Commonwealth of Pennsylvania
Environmental Resources
June 2, 1986

Subject: Stack Test Review

To: Data File
Hastings Pavement Company, Inc.
Leesport, Berks County

From: Jaydeb Pal JP
Air Pollution Control Engineer
Division of Technical Services and Monitoring
Bureau of Air Quality Control

Through: Chief, Source Testing and Monitoring Section

Hastings Pavement Company, Inc. operates a Barber Greene asphalt plant rated at 57 tons per hour at the aforementioned location. The dusts generated in the dryer and at the screens and elevator are drawn through a Barber Greene baghouse and discharged to the atmosphere through a 32 inch inside diameter stack having an exit point 36.5 feet above grade. The product (aggregate and asphalt mix) is discharged to two presses to form blocks of different sizes.

Four particulate test runs were performed by J.A.C.A. Corporation in the baghouse exhaust stack to determine compliance with the NSPS. The second test run was discarded because of several process upsets which occurred during the run. The remaining three test runs were performed according to the Departmental requirements and are acceptable to the Department. The isokinetic sampling rates for the last two test runs were slightly higher than the allowable limit which means the reported emission rates are biased low for these two test runs. However, this would not have much impact on the representability of the test results, since the test results are well below the allowable emission limit. During the testing, both presses were operating and producing blocks of 6 inch by 12 inch by 2 inch and 5 inch by 12 inch by 2 inch sizes.

The following data was extracted from the test report:

Test Date	4/14/86	4/15/86	4/15/86
Test run no.	1	3	4
Process rated capacity (tons/hr.)	57	57	57
Process normal operating rate (tons/hr.)	25	25	25
Process rate during test (tons/hr.)	28.3	28.3	28.3
Percent passing through 200 mesh	4.3	3.8	4.0
Volumetric flow rate (dscfm)	5,417	5,345	5,122
Particulate emission concentration (gr./dscf)	0.022	0.018	0.019
Particulate emission rate (lb./hr.)	1.03	0.82	0.82
Allowable particulate emission concentration (gr./dscf) (per NSPS)	0.04	0.04	0.04
Opacity readings > 20%	0	0	0

Attachment

cc: Phillip Bedein, Region I, Norristown
File 06-303-017
EPA/RSL
Reading File
Doug Lesher

JPslc

PARTICULATE EMISSION TESTING

OF THE

HASTINGS PAVEMENT ASPHALT PLANT

LEESPORT, PENNSYLVANIA

Prepared for:

Hastings Pavement
Leesport, Pennsylvania

Prepared by:

JACA Corporation
550 Pinetown Road
Fort Washington, Pennsylvania 19034

May 1986

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Introduction

Particulate emission tests and visible emissions observations were conducted by JACA Corp. on April 14 and 15, 1986 at the baghouse exhaust stack of the asphalt plant at Hastings Pavement in Leesport, Pennsylvania. Particulate testing was conducted in accordance with EPA Reference Methods 1 through 5 and PADER methods. Visible emissions observations were conducted in accordance with EPA Reference Method 9 by an observer certified in the use of EPA Reference Method 9.

A velocity traverse and two test runs were conducted on April 14th. A velocity traverse and two additional test runs were conducted on April 15th. The second test run conducted on April 14th was discarded because of several process upsets which occured during the test run.

Summary of Results

The emissions testing program was conducted to determine whether the asphalt plant was in compliance with New Source Performance Standards Subpart I - Standards of Performance for Asphalt Concrete Plants (§60.92) and PADER Regulations §123.13 and §123.41. Table 1 contains a summary of the emission test results as determined by this testing program. As shown on the table, all three test runs are well below the federal and state allowable emission limitations for particulate matter and visible emissions.

It should be noted that the isokinetic rates were slightly greater then 110 percent for the last two test runs. The problem was traced to the delta H gauge which was reading appoximately 10 percent high (based on pre

Table 1

SUMMARY OF HASTINGS PAVEMENT ASPHALT PLANT (LEESPORT, PA)
BAGHOUSE EXHAUST PARTICULATE EMISSION TESTING
APRIL 1986

	Run Number[a]			
	1	3	4	Average
Test Date	4/14/86	4/15/86	4/15/86	-
Stack Temperature, °F	177.8	179.9	182.3	-
Stack Gas Velocity, fpm	1244	1249	1222	-
Stack Gas Flow Rate,				
acfm	6954	6982	6831	-
dscfm	5417	5345	5122	-
Percent Moisture, %	5.94	7.01	8.57	-
Dry Gas Volume Sampled, dscf	54.05	55.28	53.64	-
Total Sample Duration, min.	72	72	72	-
Isokinetic Factor, %	110	114[b]	116[b]	-
Particulate Matter Collected,				
EPA Method 5, grams	0.0760	0.0625	0.0621	-
PADER Method, grams	0.0779	0.0643	0.0647	-
Particulate Concentration				
EPA Method 5, gr/dscf	0.0217	0.0174	0.0179	
PADER Method, gr/dscf	0.0222	0.0180	0.0186	
Emission Rate				
EPA Method 5, lb/hr	1.01	0.80	0.79	
PADER Method, lb/hr	1.03	0.82	0.82	
Allowable Particulate Emissions				
EPA (NSPS), gr/dscf	0.04	0.04	0.04	-
PADER (§123.13), lb/hr	6.57	6.57	6.57	
Opacity				
No. Readings ≥ 20%	0	0	0	-
No. 6 min averages ≥ 20%	0	0	0	-
Allowable Opacity				
EPA (NSPS)	Cannot exhibit 20% opacity or greater.			
PADER (§123.41)	No more than 3 min. ≥ 20% opacity, no readings ≥ 60%.			

a Run 2 discarded due to several process upsets
b See text page 1.

and post-test calibrations). As the results are well below allowable emission limitations, this should have very little impact on the sampling results.

Process Description

The Leesport facility is a Barber Greene asphalt plant with baghouse control system. The facility produces pressed asphalt blocks.

Figure 1 is a process flow diagram for the production of asphalt concrete blocks at the plant. Aggregate is loaded into cold feed bins which drop material onto an inclined conveyor which feeds a rotary dryer. The dryer is equipped with a 22 million Btu per hour burner which operates on natural gas. From the dryer, the aggregate drops into a bucket elevator and is elevated to the top of the mill where the dried aggregate is screened and separated into bins. Aggregate is metered from the bins into a mixer and mixed with asphalt cement. The asphalt concrete is then discharged to presses which form the asphalt into blocks. There are two presses at the plant.

Dust control is provided by a baghouse. The major dust pickup is at the dryer with secondary pickups located at the bucket elevator and screens.

During the test, the plant operated at a constant rate of 320 kilograms per minute of aggregate plus 90 kilograms per minute of fines recycle material and 18 kilograms per minute of asphalt. During the testing, both presses were operating producing blocks of 6 by 12 by 2 inches and 5 by 12 by 2 inches. The production rate was monitored by company personnel. Table 2 shows the sieve analysis for aggregate feed samples collected during each test run.

FIGURE 1

Process Flow Diagram

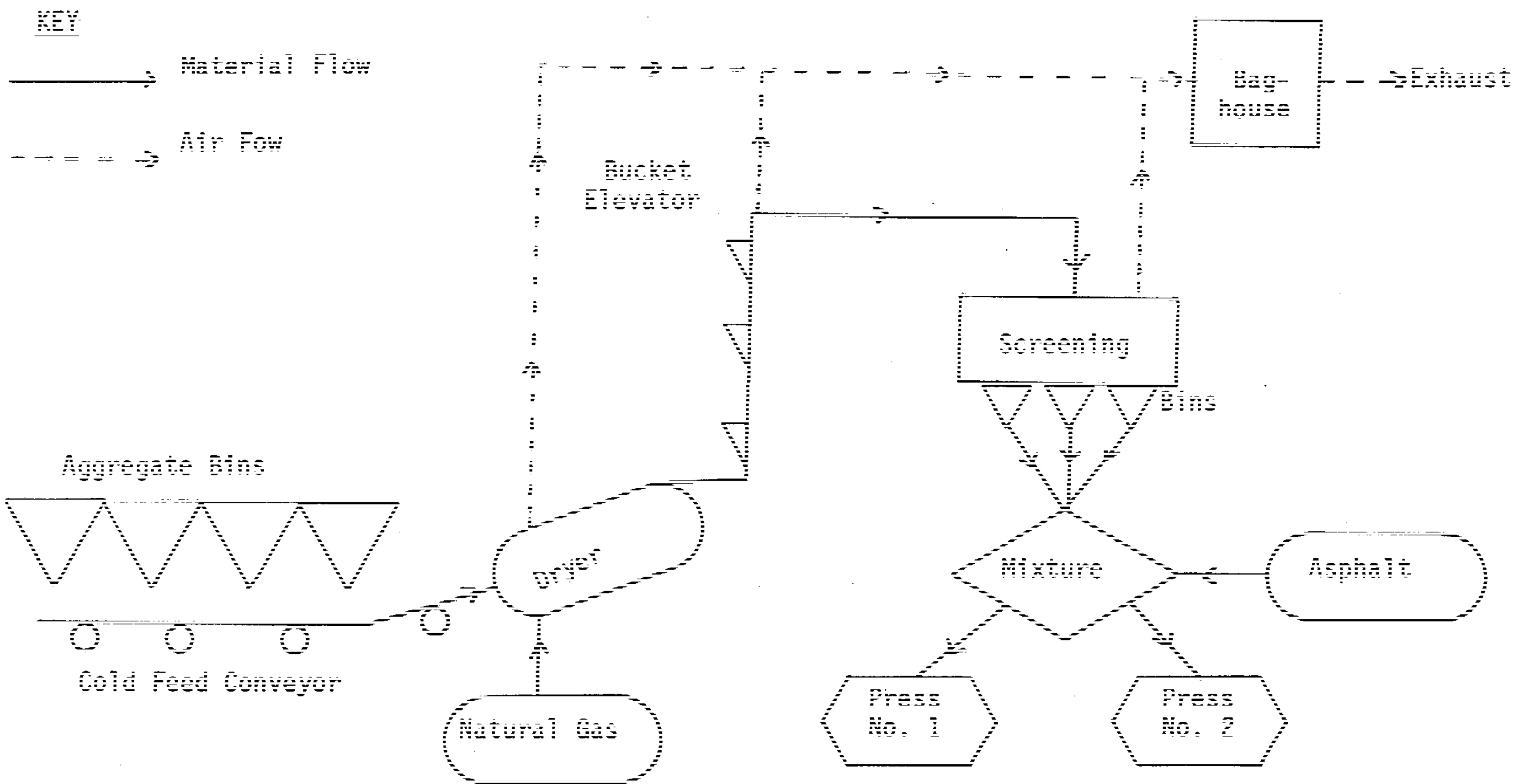


Table 2

SIEVE ANALYSIS FOR SAMPLES COLLECTED DURING STACK TESTING
HASTINGS PAVEMENT ASPHALT PLANT --
APRIL 1986

	Run Number -- Percent by Weight Passing		
Sieve	1	3	4
200 mesh	4.3	3.8	4.0
100 mesh	6	6	6
50 mesh	10	8	8
30 mesh	15	13	12
16 mesh	25	21	20
8 mesh	44	38	39
4 mesh	73	63	65
3/8 in.	91	87	88
1/2 in.	99	99	100
3/4 in.	100	100	100

Location of Sampling Points

Two three-inch ports were installed in the 32-inch diameter stack at a 90 degree angle from each other. The ports are located 39 inches from the top of the stack and approximately 15 feet from the nearest flow disturbance upstream of the ports. Figure 2 shows the location of the sampling ports. Figure 3 shows the location of the sampling points in the stack.

Prior to the first particulate test run, JACA performed an initial velocity traverse and conducted a check for cyclonic flow. The velocity traverse showed a fairly even velocity across the stack. Cyclonic flow of the stack gases was within tolerable limits.

Sampling and Analytical Procedures

The sampling and analytical procedures are essentially the same as those specified by EPA Reference Methods 2, 3, and 5. These methods (as well as Methods 1, 4, and 9) are included in Appendix A. In addition, the impinger catch and back half glassware water wash was filtered for insoluble particulate matter using a 0.22 micron filter.

The following minor modifications were made to the sampling procedures required by PADER:

o A field check of the metering system was not performed due to the errors in the Q and CF equations of Figure 3 in the PADER "Source Testing Manual", January, 1983 as per a May 18, 1983 telephone conversation with Larry Sawyer.

FIGURE 2

LOCATION OF SAMPLING PORTS

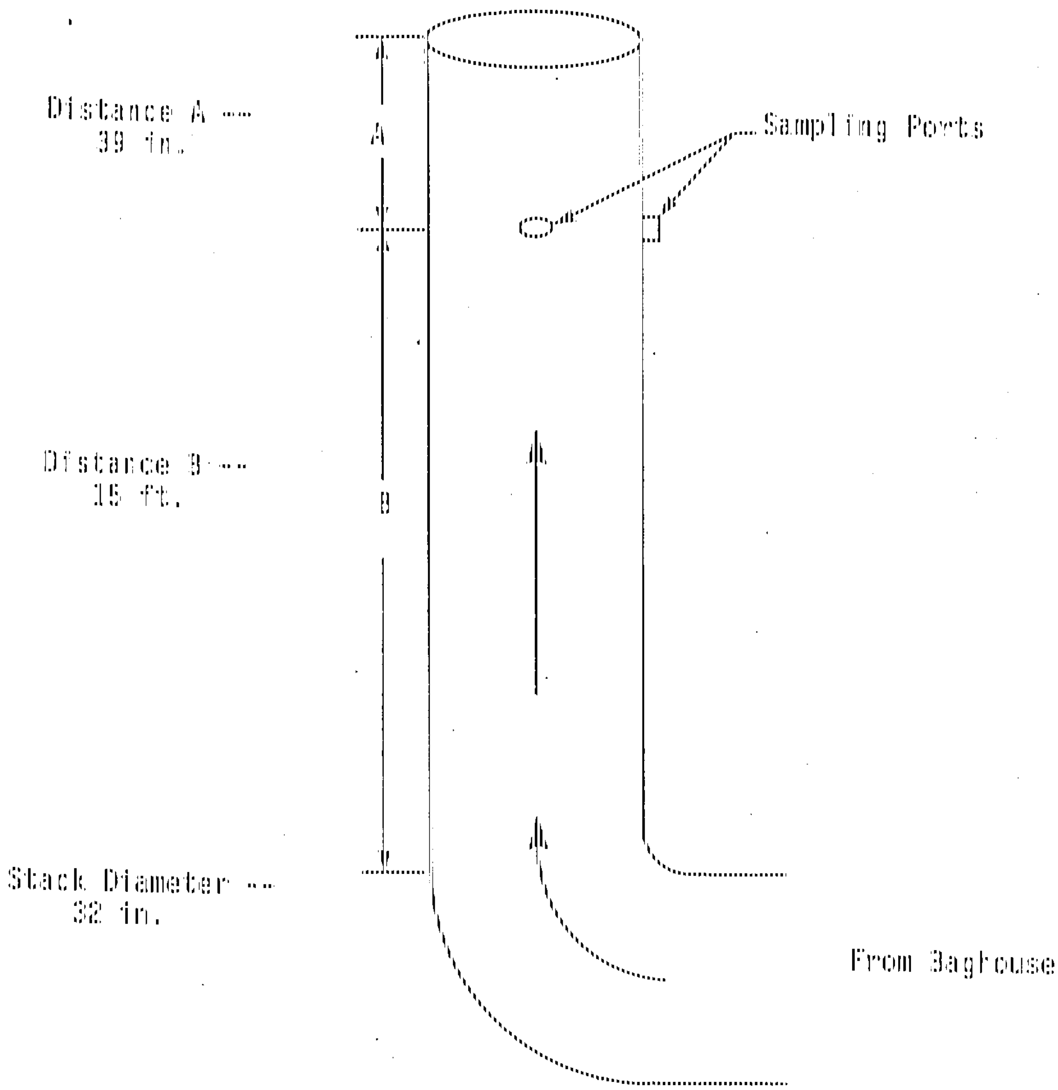
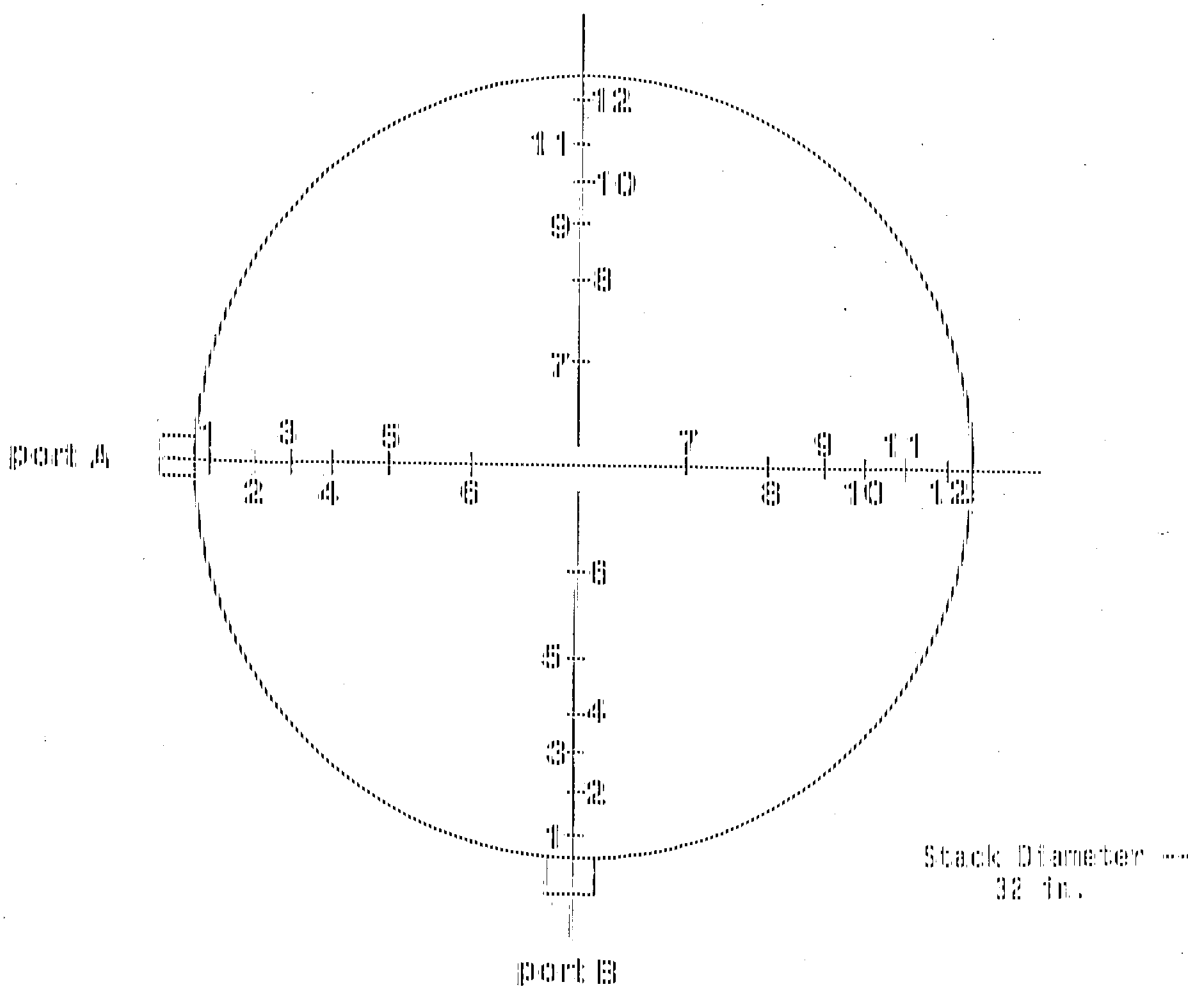


FIGURE 3

LOCATION OF SAMPLING POINTS



Location of Points from Stack Wall (inches):

1--1.0, 2--2.1, 3--3.8, 4--5.7, 5--8.0, 6--11.4, 7--20.6, 8--24.0, 9--26.3, 10--28.2, 11--29.9, 12--31.0

o The sampling train was not purged with air for 20 minutes due to the limited amount of time available for testing.

A Lace, Inc. Model 31 Stack Stampler was used for the sampling. The particulate sampling procedure as outlined in Method 5, "Determination of Particulate Emissions from Stationary Sources", consists of drawing a sample isokinetically from the stack through a heated glass probe (maintained at 248 ± 25°F) into a filter and impinger train. The filter was housed in a heated box maintained at 248 ± 25°F. Filters used in these tests were Whatman products (Reeve Angel brand), Grace 934-AH. These are glass fiber filters with a characteristic DOP penetration with 0.3um diameter smoke particles of 0.022 percent. A cyclone was not used for these tests. The sample volume was measured with a dry gas meter, and isokinetic conditions are maintained by monitoring the stack gas velocity with an "S" type pitot tube and maintaining the optimum sampling rate as indicated by the pressure drop across the orifice meter in the sampling box. A nomograph was used to quickly determine the desired isokinetic setting. Figure 4 shows the sampling train schematic.

After sampling was completed the probe was disconnected from the hot box and both ends of the probe were sealed for transport to the laboratory or cleaned using distilled water and acetone washes with a long-handled brush. Since the same nozzle was used for all test runs, the nozzle was washed, using a brush, with water and acetone after each test run. The probe and nozzle clean-up were the only portion of the analysis done in the field. Additionally, the impingers were removed from the cold box and sealed for transport to the laboratory. After completing a test run the sampling train was readied for the next run using an alternate set of impingers and filter paper, and filter holder.

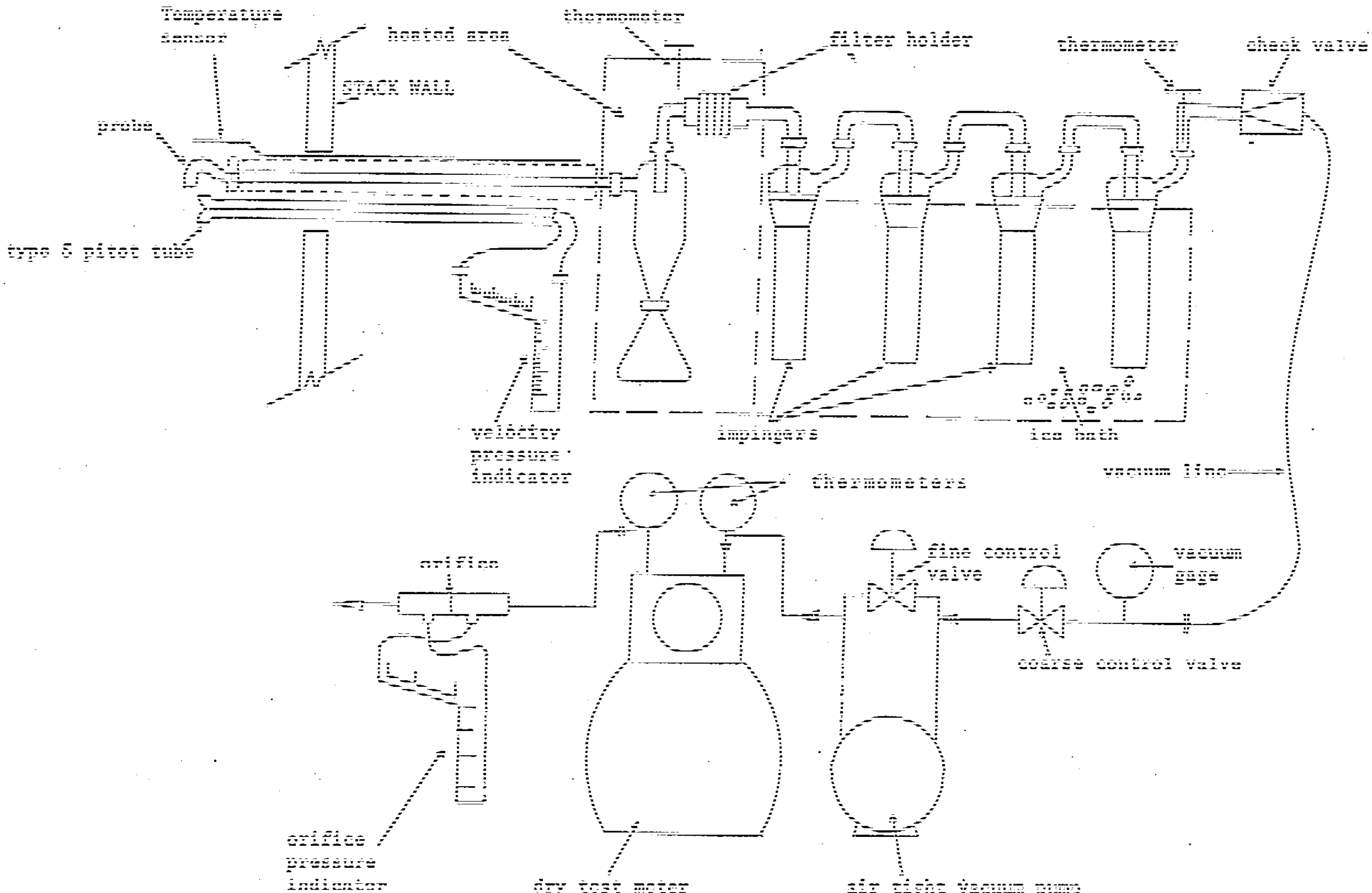


FIGURE 4 Schematic of Stack Sampling Train

In the laboratory, components of the sampling train were thoroughly washed with water and acetone, including the front and back half glassware. The water washings were filtered (0.22 micron filter) and then both water and acetone washes were evaporated, dried and weighed. The quantity of water that collected in the impinger train was also measured, which, when combined with the increase of silica gel weight yielded the moisture content of the stack gas. The impinger water was then analyzed for insoluble particulate using a 0.22 micron filter.

A grab sample of the stack gases was collected on each day of testing. The air samples were analyzed for nitrogen, oxygen, carbon monoxide, and carbon dioxide using a gas chromatograph equipped with a flame ionization detector.

Using both the weight of the particulate sample collected and the measured volume and flow rate, particulate concentrations and emission rates are calculated for each test run. It should be noted that all particulate masses except those collected on the filter, were corrected according to the mass of contaminants ("blank") found in the laboratory reagents, i.e., acetone and water.

Appendix B includes stack sampling field data from which the particulate concentrations were calculated. Sample calculations for the first test run are shown in Appendix C. Also shown in Appendix C are computer printouts of the input data and results for runs 1, 3, and 4.

Detailed laboratory procedure is described in Appendix D. Also, the pre-test and post-test laboratory sheets are contained in Appendix D.

Instrument Calibration

Equipment was calibrated prior to testing and, when specified by EPA Reference 5, after testing. Calibration procedures and results will be supplied upon request.

Visible Emissions Observations

Visible emissions readings were taken during the testing by an observer certified in EPA Reference Method 9. The observations were conducted entirely within the requirements of EPA Method 9, that is, sur within a 140° sector of the observer's back, observation angle approximately perpendicular to the direction of the plume, readings of percent opacity made every 15 seconds, and the observation point distance at least twice the stack height. The observer's watch was syrchronized with the stack testing group prior to the test to coordinate testing start and stop times.

A total of 383 minutes of opacity observations were recorded. There were no opacity readings greater than or equal to 20 percent opacity; the maximum opacity reading was 5 percent. The visible emissions sheets are included in Appendix E.

APPENDIX A

EPA METHODS 1 THROUGH 5 AND 9

APPENDIX B

STACK SAMPLING FIELD DATA SHEETS

Data Used For Setting Nomograph

12 traverse points/ diameter

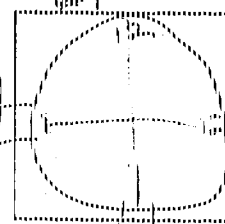
PLANT Hastings Pavement
DATE 4/17/86
RUN NO. Velocity 1
STACK DIAMETER, in. 32 in (Conversion)
BAROMETRIC PRESSURE, in. Hg
STATIC PRESSURE IN STACK (P_s), in. Hg
OPERATORS MP/GL

Plus Extension

T_s 172 °F

T_{amb} = 110 °F

B



SCHEMATIC OF STACK CROSS SECTION

A

= 30.01 in Hg

static +0.1 in H_2O

Estimated moisture 6.6%

9:15

	Loc	4 in + 7 ext
1		
2	2.14	
3	3.78	7.78
4	5.66	11.66
5	8	14
6	11.34	17.4
7	20.66	26.66
8	24	30
9	26.34	32.3
10	28.22	34.2
11	29.86	35.9
12	31.3 3/16	37

Magnahelic

Traverse point number	Velocity head, in. H_2O	$\sqrt{\Delta}$ Magnehelic	Stack Temperature (T_s), °F
A-1	0.1	0.17	85
A-2	0.15	0.16	85
A-3	0.15	0.17	85
A-4	0.15	0.19	85
A-5	0.15	0.17	85
A-6	0.15	0.16	90
A-7	0.1	0.15	90
A-8	0.1	0.15	90
A-9	0.1	0.14	90
A-10	0.05	0.12	90
A-11	0.05	0.12	65
A-12	0.75	0.13	65
B-1	0.1	0.15	90
B-2	0.1	0.16	90
B-3	0.15	0.16	90
B-4	0.15	0.16	90
B-5	0.1	0.13	90
B-6	0.1	0.12	90
B-7	0.1	0.14	90
B-8	0.15	0.16	90
B-9	0.15	0.12	90
B-10	0.1 AVERAGE	0.13	90
B-11	0.1	0.13	90
B-12	0.1	0.14	90

1.73

1.71

$\overline{\Delta P} = \frac{1.73 + 1.71}{24}$

= 0.14

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Data Used For Setting Nomograph

PLANT Hastings Pavement

DATE 4/15/86

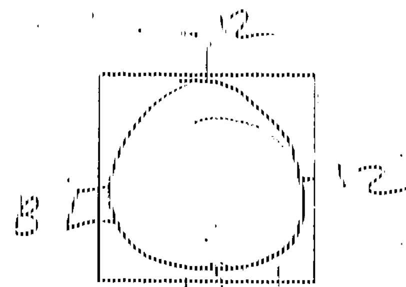
RUN NO. Velocity 2

STACK DIAMETER, in. 32

BAROMETRIC PRESSURE, in. Hg. 758 = 29.84

STATIC PRESSURE IN STACK (P_s), in. Hg. 29.85

OPERATORS MF / GL



SCHEMATIC OF STACK CROSS SECTION

g = 2.0

static = 0.19 in H_2O

Traverse point number	Velocity head, in. H_2O	$\sqrt{\Delta p}$	Stack Temperature (T_s), °F
A-1	0.14		
A-2	0.15		
A-3	0.15		
A-4	0.14		
A-5	0.15		
A-6	0.12		
A-7	0.11		
A-8	0.10		
A-9	0.11		
A-10	0.10		
A-11	0.07		
A-12	0.08		
B-1	0.12		
B-2	0.13		
B-3	0.13		
B-4	0.13		
B-5	0.12		
B-6	0.11		
B-7	0.11		
B-8	0.10		
B-9	0.11		
B-10	0.10 AVERAGE		

B-11 0.10
B-12 0.10

0.18

PARTICULATE FIELD DATA

Hastings Pavement

Ambient Temperature 60 °F
Barometric Pressure 28.92 in.Hg
Assumed Moisture 7 %
Nozzle Diameter 0.361 inches P_s = 0.015 in H_2O
C Factor, Nomograph 1.01
ΔH@ 1.800

Test I.D. Run 1
Run No.
Date 4/19/86
Operator MF/cL

P_s = 28.92 + 0.01 = 28.93 ΔP = 0.14 $T_{s\,avg}$ = 178 $T_{m\,avg}$ = 100 °F Ideal 0.34 use 0.361

Sampling Point	Sampling Time clock	(minutes)	Dry Gas Meter Reading ft^3	Pitot in. H_2O ΔP	Orifice ΔH in. H_2O Desired	Actual	Dry Gas Temp. °F, Tm Inlet	Outlet	Line Vacuum In. Hg. Gauge	Stack Temp. °F	Col Box Temp °F
A-1			695.685	0.1	1.5	1.5	94	77			
A-2	1125	3min	697.7	0.15	2.4	2.4	100	84	5	180	
A-3	1128	6min	700.2	0.15	2.4	2.4	102	83	8	183	
A-4	1131	9min	702.9	0.13	2.0	2.0	104	83	8	180	
A-5	1134	12min	705.4	0.14	2.2	2.2	106	83	7	181	
A-6	1137	15min	708.0	0.14	2.2	2.2	103	83	8	181	
A-7	1140	18min	710.8	0.11	1.7	1.7	107	83	7	183	
A-8	1143	21min	713.4	0.09	1.4	1.4	110	94	6	181	
A-9	1146	24min	715.0	0.08	1.3	1.3	111	84	5	180	
A-10	1149	27min	717.3	0.08	1.3	1.3	112	84	5	180	
A-11	1152	30	719.0	0.08	1.3	1.3	112	85	4	182	
A-12	1155	33	721.0	0.08	1.3	1.3	113	85	4	185	
	1158	36	723.00						4		
B-12	1304		723.00	0.13	2.0	2.0	98	88			
B-11	1307	3min	725.4	0.14	2.2	2.2	98	86	6	180	
B-10	1310	6min	728.0	0.15	2.4	2.4	100	83	7	180	
B-9	1313	9min	730.7	0.13	2.0	2.0	100	82	7	181	
B-8	1316	12	733.2	0.13	2.0	2.0	102	80	7	181	
B-7	1319	15	735.8	0.13	2.0	2.0	102	80	7	183	
B-6	1322	18	738.3	0.13	2.0	2.0	104	80	7	181	
B-5	1325	21	740.9	0.13	2.0	2.0	106	80	7	180	
B-4	1328	24	743.3	0.13	2.0	2.0	106	80	7	178	
B-3	1331	27	745.8	0.12	1.8	1.8	106	80	7	177	
B-2	1334	30	748.2	0.12	1.8	1.8	108	81	7	178	
B-1	1337	33	750.6	0.10	1.5	1.5	108	81	7	178	
	1340	36	753.80						5	178	

10:51 – pre test leak = ok @ 15 in
start side A – 11:02
end side A – 11:38
start side B – 13:04
end side B – 13:40

Net ______ $ft^3 = V_m$

ΔH avg. = in. H_2O
T_m avg. = °F
T_s avg. = °F

PARTICULATE FIELD DATA

Ambient Temperature 75 °F
Barometric Pressure 755mm = in.Hg
Assumed Moisture 7 %
Nozzle Diameter 0.561 inches
C Factor, Nomograph 1.02
ΔH@ 1.600

Test I.D. Run 2
Run No.
Date 4/16/86
Operator MG/GL

$T_{s_{ass}}$ = 175

static = +0.1 in H_2O
ΔP = 0.12

Sampling Point	Sampling Time (minutes)	Dry Gas Meter Reading ft³	Pitot in. H_2O ΔP	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Dry Gas Temp. °F, Tm Inlet	Dry Gas Temp. °F, Tm Outlet	Line Vacuum In. Hg. Gauge	Stack Temp. °F	Co B Tem °F
B-12	1442 0	753.76	0.1	1.5	1.5					
B-11	1445 3	755.9	0.11	1.7	1.7	96	90	5	180	
B-10	1448 6	758.3	0.12	1.85	1.85	104	88	6	180	
B-9	1451 9	760.6	0.13	2.0	2.0	108	87	7	180	
B-8	1454 12	763.1	0.13	2.0	2.0	109	88	7	182	
B-7	1457 15	765.6	0.11	1.7	1.7	110	88	7	181	
B-6	1500 18	768.0	0.12	1.85	1.85	111	88	7	180	
B-5	1503 21	770.3	0.13	2.0	2.0	112	89	7	182	
B-4	1506 24	772.9	0.13	2.0	2.0	113	95	9	181	
B-3	1538 27	775.52	0.14	2.2	2.2	113	97	5	181	
	1538	Down at	1509	restart	at	101	96	7	175	
B-2	1533 30	778.0	0.13	2.0	2.0	1533				
B-1	1536 33	780.6	0.10	1.5	1.5	108	93	5	183	
	1539 36	782.95				109	91	6	182	
A-12	1556 0	782.995	0.06	0.9	0.9	99	91			
A-11	1559 3	784.6	0.07	1.1	1.1	109	89	2	181	
A-10	1602 6	786.7	0.08	1.2	1.2	112	88	3.5	180	
A-9	1605 9	788.	0.08	1.2	1.2	113	89	5	180	
A-8	1603	790.37	down at		1603	/ restart	1633	5	181	
A-8	1633	790.39	0.01	0.15	0.15	99	85	0	135	
A-7	1636	792.5	0.01	0.15	0.15	102	82	0	135	
A-6	1639	793	0.01	0.15	0.15	100	80	0	135	
A-5	1642	794	0.01	0.15	0.15	103	81	0	135	
A-4	1645	795	0.01	0.15	0.15	104	82	0	129	
A-3	1648	796.2	0.01	0.15	0.15	106	83	0	140	
A-2	1651	797.1	0.01	0.15	0.15	108	84	0	140	
A-1	1654	798.0	0.01	0.15	0.15	105	84	0	135	
	1657	798.98								

down at 1603
restart at 1633
orig test dura
ft³ = Vm

process leak ✓ =
shaved back 1454
down at 1509 - process problems
restart @ 1533
end side B @ 1544
start A @ 1551

0.15 in H_2O

Net

ΔH avg.= in. H_2O
T_m avg.= °F
T_s avg.= °F

PARTICULATE FIELD DATA

Slightly 0.12
Filter 4
Probe 1

Ambient Temperature 60 °F
Barometric Pressure 29.84 in.Hg
Assumed Moisture 6 %
Nozzle Diameter 0.381 inches
C Factor, Nomograph 1.08
ΔH@ 1.8

Test I.D. Augusta
Run No. Run 3
Date 4/15/86
Operator MF/GL

Ideal nozzel 0.36 P_s = 29.85 T_s = 195 ΔP = 0.12
T_{meas} = 80

Sampling Point	Sampling Time (minutes)	Dry Gas Meter Reading ft³	Pitot in. H_2O ΔP	Orifice ΔH in. H_2O Desired	Orifice ΔH in. H_2O Actual	Dry Gas Temp. °F, Tm Inlet	Dry Gas Temp. °F, Tm Outlet	Line Vacuum In.Hg. Gauge	Stack Temp. °F	Coil Box Temp °F
A-12	913	899.66	0.10	1.6	1.6	70	64			
A-11	916 03	901.9	0.09	1.4	1.4	82	65	1	181	
A-10	919 06	904.0	0.10	1.6	1.6	85	64	1	181	
A-9	922 09	906.1	0.10	1.6	1.6	88	65	2	180	
A-8	925 12	908.3	0.10	1.6	1.6	92	66	2	179	
A-7	928 15	910.6	0.11	1.7	1.7	92	65	2	179	
A-6	931 18	912.7	0.12	1.9	1.9	92	65	2.5	182	
A-5	934 21	915.2	0.15	2.4	2.4	93	64	4	182	
A-4	937 24	917.7	0.15	2.4	2.4	93	64	5	181	
A-3	940 27	920.3	0.15	2.4	2.4	95	65	5	180	
A-2	943 30	923.2	0.15	2.4	2.4	96	66	5	180	
A-1	946 33	925.8	0.13	2.1	2.1	97	67	5	179	
	949 36	928.435						4.5	175	
B-12	957 0	928.435	0.12	1.9	1.9	94	70	4	181	
B-11	1000 3	930.7	0.10	1.6	1.6	94	68	3	181	
B-10	1003 6	933.0	0.10	1.6	1.6	95	68	3	181	
B-9	1006 9	935.1	0.11	1.7	1.7	96	68	3	180	
B-8	1009 12	937.5	0.11	1.7	1.7	98	68	3	180	
B-7	1012 15	939.7	0.12	1.9	1.9	98	69	3	180	
B-6	1015 18	942.1	0.11	1.7	1.7	99	69	3	181	
B-5	1018 21	944.4	0.11	1.7	1.7	99	69	3	180	
B-4	1021 24	946.7	0.12	1.9	1.9	99	69	3	180	
B-3	1024 27	949.1	0.13	2.1	2.1	100	70	4	179	
B-2	1027 30	951.5	0.13	2.1	2.1	100	70	4	180	
B-1	1030 33	954.1	0.14	2.3	2.3	98	69	5	178	
	1033 36	956.79								

post test leak @ 10"
pretest leak ✓ @ 15" Hg
Start A @ 913
end A @ 949
Start B @ 957
End B @ 1033

Net ______ ft³ = V_m

ΔH avg.= in.H_2O
T_m avg.= °F
T_s avg.= °F

(12/5)

PARTICULATE FIELD DATA

Ambient Temperature 60 °F
Barometric Pressure 29.84 in.Hg
Assumed Moisture 6% %
Nozzle Diameter 0.361 inches
C Factor, Nomograph 1
ΔH@ 1.80

Test I.D. Hastings
Run No. Run 4
Date 4/15/86
Operator MF/GH

T_s avg = 175 T_m avg = 85 P_s = 29.85 $\overline{\Delta P}$ = 0.12   assumed moisture = 7%

Sampling Point	Sampling Time (clock)	(minutes)	Dry Gas Meter Reading ft³	Pitot in.H₂O ΔP	Orifice ΔH in. H₂O Desired	Orifice ΔH in. H₂O Actual	Dry Gas Temp. °F, Tm Inlet	Dry Gas Temp. °F, Tm Outlet	Line Vacuum In.Hg. Gauge	Stack Temp. °F	Co' B Temp °F
B-12	1252	0	857.10	0.09	1.4	1.4					
B-11	1255	3	859.10	0.11	1.7	1.7	65	63	4	182	
B-10	1258	6	861.4	0.10	1.6	1.6	78	62	5	183	
B-9	1301	9	863.6	0.11	1.7	1.7	82	61	5.5	183	
B-8	1304	12	866.8	0.11	1.7	1.7	84	61	6.0	183	
B-7	1307	15	868.2	0.12	1.9	1.9	86	61	6.0	183	
B-6	1310	18	870.4	0.12	1.9	1.9	87	62	7.0	180	
B-5	1313	21	872.8	0.11	1.7	1.7	92	63	7	181	
B-4	1316	24	875.1	0.12	1.9	1.9	92	64	6	181	
B-3	1319	27	877.5	0.12	1.9	1.9	92	64	7	180	
B-2	1322	30	879.8	0.13	2.0	2.0	92	64	7	182	
B-1	1325	33	882.3	0.13	2.0	2.0	92	64	8	182	
	1328	36	884.82				93	64	8	178	
A-12	1355	0	884.82	0.08	1.2	1.2					
A-11	1358	3	886.7	0.08	1.2	1.2	74	68	4	187	
A-10	1401	6	888.6	0.09	1.4	1.4	86	67	4	183	
A-9	1404	9	890.7	0.09	1.4	1.4	89	65	5	185	
A-8	1407	12	892.8	0.09	1.4	1.4	91	65	5	186	
A-7	1410	15	894.8	0.11	1.7	1.7	92	65	5	184	
A-6	1413	18	897.0	0.13	2.0	2.0	93	66	6	185	
A-5	1416	21	899.6	0.14	2.2	2.2	94	66	8	182	
A-4	1419	24	902.2	0.15	2.4	2.4	96	67	8	185	
A-3	1422	27	904.7	0.14	2.2	2.2	97	68	9	185	
A-2	1425	30	907.3	0.13	2.0	2.0	96	68	8.5	187	
A-1	1428	33	909.7	0.12	1.9	1.9	98	69	7	179	
	1431	36	912.255				100	70	7	179	

post test leak chk 0.005 @ 12"
pretest leak chk = ok (0)
start B @ 1252
end B @ 1328
start A @ 1355
end A @ 1431

Net ________ ft³ = V_m

ΔH avg.= in.H₂O
T_m avg.= °F
T_s avg.= °F

APPENDIX C

CALCULATIONS

Revised: 5/11/83

Test ID: Hastings Pavement

Run Number: 1

Date: 9/19/86

CALCULATIONS

1. Dry Gas Volume Sampled, at Standard Conditions, V_{mstd}

$$V_{mstd} = \frac{17.64\ V_m\ Y\ \left[P_{bar} + \frac{\Delta H_{avg}}{13.6}\right]}{T_{mavg} + 460}$$

V_m = 59.115 dacf

Y = 0.988 (unitless)

ΔH_{avg} = 1.86 in H_2O

T_{mavg} = 93.5 F = R

P_{bar} = mmHg = 29.92 in Hg

$$V_{mstd} = \frac{17.64 \times 59.115 \times 0.988 \left[29.92 + \frac{1.86}{13.6}\right]}{93.5 + 460}$$

V_{mstd} = 54.05 dscf

2. Volume of Moisture in Sampled Gas, at Standard Conditions, V_{wstd}

V_{wstd} = $0.04707\ V_{lc}$ scf

V_{lc} = volume of liquid collected in impinger train

= $V_{imp1} + V_{imp2} + V_{imp3}$ ml

+ V_{imp4} grams x 1.0 ml/gram

= 46 + 14.5 + 12.05

= ml

V_{wstd} = 3.415 scf

3. Percent Moisture, B_{wo}

$$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$$

$$= \frac{3.415}{59.05 + 3.415}$$

B_{wo} = 0.0547 = 5.47 %

4. Dry Fraction, B_{mo}

$$B_{mo} = 1 - B_{wo}$$

$$B_{mo} = 1 - 0.0594 = 94.06\%$$

5. Molecular Weight of Stack Gas, M_s

$$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + CO)$$

From Orsat analysis

$\% CO_2$ = 0.045

$\% O_2$ = 21.7

$\% N_2$ = 78.255

$\% CO$ = 0.0

$$M_d = 0.44\ (0.045) + 0.32\ (21.7) + 0.28\ (78.255)$$

$$= 28.88$$

$$M_s = M_d \times B_{mo} + M_w \times B_{wo}$$

$$= 28.88 \times 0.9406 + 18 \times 0.0594$$

$$M_s = 28.23$$

6. Average Stack Gas Velocity, V_{savg}

$$V_{savg} = K\ C_p\ (\sqrt{P})_{avg} \sqrt{\frac{T_{savg} + 460}{P_s\ M_s}}\ \text{fps}$$

K = dimensional constant = 85.48

C_p = probe coefficient = 0.812

$\Sigma(\sqrt{P})$ = 8.257

$(\sqrt{P})_{avg}$ = 0.344 (in H_2O)

T_{savg} = average stack temperature = 177.8 °F = °R

P_s = absolute stack pressure = 29.93 in Hg (-)

$$V_{savg} = 85.48 \times 0.812 \times 0.344 \times \sqrt{\frac{177.8 + 460}{29.93 \times 28.23}}$$

V_{savg} = 20.74 fps = 1244 fpm

7. Isokinetic Factor, I

$$I = 1.667\,(T_{savg} + 460)\,\frac{\left[0.002669\,V_{lc} + \frac{V_m}{T_{mavg} + 460}\left(P_{bar} + \frac{\Delta H_{avg}}{13.6}\right)\right]}{\theta\, V_{savg}\, P_s\, A_n}$$

$0.002669\,V_{lc} = 0.002569 \times 72.55 \quad = 0.1936$

$+$

$$\frac{V_m}{T_{mavg} + 460}\left(P_{bar} + \frac{\Delta H_{avg}}{13.6}\right)$$

$$\frac{53.115}{93.5+460}\left[29.92 + \frac{1.86}{13.6}\right] \qquad = \underline{3.1015}$$

$$3.2951$$

θ = total sampling duration = 72 min.

A_n = area of nozzle = $\pi \dfrac{d_n^2}{4 \times 144}\ ft^2$

$= \pi \dfrac{(0.360)^2}{4 \times 144} = 0.00071\ ft^2$

$$I = \frac{1.667 \times (177.8 + 460) \times 3.2951}{72 \times 20.74 \times 29.93 \times 0.00071}$$

$I = 110\ \%$

8. Particulate Matter collected, M_n

a) M_n = M_{nf} (particulate matter collected in front half of train)

+ M_{ni} (insoluble particulate matter in impingers)

+ M_{nc} (condensible matter in impinger catch)

M_{nf} = nozzle = gm

+ tube = gm

+ glassware before filter = 0.0163 gm

+ filter = 0.0597 gm

M_{nf} = 0.076 grams

b) M_{ni} = glassware after filter = gm

+ insoluble weight, Impinger No. 1 = gm

+ insoluble weight, Impinger Nos. 2 and 3 = gm

M_{ni} = 0.0019 grams

c) M_{nc} = M_{oe} (organic extract) + M_{we} (water extract)

M_{oe} = impinger #1 OE = gm

+ impingers #2, 3 OE = gm

= grams

M_{we} = impinger #1 WE = $x \frac{\quad}{40}$ - ( )

= gm

+ impingers #2,3 WE = $x \frac{\quad}{40}$ - ( )

= gm

= grams

M_{nc} = grams

9. Particulate Concentration, C_{ffc}

C_f = concentration (gr/dscf) derived from front-half catch, M_{nf}, only

C_{fi} = concentration (gr/dscf) derived from front-half catch and the insoluble impinger catch ($M_{nf} + M_{ni}$)

C_{ffc} = total particulate concentration (gr/dscf) derived from the front-half catch, the insoluble impinger catch, and the condensible impinger catch ($M_n = M_{nf} + M_{ni} + M_{nc}$)

$$C_{ffc} = [\frac{M_n}{V_{mstd}} \times 15.432455 \text{ grains/gram}]$$

$$C_{ffc} = \text{——} \times 15.432455$$

C_{ffc} = gr/dscf

C_{fi} = 0.0226 gr/dscf $\quad 0.0779 / 54.05 \times 15.432455$

C_f = 0.0217 gr/dscf $\quad 0.076 / 54.05 \times 15.432455$

10. Stack Gas Flow Rate, Q_s

$$r = 32 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} = 1.333 \text{ ft}$$

$$Q_s = V_{savg} \times A_s$$

$$A_s = (1.33)^2 \times \pi \text{ ft}^2 = 5.59 \text{ ft}^2$$

$$Q_s = 1244 \times 5.59 = 6954 \text{ acfm}$$

$$= \quad \times \frac{528}{T_{savg} + 460} \times \frac{P_s}{29.92}$$

$$= 6954 \times \frac{528}{637.8} \times \frac{29.93}{29.92} = 5759 \text{ scfm}$$

$$= \quad \times B_{mo}$$

$$= 5759 \times 0.9406 = 5417 \text{ dscfm}$$

11. Particulate Emission Rate, R_{fic}

R_f = emission rate (lb/hr) derived from the front-half concentration, C_f

R_{fi} = emission rate (lb/hr) derived from the front-half and insoluble impinger concentration, C_{fi}

R_{fic} = total emission rate (lb/hr) derived from the total particulate concentration, C_{fic} (includes condensibles)

$$R_{fic} = C_{fic}\ \frac{\text{grains}}{\text{dscf}} \times Q_s\ \text{dscfm} \times \frac{1\ \text{lb.}}{7{,}000\ \text{grains}} \times \frac{60\ \text{min}}{\text{hr}}$$

$$= \qquad \times \qquad \times \frac{1}{7{,}000} \times 60$$

R_{fic} = lbs/hr

R_{fi} = 1.03 lbs/hr

R_f = 1.01 lbs/hr $\quad 0.0217 \times 5417 \times \frac{1}{7000} \times 60$

11a. PPDER allowable

$E = Fxw = \frac{6\ \text{lb}}{\text{ton}} \times \frac{28\ \text{ton}}{\text{hr}} = 168$ feed

$P = 0.76\ E^{0.42} = 0.76\,(168)^{0.42}$

$= 6.57$ lb/hr

12. Weights of Sulfur Dioxide Collected, W_{SD}

$$W_{SD} = [\text{wt. of } BaSO_4 - \text{blank}] \times 0.27445 \times \left[\frac{\text{Final Volume}}{\text{Aliquot Volume}}\right]$$

W_{SD} (Total) = W_{SD} (Filter) + W_{SD} (Nozzle and Tube Washings) + W_{SD} (Impinger #1) + W_{SD} (Impinger #2) + W_{SD} (Impinger #3)

a) W_{SD} (Filter) = [wt. of $BaSO_4$ - filter blank] x 0.27446 x $\left[\frac{100}{100}\right]$

= [ ] x 0.27446

= gm

b) W_{SD} (Nozzle and Tube) = [wt. of $BaSO_4$ - blank] x 0.27446 x $\left[\frac{100}{100}\right]$

= [ ] x 0.27446

= gm

c) W_{SD} (Impinger #1) = [wt. of $BaSO_4$ - blank] x 0.27446 x $\left[\frac{\quad}{100}\right]$

= [ ] x 0.27446 x

= gm

d) W_{SD} (Impinger #2) = [wt. of $BaSO_4$ - blank] x 0.27446 x $\left[\frac{\quad}{100}\right]$

= [ ] x 0.27446 x

= gm

e) W_{SD} (Impinger #3) = [wt. of $BaSO_4$ - blank] x 0.27446 x $\left[\frac{\quad}{100}\right]$

= [ ] x 0.27446 x

= gm

W_{SD} (Total) = a + b + c + d + e

= + + + +

= gm

13. Concentration of Sulfur Dioxide, C_{SD}

C_{SD} = sulfur dioxide concentration, parts per million by volume

$$C_{SD} = 13{,}040 \frac{M_{SD}\ (\text{Total})}{V_{mstd}}$$

$$C_{SD} = 13{,}040 \frac{\qquad}{V_{mstd}}$$

C_{SD} = ppm (by volume)

14. Sulfur Dioxide Emission Rate, M_{SD}

M_{SD} = emission rate of sulfur dioxide, pounds per hour

$$M_{SD} = 10.1 \times 10^{-6}\ C_{SD} \times Q_s$$

$$= 10.1 \times 10^{-6} \times \qquad \times$$

= lb/hr

*** INPUT PARAMETERS ***

Parameter	Value
Plant name	HASTINGS
Plant location	LEESPORT
Type of process	ASPHALT
Run number	1
Test Date	4/14/86
No. of sampling points	24
Stack shape (1 = round, 2 = rectangular)	1
If round: Stack diameter, in.	32
If rectangular: Stack length, in.	
Stack width, in.	
Barometric pressure, in Hg	29.92
Stack pressure, in Hg	29.93
Sampling time, minutes	72
Initial dry gas meter reading, dacf	695.685
Final dry gas meter reading, dacf	752.8
Volume of liquid collected:	
Impinger 1, ml	46
Impingers 2 and 3, ml	14.5
Impinger 4, g	12.05
Assume molecular weight? (1 = yes, 2 = no)	2
If yes, enter assumed molecular weight, dry	
If no, enter: Carbon dioxide, %	0.045
Oxygen, %	21.7
Carbon monoxide, %	0
Diameter of nozzle, in.	0.361
Probe coefficient	0.812
Dry gas meter correction factor	0.988
Particulate matter collected:	
Front half (Method 5), g	0.076
Back half filterable, g	0.0019
Back half soluble, g	
Back half condensible, g	
Other, g	
Production rate	

Run No.: 1
Test Date: 4/14/86
Company: HASTINGS
Location: LEESPORT
Process: ASPHALT

*** METER BOX READINGS ***

Point No.	Delta P (in. water)	Delta H (in. water)	Dry Gas Temp. (F) Inlet	Dry Gas Temp. (F) Outlet	Stack Temp. (F)
1	0.10	1.50	94	79	180
2	0.15	2.40	100	84	180
3	0.15	2.40	102	83	180
4	0.13	2.00	104	83	181
5	0.14	2.20	106	83	181
6	0.14	2.20	107	83	183
7	0.11	1.70	107	83	181
8	0.09	1.40	110	84	180
9	0.08	1.30	111	84	160
10	0.08	1.30	112	84	160
11	0.08	1.30	112	85	175
12	0.08	1.30	113	85	175
13	0.13	2.00	92	88	180
14	0.14	2.20	98	85	180
15	0.15	2.40	100	83	181
16	0.13	2.00	100	82	181
17	0.13	2.00	102	80	180
18	0.13	2.00	102	80	181
19	0.13	2.00	104	80	180
20	0.13	2.00	106	80	178
21	0.13	2.00	106	80	177
22	0.12	1.80	106	80	178
23	0.12	1.80	108	81	178
24	0.10	1.50	108	81	178
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					

Run No.: 1
Test Date: 4/14/88
Company: HASTINGS
Location: LEESPORT
Process: ASPHALT

*** R E S U L T S ***

Parameter	Results	Units
Average stack gas temperature	177.8	F
Average Delta P	0.12	in. water
Sum of square roots of Delta P	8.259	--
Average sum of square roots of Delta P	0.344	--
Average Delta H	1.86	in. water
Average meter inlet temperature	104.6	F
Average meter outlet temperature	82.5	F
Average meter temperature	93.5	F
Area of nozzle	0.000710	sq. feet
Area of stack cross section	5.59	sq. feet
Dry gas volume sampled, actual conditions	57.115	dacf
Dry gas volume sampled, std. conditions	54.05	dscf
Volume moisture in sampled gas, standard	3.415	scf
Percent moisture	5.94	%
Molecular weight of stack gas, dry	28.88	--
Molecular weight of stack gas, wet	28.23	--
Average stack gas velocity	20.74	fps
	1244	fpm
Isokinetic factor	110.3	%
Particulate concentration, EPA Method 5	0.0217	gr/dscf
Particulate concentration, PADER	0.0222	gr/dscf
Particulate concentration w/ PADER and back-half condensibles		gr/dscf
Allowable particualte concentration		gr/dscf
Stack gas flow rate	6954	acfm
	5759	scfm
	5417	dscfm
Particulate emission rate, EPA Method 5	1.01	lb/hr
Particulate emission rate, PADER	1.03	lb/hr
Particulate emission rate, PADER and back-half condensibles		lb/hr
Allowable emission rate		lb/hr

*** INPUT PARAMETERS ***

Parameter	Value
Plant name	HASTINGS
Plant location	LEESPORT
Type of process	ASPHALT
Run number	3
Test Date	4/15/86
No. of sampling points	24
Stack shape (1 = round, 2 = rectangular)	1
If round: Stack diameter, in.	32
If rectangular: Stack length, in.	
Stack width, in.	
Barometric pressure, in Hg	29.84
Stack pressure, in Hg	29.85
Sampling time, minutes	72
Initial dry gas meter reading, dacf	799.66
Final dry gas meter reading, dacf	856.79
Volume of liquid collected:	
Impinger 1, ml	46
Impingers 2 and 3, ml	28
Impinger 4, g	14.5945
Assume molecular weight? (1 = yes, 2 = no)	2
If yes, enter assumed molecular weight, dry	
If no, enter: Carbon dioxide, %	0.79
Oxygen, %	21.51
Carbon monoxide, %	0
Diameter of nozzle, in.	0.361
Probe coefficient	0.812
Dry gas meter correction factor	0.988
Particulate matter collected:	
Front half (Method 5), g	0.0625
Back half filterable, g	0.0018
Back half soluble, g	
Back half condensible, g	
Other, g	
Production rate	

Run No.: 3
Test Date: 4/15/86
Company: HASTINGS
Location: LEESPORT
Process: ASPHALT

*** METER BOX READINGS ***

Point No.	Delta P (in. water)	Delta H (in. water)	Dry Gas Temp. (F) Inlet	Dry Gas Temp. (F) Outlet	Stack Temp. (F)
1	0.10	1.60	78	64	181
2	0.09	1.40	82	65	181
3	0.10	1.60	85	64	180
4	0.10	1.60	88	65	179
5	0.10	1.60	92	66	180
6	0.11	1.70	92	65	182
7	0.12	1.90	92	65	182
8	0.15	2.40	93	64	181
9	0.15	2.40	93	64	180
10	0.15	2.40	95	65	180
11	0.15	2.40	96	66	175
12	0.13	2.10	97	67	175
13	0.12	1.90	84	70	181
14	0.10	1.60	94	68	181
15	0.10	1.60	95	68	181
16	0.11	1.70	96	68	180
17	0.11	1.70	98	68	180
18	0.12	1.90	98	69	180
19	0.11	1.70	99	69	181
20	0.11	1.70	99	69	180
21	0.12	1.90	99	69	180
22	0.13	2.10	100	70	179
23	0.13	2.10	100	70	180
24	0.14	2.30	98	69	178
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					

Run No.: 3
Test Date: 4/15/86
Company: HASTINGS
Location: LEESPORT
Process: ASPHALT

*** R E S U L T S ***

Parameter	Results	Units
Average stack gas temperature	179.9	F
Average Delta P	0.12	in. water
Sum of square roots of Delta P	8.245	--
Average sum of square roots of Delta P	0.344	--
Average Delta H	1.89	in. water
Average meter inlet temperature	93.1	F
Average meter outlet temperature	67	F
Average meter temperature	80	F
Area of nozzle	0.000710	sq. feet
Area of stack cross section	5.59	sq. feet
Dry gas volume sampled, actual conditions	57.13	dacf
Dry gas volume sampled, std. conditions	55.28	dscf
Volume moisture in sampled gas, standard	4.17	scf
Percent moisture	7.01	%
Molecular weight of stack gas, dry	28.99	--
Molecular weight of stack gas, wet	28.22	--
Average stack gas velocity	20.81	fps
	1249	fpm
Isokinetic factor	114.4	%
Particulate concentration, EPA Method 5	0.0174	gr/dscf
Particulate concentration, PADER	0.018	gr/dscf
Particulate concentration w/ PADER and back-half condensibles		gr/dscf
Allowable particualte concentration		gr/dscf
Stack gas flow rate	6982	acfm
	5748	scfm
	5345	dscfm
Particulate emission rate, EPA Method 5	0.8	lb/hr
Particulate emission rate, PADER	0.82	lb/hr
Particulate emission rate, PADER and back-half condensibles		lb/hr
Allowable emission rate		lb/hr

*** INPUT PARAMETERS ***

Parameter	Value
Plant name	HASTINGS
Plant location	LEESPORT
Type of process	ASPHALT
Run number	4
Test Date	4/15/86
No. of sampling points	24
Stack shape (1 = round, 2 = rectangular)	1
If round: Stack diameter, in.	32
If rectangular: Stack length, in.	
Stack width, in.	
Barometric pressure, in Hg	29.84
Stack pressure, in Hg	29.85
Sampling time, minutes	72
Initial dry gas meter reading, dacf	857.1
Final dry gas meter reading, dacf	912.255
Volume of liquid collected:	
Impinger 1, ml	82
Impingers 2 and 3, ml	12
Impinger 4, g	12.7631
Assume molecular weights? (1 = yes, 2 = no)	2
If yes, enter assumed molecular weight, dry	
If no, enter: Carbon dioxide, %	0.79
Oxygen, %	21.51
Carbon monoxide, %	0
Diameter of nozzle, in.	0.361
Probe coefficient	0.812
Dry gas meter correction factor	0.988
Particulate matter collected:	
Front half (Method 5), g	0.0621
Back half filterable, g	0.0026
Back half soluble, g	
Back half condensible, g	
Other, g	
Production rate	

Run No.: 4
Test Date: 4/15/86
Company: HASTINGS
Location: LEESPORT
Process: ASPHALT

*** METER BOX READINGS ***

Point No.	Delta P (in. water)	Delta H (in. water)	Dry Gas Temp. (F) Inlet	Dry Gas Temp. (F) Outlet	Stack Temp. (F)
1	0.09	1.40	65	63	182
2	0.11	1.70	78	62	183
3	0.10	1.60	82	61	183
4	0.11	1.70	84	61	183
5	0.11	1.70	86	61	183
6	0.12	1.90	89	62	180
7	0.12	1.90	92	63	181
8	0.11	1.70	92	64	181
9	0.12	1.90	92	64	180
10	0.12	1.90	92	64	183
11	0.13	2.00	92	64	182
12	0.13	2.00	93	64	178
13	0.08	1.20	74	68	181
14	0.08	1.20	86	67	183
15	0.09	1.40	89	65	185
16	0.09	1.40	91	65	186
17	0.09	1.40	92	65	184
18	0.11	1.70	93	66	185
19	0.13	2.00	94	66	182
20	0.14	2.20	96	67	185
21	0.15	2.40	97	68	185
22	0.14	2.20	96	68	181
23	0.13	2.00	98	69	179
24	0.12	1.90	100	70	179
25					
26					
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Run No.: 4
Test Date: 4/15/86
Company: HASTINGS
Location: LEESPORT
Process: ASPHALT

*** R E S U L T S ***

Parameter	Results	Units
Average stack gas temperature	182.3	F
Average Delta P	0.11	in. water
Sum of square roots of Delta P	8.051	--
Average sum of square roots of Delta P	0.335	--
Average Delta H	1.77	in. water
Average meter inlet temperature	89.3	F
Average meter outlet temperature	64.9	F
Average meter temperature	77.1	F
Area of nozzle	0.000710	sq. feet
Area of stack cross section	5.59	sq. feet
Dry gas volume sampled, actual conditions	55.155	dacf
Dry gas volume sampled, std. conditions	53.64	dscf
Volume moisture in sampled gas, standard	5.025	scf
Percent moisture	8.57	%
Molecular weight of stack gas, dry	28.99	--
Molecular weight of stack gas, wet	28.05	--
Average stack gas velocity	20.37	fps
	1222	fpm
Isokinetic factor	115.7	%
Particulate concentration, EPA Method 5	0.0179	gr/dscf
Particulate concentration, PADER	0.0186	gr/dscf
Particulate concentration w/ PADER and back-half condensibles		gr/dscf
Allowable particualte concentration		gr/dscf
Stack gas flow rate	6831	acfm
	5602	scfm
	5122	dscfm
Particulate emission rate, EPA Method 5	0.79	lb/hr
Particulate emission rate, PADER	0.82	lb/hr
Particulate emission rate, PADER and back-half condensibles		lb/hr
Allowable emission rate		lb/hr

APPENDIX D

LABORATORY PROCEDURES AND PRE AND POST-TEST LABORATORY SHEETS

APPENDIX D

DETAILED LABORATORY AND ON-SITE PROCEDURE

Pre-Test Procedure. In preparation for the stack sampling all segments of the sampling train up to the fourth impinger were thoroughly washed, rinsed with acetone and water, and dried. Glass fiber 90 mm filters were labeled for identification, desiccated for 24 hours and weighed to the nearest 0.0001 g. One of the filters was then placed in each filter holder, the others serving as extra filters.

100 ml of distilled water was placed in each of the first two impingers. The third impinger was left empty. Approximately 200 g. of pre-weighed dry silica gel was placed in the fourth impinger.

The filter holder, impingers, and the rest of the glassware were put together in the sampling box, using vacuum grease to ensure leak-proof connections at all ball joints.

On-Site Procedure. By using the data obtained from the initial velocity profile traverse, the correct-sized nozzle was determined from the nomograph. The sampling train was set up as shown in Figure 4, with an umbilical cord carrying all electrical and pneumatic connections from the sample box near the stack location to the meter and control box.

The sampling train and pitot tubes were leak-checked (pre and post-test). Temperature gauges were calibrated against a mercury thermometer. Crushed ice was placed in the cold box around the impingers. The probe heater and the filter heating systems were turned on to give approximately 250°F before the start of the sampling. Temperatures of the filter box, and the gases leaving the fourth impinger, were monitored periodically during the test.

After the completion of a test run, the probe and nozzle were disconnected from the impinger train and all open ends sealed immediately to avoid contamination.

<u>Post-Test Procedure.</u> The nozzle was disconnected from the tube and very carefully washed with distilled water and acetone using a fine bristled brush. At the laboratory facility, clean pyrex dishes were oven dried at 100°C desiccated, labeled, and tare weighed. The nozzle and the probe were wiped clean on the outside. All washings were collected in a clean, preweighed pyrex dish, the dish itself being placed on a large piece of clean aluminum foil. The glass tube (probe) was then washed, using a long handled brush rotated through it under streams of distilled water and acetone. The brush was also carefully cleaned, and all washings collected in the same beaker. The probe was finally checked visually for any residue. An accurate account of the quantity of liquid used in each washing operation was recorded. From the mass of residue found in 40 ml sample blanks and the volume of liquid used in the washings, we then estimated the mass of contaminants contained in the washings. This mass is subtracted from the total mass determinations.

All the pyrex dishes to be used for the washes were washed thoroughly and oven-dried overnight. These were then desiccated for 24 hours, labeled and tared. Once tared, the dishes were handled with tongs.

The impinger train was initially wiped clean on the outside and all glassware connectors, including the filter, removed carefully and all exposed surfaces wiped clean. All the connectors were placed on a piece of aluminum foil, ready for washing. The first three impingers were then analyzed for water collection by transferring the water into a graduated cylinder and noting the volume. The water from the graduated cylinder was then transferred into labeled bottles for further analysis for condensibles and filterable particulate. Silica gel in the fourth impinger was weighed in a previously tared beaker using an analytical balance.

The filter was carefully removed from the filter holder. Filter particles adhering to the seal of the filter holder were carefully scraped, and included with the filter. The filter was oven dried for 2 hours at 100°C, deciccated and weighed to a constant weight, to the nearest 0.0001 g.

Glassware before the filter was washed with distilled water and acetone. Particulates were loosened from the walls with the help of a special brush, which was subsequently washed. The water wash was collected in a pyrex dish. A similar procedure was followed for the glassware after the filter.

The dishes containing the washes were placed in an oven at 100°C until the liquid was evaporated. The dishes were then desiccated for 24 hours and weighed to a constant weight.

Membrane filters were oven dried at 100°C for 2 hours, desiccated for 24 hours, and weighed to a constant weigh. After filtering, the filters were dried, desiccated, and weighed to a constant weight.

A summary of weights is shown on Table D-1. Table D-2 summarizes the stack gas composition.

Table D-1

PARTICULATE WEIGHT AND ORGANIC EXTRACT ANALYSIS SUMMARY

Sampling Train Segment	Weight, grams[a]		
	Run 1	Run 3	Run 4
Filter	0.0597	0.0455	0.0417
Front Half[b]			
Filterable[c]	0.0092	0.0109	0.0173
Water Wash	0.0033	0.0021	0.0021
Acetone Wash	0.0038	0.0039	0.0010
Back Half[d]			
Filterable[c]	0.0001	0.0000	0.0000
Water Wash	0.0012	0.0004	0.0018
Acetone Wash	0.0006	0.0005	0.0006
Impingers			
Filterable[c]	0.0000	0.0009	0.0002

[a] Corrected for blanks
[b] Front half includes nozzle, probe, and glassware in front of filter
[c] Filterable by 0.22 micron filter
[d] Back half includes back half or filter glassware, back half connecting tubes, and impinger washes
[e] Water and acetone washes of impingers are included with back half washes.

Table D-2

STACK GAS COMPOSITION[a]

	Day 1	Day 2
Oxygen	21.7%	21.51%
Nitrogen	78.25%	77.69%
Carbon Dioxide	0.045%	0.79%
Carbon Monoxide	0%	0%

[a]Analysis performed using a gas chromatograph equipped with flame ionization detection.

[illegible]
Run# 1

Not corrected
for blanks

PRETEST LAB SHEET

1. Desiccated Filter Weight

i) Filter No. 3000 Weight 0.4439 g

ii) Filter No. Weight g

2. Impinger #1

distilled water 100 ml

3. Impinger #2

distilled water 100 ml

4. Impinger #3

distilled water 0 ml

5. Impinger #4

container + silica gel	116.9430	121.9995	
tare weight of container	47.4500	47.4495	
	69.393	74.5	
total weight of dry silica gel	143.893		g

TEST ID 1

POSTTEST LAB SHEET

1. Desiccated Filter Weight

Filter No. 3001 weight 0.5036 g
0.4439
.0597

2. Impinger #1

Liquid 146 ml

3. Impinger #2

Liquid 114.5 ml 2&3

4. Impinger #3

Liquid ml

5. Impinger #4

container + silica gel	131.7997	119.0553
tare weight of container	47.4510	47.4510
total weight of wet silica gel	84.3487	71.6043
		155.9439

6. ~~Nozzle~~ Front half # #104 H_2O Wash 75 ml | Acetone Wash #11 25 ml | Acetone Wash + H_2O Wash

	H_2O Wash	Acetone Wash
dish + particulate	46.1625	45.5628
tare weight of dish	46.1592	45.5585
	.0033	.0043 g

(0.0038) blank corrected

7. ~~Probe~~ Front half 0.22μ filter — ~~Acetone Wash~~ + H_2O Wash

~~dish~~ + particulate	0.0262
tare weight of ~~dish~~ filter	0.0170
	0.0092 g

8. Glassware Before Filter — Acetone Wash + H_2O Wash

dish + particulate

tare weight of dish

g

9. ~~Glassware After Filter~~ Back half #98 H_2O wash 50 ml | Acetone Wash #10 25 ml | Acetone Wash + H_2O Wash

	H_2O wash	Acetone Wash
dish + particulate	47.7493	46.5784
tare weight of dish	47.7481	46.5773
	.0012	.0011 g (0.0006)

Insoluble Back half .22μ filter

final	0.0170
tare	0.0169

TEST ID 1

Impinger Water Analysis

10. Insoluble

Impinger #1

filter + particulate	0.0171	0.0170
tare weight of filter	0.0170	0.0170
	0.0001	0

50 ml 50 ml

11. Ether-Chloroform Extract

Impinger #1, 2 & 3

dish + particulate	48.7656
tare weight of dish #105	48.7646
	.0010

12. Other Soluble

Volume 50 ml

dish + particulate	46.4407
tare weight of dish #103	46.4391
	.0016

13. Insoluble

Impinger #2 + #3

filter + particulate	0.0170
tare weight of filter	0.0170
	0

14. Ether-Chloroform Extract

Impinger #2 + #3

dish + particulate

tare weight of dish

15. Other Soluble

Volume

dish + particulate

tare weight of dish

Hastings Pavement
Run #3

not corrected
for blanks

PRETEST LAB SHEET

1. Desiccated Filter Weight

i) Filter No. 30004 Weight 0.4444 g

ii) Filter No. Weight g

2. Impinger #1

distilled water 100 ml

3. Impinger #2

distilled water 150 ml

4. Impinger #3

distilled water 0 ml

5. Impinger #4

container + silica gel	119.2725	121.2273
tare weight of container	47.4507	47.4500
	71.8218	73.7773
total weight of dry silica gel	145.5991 g	

used for Run #4

Silica #1	117.9839	113.0279
	47.4510	47.4510

Silica #3	117.4229	120.7381
	47.4510	47.4510

Silica #2	114.9052	124.7479
	47.4510	47.4510

Silica #4	121.5316	126.0677
	47.4533	47.4507

TEST ID 3

POSTTEST LAB SHEET

1. Desiccated Filter Weight

Filter No. 20004 weight 0.4950 g

.4494

.0456

2. Impinger #1

Liquid 46 ml

3. Impinger #2

Liquid 12.8 ml

Front Impinger 74 ml

4. Impinger #3

Liquid ml

5. Impinger #4

container + silica gel	127.0613	128.0343	
tare weight of container	47.4510	47.4510	
total weight of wet silica gel	79.6103	80.5833	160.1936

6. Front half ~~Nozzle~~ # 45 ml 72 H_2O wash — 25 ml g 83 Probe Wash Acetone Wash + H_2O Wash

dish + particulate	67.3245	75.8136	
tare weight of dish	67.3224	75.8092	
	0.0021	0.0044 g	(0.0039)

7. Front half ~~Tube~~ H_2O 45 ml — Acetone Wash + H_2O Wash

Filter
~~dish~~ + particulate 0.5276

tare weight of ~~dish~~ Filter 0.0167

.0109 g

8. Glassware Before Filter — Acetone Wash + H_2O Wash

dish + particulate

tare weight of dish

9. Back half ~~Glassware~~ After Filter 83 35 ml H_2O — Acetone 85 g 20 ml — Acetone Wash + H_2O Wash

dish + particulate	59.1559	54.4153	
tare weight of dish	59.1455	54.4144	
	0.0104	.0009 g	(0.0005)

Filter placed in the same filter Tare

0.0174

0.0174

0

TEST ID 3

Impinger Water Analysis

10. Insoluble

Impinger #1

filter + particulate 0.0176

tare weight of filter 0.0171

.0005

11. Ether-Chloroform Extract 50ml 50ml

Impinger #1 2 & 3

dish + particulate

tare weight of dish #0 97.3586

12. Other Soluble

50ml

Volume

dish + particulate

tare weight of dish #1 88.0064

13. Insoluble

Impinger #2 + #3

filter + particulate 0.0174

tare weight of filter 0.0168

0.0004

14. Ether-Chloroform Extract

Impinger #2 + #3

dish + particulate

tare weight of dish

15. Other Soluble

Volume

dish + particulate

tare weight of dish

Hastings [illegible]
Run #4

not corrected for blanks

PRETEST LAB SHEET

1. Desiccated Filter Weight

   i) Filter No. 30005 Weight 0.4458 g

   ii) Filter No. Weight g

2. Impinger #1

   distilled water 100 ml

3. Impinger #2

   distilled water 100 ml

4. Impinger #3

   distilled water 0 ml

5. Impinger #4

container + silica gel	117.4839	113.2478
tare weight of container	47.6510	47.6510
	70.5329	65.5968

total weight of dry silica gel 136.1097 g

TEST ID 4

POSTTEST LAB SHEET

1. Desiccated Filter Weight

Filter No. weight 0.5075 g
0.4658
0.0417

2. Impinger #1

Liquid 182 ml

3. Impinger #2

Liquid 112 ml

94 ml gain

4. Impinger #3

Liquid ml

5. Impinger #4

container + silica gel 151.4735 | 111.8023

tare weight of container 47.4515 | 47.4515

total weight of wet silica gel 94.5?? | 64.3508 g

6. ~~Nozzle~~ Front half

90 ml H_2O wash | Acetone wash | Acetone Wash + H_2O Wash

dish + particulate 56.5197 | 59.4082

tare weight of dish 56.5176 | 59.4067

.0021 | .0015 g (0.0010)

7. ~~Probe~~ Filter and front half H_2O 90 ml

Acetone Wash + H_2O Wash

dish + particulate 9.0342

tare weight of dish 9.0169

.0173 g

8. Glassware Before Filter

Acetone Wash + H_2O Wash

dish + particulate

tare weight of dish

g

9. Glassware After Filter 35 ml H_2O | Acetone 35 ml | Acetone Wash + H_2O Wash

dish + particulate 49.5012 | 47.8755

tare weight of dish 49.4998 | 47.8744

0.0014 | .0011 g (0.0006)

Filter + Particulate 0.0015

.0222 ???? 0.0015

TEST ID 4

Impinger Water Analysis

10. Insoluble

Impinger #1

filter + particulate	0.0171
tare weight of filter	0.0169
	.0002

11. Ether-Chloroform Extract

Impinger #1

dish + particulate	
tare weight of dish	

12. Other Soluble

Volume

dish + particulate	
tare weight of dish	

13. Insoluble

Impinger #2 + #3

filter + particulate	0.0170
tare weight of filter	0.0170
	0

14. Ether-Chloroform Extract

Impinger #2 + #3

dish + particulate	
tare weight of dish	

15. Other Soluble

Volume

dish + particulate	
tare weight of dish	

APPENDIX E

VISIBLE EMISSIONS FIELD DATA SHEETS