad)^2} =$

E. [illegible]

ONETRIC PRESSURE [illegible] "Hg

IBRATOR [illegible] M. S[illegible]

GAS METER NO. [illegible]

FLOW METER NO.

CLIENT [illegible]

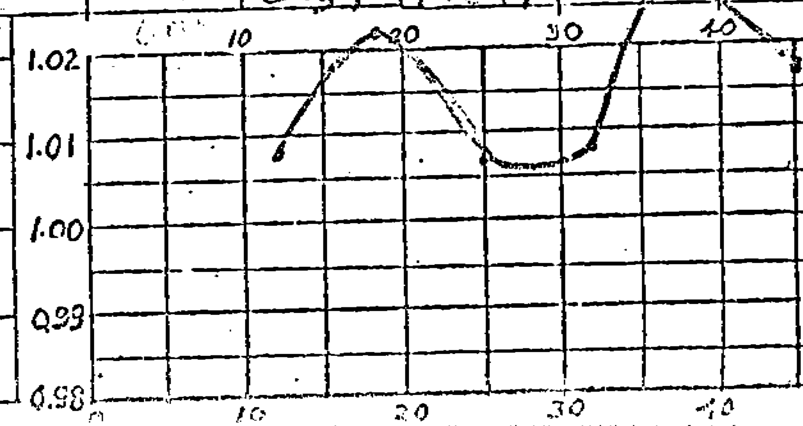
VACUUM GAGE NO.

TEMP. GAGE NO.

RIG NO. [illegible]

wmeter Rate		Gas Volume Test Meter V_w	Gas Volume Field Meter V_d	Time Min	Test Meter Temp t_w	Test Meter Vacuum P_w		Field Meter Temp t_d	Field Meter Vacuum P_d	Pd	γ Gas Meter	γ Flow Meter	ΔH@
%	Stop	[illegible]	[illegible]	9.1		.009	100	[illegible]	[illegible]	0.04	1.008	✓	
5	Start	[illegible]	[illegible]	7.6	71	[illegible]		[illegible]	[illegible]				
	Final Avg	5 5.00	4.851										
%	Stop	[illegible]	471.510	6.5		.007	101	[illegible]	[illegible]	0.07	1.022		
0	Start	[illegible]	471.261	[illegible]	72.8	.10		[illegible]	[illegible]				
		5 6.5	6.257										
%	Stop	[illegible]	500.321	9.6		.007	109	[illegible]	[illegible]	0.15	1.007	✓	
0	Start	[illegible]	490.5[illegible]	4.39	71	.10		[illegible]	[illegible]				
		10 10.00	9.789										
%	Stop	[illegible]	511.641	8.6		.01	108	[illegible]	[illegible]	0.22	1.005	✓	
0	Start	[illegible]	501.312	8.34	73	.15		[illegible]	[illegible]				
		10 10.60	10.333										
%	Stop	[illegible]	[illegible]	9.8		.01	109	[illegible]	[illegible]	0.29	1.028		
0	Start	[illegible]	51[illegible]	9.51	72	.16		[illegible]	[illegible]				
		10 14.00	13.402										
5%	Stop	[illegible]	541.[illegible]	9.8		.01	70	[illegible]	[illegible]	0.27	1.017		
0	Start	[illegible]	526.[illegible]	9.45	72	[illegible]		[illegible]	[illegible]				
		10 15.31	14.805										

Vacuum Gage Test									
	Mano. Reading	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0
	Gage Reading								



MACS
11/18/74

$$\frac{0.704}{\sqrt{\frac{(531)0.5}{29.5}}} = 0.23467$$

$$\frac{1.000}{\sqrt{\frac{532(1)}{29.49}}} = 0.23544$$

$$\frac{1.042}{\sqrt{\frac{532(2)}{29.49}}} = 0.17364$$

$$\frac{1.233}{\sqrt{\frac{532(5)}{29.49}}} = 0.16745$$

$$\frac{1.429}{\sqrt{\frac{532(8)}{29.49}}} = 0.16822$$

$$\frac{1.562}{\sqrt{\frac{532(5)}{29.49}}} = 0.16447$$

avg Km = 0.19065

new factor = 754

APPENDIX G

EXAMPLE CALCULATIONS

NOMENCLATURE

γ = Dry gas meter correction factor, dimensionless

V_m = Volume of dry gas at meter conditions, ft^3

P_b = Barometric pressure, inches mercury

P_m = Average orifice pressure drop, inches water

T_m = Average meter temperature, °F

$V_{m_{std}}$ = Volume of dry gas at standard conditions, DSCF

$V_{w_{gas}}$ = Volume of water vapor at standard conditions, SCF

V_w = Total condensate collected in sampling train, ml

M_d = Mole fraction of dry gas, g/g-mole

MW_d = Molecular weight of dry stack gas

MW = Molecular weight of wet stack gas

V_s = Stack gas velocity at stack conditions, fpm

C_p = Pitot tube correction factor, dimensionless

ΔP_s = Velocity pressure, inches water

T_s = Stack temperature, °F

P_s = Absolute stack gas pressure, inches mercury

P_{st} = Static pressure of stack gas, inches mercury

Q_s = Dry stack gas flowrate at standard conditions, DSCFM

A_s = Stack area, $inches^2$

T_t = Net time of test, minutes

D_n = Sampling nozzle diameter, inches

C_f = Front half (probe & filter) particulate concentration, gr/DSCF

C_t = Total particulate concentration, gr/DSCF

SW_f = Front half sample weight, mg

SW_t = Total Sample weight, mg

ER_f = Emission rate of front half particulate, lbs/hr

ER_t = Emission rate of total particulate, lbs/hr.

%M = Percent moisture, dimensionless

CONVERSION FACTORS

mg/DNm^3 = 2288 * gr/DSCF

kg/hr = 0.4536 * lbs/hr

kg/Mton of feed = 0.500 * lb/ton of feed

The dry volume of sampled gas corrected to standard conditions of 20°C and at 760 mm Hg (29.92 in.Hg) is calculated as follows:

$$V_{m_{std}} = \frac{17.65 * V_m * \gamma * \left(P_b + \frac{P_m}{13.6}\right)}{T_m + 460}$$

For the first particulate test on Outlet A at the J.M. Brenner Company,

$$V_{m_{std}} = \frac{17.65\ (54.240)(1.006)\left(29.78 + \frac{0.67}{13.6}\right)}{(74 + 460)}$$

$$= 53.80$$

The dry stack gas flowrate corrected to standard conditions is calculated using the following set of equations sequentially.

$$V_{w_{gas}} = 0.0471 * V_w$$

$$\% M = \frac{100 * V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}}$$

$$M_d = \frac{100 - \%M}{100}$$

$$MW = (MW_d * M_d) + 18(1 - M_d)$$

$$P_s = P_b + P_{st}$$

$$V_s = 5121 * C_p * \sqrt{\Delta P_s * (T_s + 460)} * \sqrt{\frac{1}{P_s * MW}}$$

$$Q_s = \frac{0.123 * V_s * A_s * M_d * P_s}{(T_s + 460)}$$

Since the process at the J. M. Brenner Company emits essentially air, a dry stack gas molecular weight of 29 was assumed. The calculations for determining the flowrate for particulate test 1 on Outlet A, a 16" x 13-1/4" stack, follow:

$$V_{w_{gas}} = 0.0474\ (11.5)$$

$$= 0.545$$

$$\% M = \frac{100 * 0.545}{53.80 + 0.545}$$

$$= 1.00$$

$$M_d = \frac{100 - 1.0}{100}$$

$$= 0.99$$

$$MW = (29 * 0.99) + 18(1 - 0.99)$$

$$= 28.89$$

$$P_s = 29.78 - 0.14$$

$$= 29.64$$

$$V_s = 5121 * 0.820 * 34.76 * \sqrt{\frac{1}{29.64 * 28.89}}$$

$$= 4988$$

$$Q_s = \frac{0.123 * 4988 * 212 * 0.99 * 29.64}{(66 + 460)}$$

$$= 7260$$

The equation employed to determine percent of isokinetic variation is:

$$\% I = \frac{1032 * (T_s + 460) * V_{m_{std}}}{V_s * T_t * P_s * M_d * (D_n)^2} .$$

For the first particulate test done on Outlet A at the J. M. Brenner Company,

$$\% I = \frac{1032 * (66 + 460) * 53.80}{4988 * 120 * 29.64 * 0.99 * (0.125)^2}$$

$$= 106.4.$$

To determine the concentration of particulate matter in grains per dry standard cubic foot (gr/DSCF), one of the following equations is used:

$$C_f = 0.01543 * \frac{SW_f}{V_{m_{std}}} \quad \text{or}$$

$$C_t = 0.01543 * \frac{SW_t}{V_{m_{std}}} .$$

Front half particulate concentrations are obtained by summing the weight of particulate matter collected on the filter and all portions of the train preceeding it. Total particulate concentration includes, in addition, any particulate matter collected in the impinger water. (The impingers were not washed with acetone.)

At the J. M. Brenner Company the first particulate test on Outlet A yielded the following concentrations of filterable and total particulate:

$$C_f = 0.01543 * \frac{10.3}{53.80}$$

$$= 0.00295$$

$$C_t = 0.01543 * \frac{24.3}{53.80}$$

$$= 0.00697$$

The emission rate of particulate matter can be calculated from the filterable or total particulate concentration using one of the following equations:

$$ER_f = 0.00857 * C_f * Q_s \quad \text{or}$$

$$ER_t = 0.00857 * C_t * Q_s .$$

To avoid rounding errors it is preferable to carry out the calculation of concentration and emission rate in one operation.

The emission rates of front half and total particulate matter for the first test on Outlet A at the J. M. Brenner Company are calculated as follows:

$$ER_f = 0.00857 * 0.00295 * 7260$$

$$= 0.18$$

$$ER_t = 0.00857 * 0.00697 * 7260$$

$$= 0.43.$$

APPENDIX H

AUXILIARY SOURCE TESTING INFORMATION

SAMPLE IDENTIFICATION
Task 6
U.S. EPA Contract No. 68-02-1408

EPA Number	Description
S-74-000-144	11-19 Distilled water blank
S-74-000-145	11-19 Filter blank
S-74-000-146	11-19 Acetone blank
S-74-000-147	11-19 Silica gel blank
S-74-000-148	B P-1 Water
S-74-000-149	B P-1 Silica gel
S-74-000-150	A P-1 Filter
S-74-000-151	B P-1 Filter
S-74-000-152	A P-1 Water
S-74-000-153	A P-1 Silica gel
S-74-000-154	B P-1 Acetone
S-74-000-155	A P-1 Acetone
S-74-000-156	11-21 Filter blank
S-74-000-157	A P-2 Filter
S-74-000-158	B P-2 Filter
S-74-000-159	C P-2 Filter
S-74-000-160	D P-2 Filter
S-74-000-161	E P-2 Filter
S-74-000-162	11-21 Distilled water blank
S-74-000-163	11-21 Acetone blank
S-74-000-164	A P-2 Acetone
S-74-000-165	A P-2 Water
S-74-000-166	B P-2 Acetone
S-74-000-167	B P-2 Water
S-74-000-168	C P-2 Acetone
S-74-000-169	C P-2 Water
S-74-000-170	D P-2 Acetone
S-74-000-171	D P-2 Water
S-74-000-172	E P-2 Acetone
S-74-000-173	E P-2 Water
S-74-000-174	11-22 Acetone blank
S-74-000-175	11-22 Distilled water blank
S-74-000-176	A P-3 Acetone
S-74-000-177	A P-3 Water
S-74-000-178	B P-3 Acetone
S-74-000-179	B P-3 Water
S-74-000-180	C P-3 Acetone
S-74-000-181	C P-3 Water
S-74-000-182	D P-3 Acetone
S-74-000-183	D P-3 Water
S-74-000-184	E P-3 Acetone
S-74-000-185	E P-3 Water

H. REEVE ANGEL & CO., Incorporated
9 BRIDEWELL PLACE, CLIFTON, NEW JERSEY 07014
Area Code 201 777-4825

reeve angel

December 4, 1974

Mr. Richard Powals
CLAYTON & ASSOCIATES
25711 Southfield Road
Southfield, Michigan 48075

Dear Mr. Powals:

It was a pleasure speaking with you on November 27th concerning our glass fiber papers, in particular, Reeve Angel grade 900AF.

As per your request, I am sending to you a copy of our "specification-information" sheet. I hope this piece of literature is helpful to you.

If you should have any further questions, please feel free to call on me at your convenience. Thank you for your interest in our products.

Sincerely yours,

Salvatore J. Averso
Technical Manager

SJA:atm

Enclosure

REEVE ANGEL GRADE

900AF

TECHNICAL DATA*

Caliper	14 mils
Dry Tensile MD (lbs/inch of width)	2.0 lbs
Water-repellent	No
Resistance	35 mm
DOP Efficiency	99.97%

* Typical values unless otherwise specified

PRODUCT FEATURES

- Binder-less glass media is low in metallic contaminants, high in purity levels.
- Specifically designed for air pollution control devices.
- Assures precise and accurate analysis of atmospheric conditions.
- May also be used inside industrial and institutional buildings.
- Available in sheet form.

TEST CRITERIA

Resistance - measures the resistance which a 100 square centimeter sample of paper offers to air at a constant flow velocity of 10.5 feet per minute (32 liters per minute). This measurement is in mm of water pressure drop at 32 liters per minute.

DOP Penetration - the measurement of the percentage of penetration of smoke having an average particle size of 0.3 microns at a concentration of 100 micrograms per liter of air. This smoke is passed through a paper sample of 100 square centimeters area at a flow velocity of 10.5 feet per minute (32 liters per minute). The number reported above is DOP efficiency (100% - % DOP penetration).

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

A. GENE GAZLAY, Director

September 23, 1974

Mr. Richard Powals
George D. Clayton & Associates
25711 Southfield Road
Southfield, Michigan 48075

Dear Mr. Powals:

Please be advised that you have successfully completed the requirements of the Michigan Air Pollution Control Commission's Rule 336.43(2) for visible emission evaluation in Michigan. As of August 20, 1974 you met the following qualifications:

(1) Completed a staff sponsored class and field instruction in visible emissions evaluation, or its equivalent.

(2) Completed 400 smoke plume readings of which 200 were white and 200 were black.

(3) Maintained an average deviation from the correct reading of less than 7.5% for a set of 25 white and 25 black readings.

(4) Had no errors of 20% or more for the set of 25 white and 25 black readings.

This certification is valid for one year from the above date. Enclosed is a copy of your qualifying form.

Sincerely yours,

Stephan K. Byrd

Stephan K. Byrd
Air Quality Investigator
Technical Services Section

SKB:ed

Enclosure

MICHIGAN
THE GREAT LAKES STATE

4/74

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

AIR POLLUTION CONTROL DIVISION

VISIBLE EMISSIONS TRAINING FORM

Observer RICHARD POWALS Affiliation CLAYTON & ASSOC. Date 8-20-74

Speed 0 - 5 mph Direction FROM S Sky Condition CLEAR & BLUE Time 1015

Observers Position _____ Corrected By [illegible]

Record Black and/or White Smoke in Percent Opacity (for example: 5 percent smallest division)

RUN NO. 1-W

Observer Reading	Transmissometer Reading	+ Deviation	− Deviation
0	10		
10	25		5
35	30		
35	45		10
35	40		5
35	50		5
35	45		10
35	35		10
35	25	10	
20	15	5	
15	15		
40	40		

Reading No.	Observer Reading	Transmissometer Reading	+ Deviation	− Deviation
13	60	50	10	
14	40	75		5
15	75	40		5
16	55	50		
17	20	10	10	
18	25	15	10	
19	35	30	10	
20	60	50	10	
21	25	15	10	
22	45	35	10	
23	50	40	10	
24	35	30	5	
25	15	10	5	

55

RUN NO. 1-B

Reading No.	Observer Reading	Transmissometer Reading	+ Deviation	− Deviation
1	20	20		
2	35	25	10	
3	45	30	10	
4	50	40	10	
5	40	30		10
6	55	60		5
7	45	30		5
8	40	40		5
9	40	45		5
10	30	25		5
11	25	25		
12	20	20		

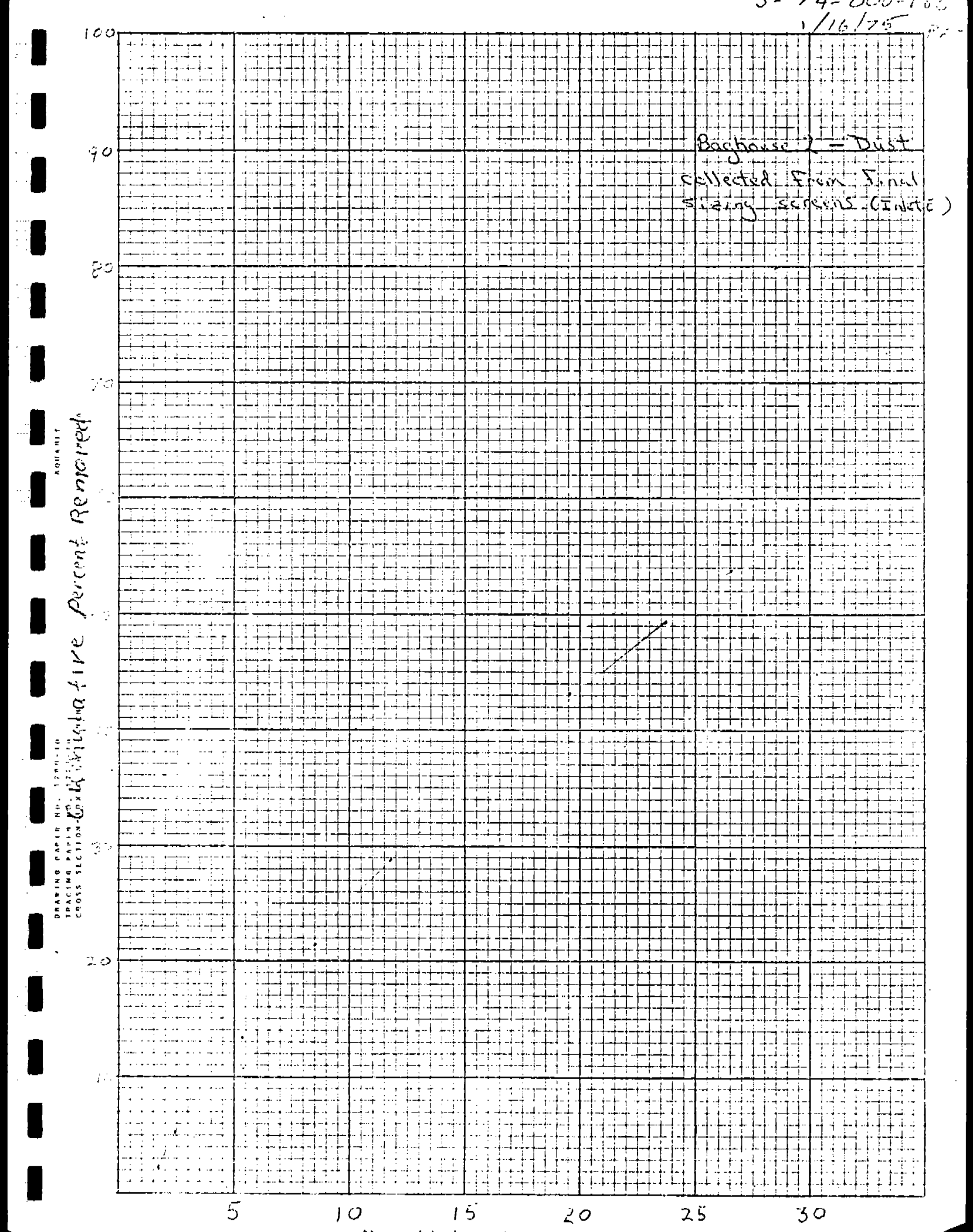
Reading No.	Observer Reading	Transmissometer Reading	+ Deviation	− Deviation
13	35	25		
14	30	25		5
15	35	40		5
16	50	45	5	
17	40	30		10
18	30	25	5	
19	25	30		5
20	40	40		
21	45	40		5
22	35	35		
23	30	30		
24	20	20		
25	10	10		

	1W	1B
1. Run Number		
2. Number Correct	5	9
3. Number of Plus Deviations	12	5
4. Number of Minus Deviations	8	11
5. Average Plus Deviations = Sum of Plus Deviations / No. of Plus Deviations	105/12	
6. Average Minus Deviations = Sum of Minus Deviations / No. of Minus Deviations		
7. Average Deviation = (Sum of Plus Deviations) + (Sum of Minus Deviations) / Total No. of Readings	265/50	
Tot	5.3	
	0	

APPENDIX I

PARTICLE SIZING DATA

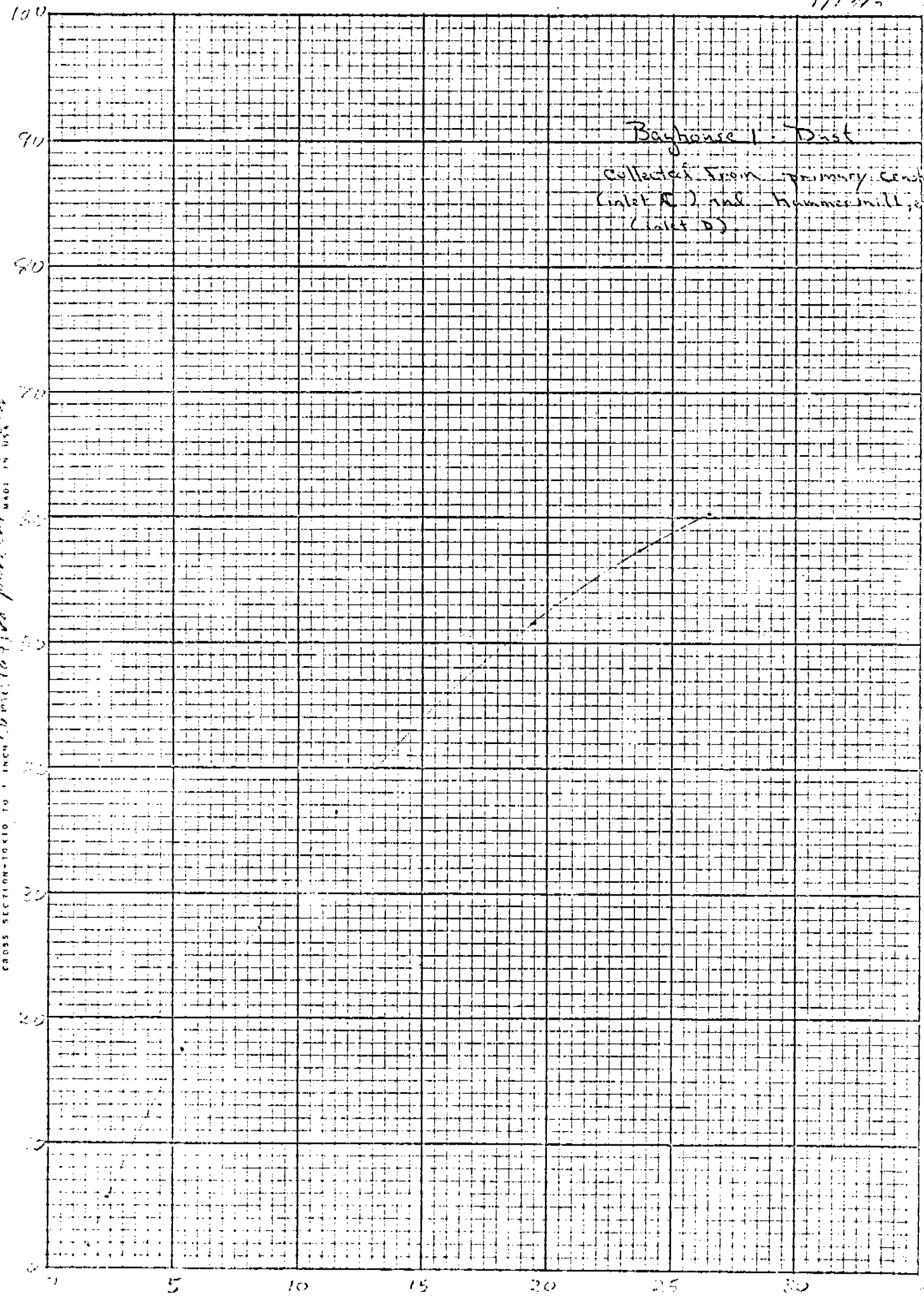
3-74-000-103
1/16/75



1/1 3/5

Baghouse 1 - Dust

collected from primary crusher (inlet A) and hammermill, etc. (inlet B)



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