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.

CHARACTERIZATION OF INHALABLE PARTICULATE MATTER EMISSIONS FROM THE LIME INDUSTRY

DRAFT REPORT

Volume IV
Appendix D

EPA Contract No. 68-02-3158, Technical Directive No. 4
MRI Project No. 4891-L(93)

For

Industrial Environmental Research Laboratory
Environmental Protection Agency
Cincinnati, Ohio 45268

Attn: Charles H. Darvin

MIDWEST RESEARCH INSTITUTE 425 VOLKER BOULEVARD, KANSAS CITY, MISSOURI 64110 • 816 753-7600

APPENDIX D

ACCEPTED RUNS BUT NOT USED IN CALCULATIONS

FILE NAME - DC141
RUN # - DC-1-4-(1)
LOCATION - PFIZER
DATE - 12-3-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	16.500
FINAL METER VOLUME (CUBIC FEET)=	58.400
METER FACTOR= 1.018	
NET METER VOLUME (CUBIC FEET)=	42.654
GAS VOLUME (DRY STANDARD CUBIC FEET)=	43.880
BAROMETRIC PRESSURE (IN. HG)=	29.76
STATIC PRESSURE (INCHES H20)=	-7.65
PERCENT OXYGEN=	21.00
PERCENT CARBON DIOXIDE=	0.00
MOISTURE COLLECTED (ML)=	0.0
PERCENT WATER=	1.00
AVERAGE METER TEMPERATURE (F.)=	52.6
AVERAGE DELTA H (IN. H20)=	1.85
AVERAGE DELTA P (IN. H20)=	1.26
AVERAGE STACK TEMPERATURE (F.)=	40.8
DRY MOLECULAR WEIGHT=	28.840
WET MOLECULAR WEIGHT=	28.732
AVERAGE SQUARE ROOT OF DELTA P (IN. H20)=	1.1212
% ISOKINETIC=	105.3
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	60.0
NOZZLE DIAMETER (INCHES)=	0.1830
STACK AXIS #1 (INCHES)=	15.50
STACK AXIS #2 (INCHES)=	15.50
CIRCULAR STACK	
STACK AREA (SQUARE FEET)=	1.310
STACK VELOCITY (ACTUAL, FEET/MIN)=	3,732
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	4,890
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	5,032
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	~~4,982~~ 4981

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	2.4500
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.8598
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.8755
EMISSION RATE (LB/HR)=	~~36.71~~ 36.70

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	2.4500
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.8598
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.8755
EMISSION RATE (LB/HR)=	~~36.71~~ 36.70
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - DC14
RUN # - DC-1-4
LOCATION - PFIZER
DATE - 12-3-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	0.467
FINAL METER VOLUME (CUBIC METERS)=	1.654
METER FACTOR= 1.018	
NET METER VOLUME (CUBIC METERS)=	1.208
GAS VOLUME (DRY STANDARD CUBIC METERS)=	1.243
BAROMETRIC PRESSURE (MM HG)=	755.90
STATIC PRESSURE (MM H2O)=	-194.3
PERCENT OXYGEN=	21.00
PERCENT CARBON DIOXIDE=	0.00
MOISTURE COLLECTED (ML)=	0.0
PERCENT WATER=	1.00
AVERAGE METER TEMPERATURE (C.)=	11.5
AVERAGE DELTA H (MM H2O)=	46.9
AVERAGE DELTA P (MM H2O)=	32.0
AVERAGE STACK TEMPERATURE (C.)=	4.9
DRY MOLECULAR WEIGHT=	28.840
WET MOLECULAR WEIGHT=	28.732
AVERAGE SQUARE ROOT OF DELTA P (MM H2O)=	5.6509
% ISOKINETIC=	105.3
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	60.0
NOZZLE DIAMETER (MM)=	4.65
STACK AXIS #1 (METERS)=	0.394
STACK AXIS #2 (METERS)=	0.394
CIRCULAR STACK	
STACK AREA (SQUARE METERS)=	0.122
STACK VELOCITY (ACTUAL, M/MIN)=	1,138
FLOW RATE (ACTUAL, CUBIC M/MIN)=	138
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	142
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	~~141~~ 140.

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	2.4500
PARTICULATE LOADING, DRY STD. (G/CU. M)=	1.9718
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	2.0078
EMISSION RATE (KG/HR)=	16.67

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	2.4500
PARTICULATE LOADING, DRY STD. (G/CU. M)=	1.9718
PARTICULATE LOADING, ACTUAL (G/CU. M)=	2.0078
EMISSION RATE (KG/HR)=	16.67
PERCENT IMPINGER CATCH=	0.0

FILE NAME - DC14
RUN # - DC-1-4
LOCATION - PFIZER
DATE - 12-3-80
PROECT # - 4891-L93

POINT #	DELTA P (IN. H20)	DELTA H (IN. H20)	STACK T (F.)	METER T. IN(F.)	METER T. OUT(F.)
1	1.20	1.80	57	32	31
2	1.10	1.60	67	46	32
3	1.20	1.70	53	52	34
4	1.30	1.80	41	59	36
5	1.30	1.80	37	63	38
6	1.30	1.80	40	68	41
7	1.30	1.85	34	70	44
8	1.30	1.60	35	67	47
9	1.40	2.10	32	71	48
10	1.30	1.90	30	74	50
11	1.20	2.10	33	82	52
12	1.20	2.10	30	74	52

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	1.1153	0.7893	0.0033	0.3227

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	88.0377	85.9072	130.0	2.1272
IMPINGERS	0.0000	0.0000	0.0	0.0000

PROBE RINSE BLANK (MG/ML)= .0250769
IMPINGER BLANK (MG/ML)= 0

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RUN Dust-1-4

MRI Project Number 4891-L93
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-3-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Cobb
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 12-3-80

SAMPLING LOCATION Dust Collector

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	65
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.76
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.19
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	25
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.7
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.05	
CALCULATED NOZZLE DIAMETER, in.	3/16 (.187)	
ACTUAL NOZZLE DIAMETER, in.	.183	
REFERENCE Δp, in. H_2O	1.25	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number Dust-1-4

Date 12-3-80
Initial LE.

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where:

$$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

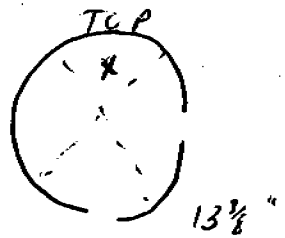
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	65
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.99
Nozzle diameter, inches	Dn	.183
Barometric pressure, inches Hg	Pb	29.76
$\frac{5.168\ (65 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.76}}$	K	69.26

FIELD DATA

PLANT Rizer
DATE 12-3-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Mass
RUN NUMBER Dust-1-4
OPERATOR Cobb
AMBIENT TEMPERATURE 45
BAROMETRIC PRESSURE 29.76
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 63



PROBE LENGTH AND TYPE 2' SS
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR 1.05
PROBE HEATER SETTING N/A
HEATER BOX SETTING N/A
REFERENCE Δp 1.25

Leak CK: Initial at 15" Hg, CFM 0.0
Final at Hg, CFM

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 69.26 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired 16.5	Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1455											
	5	1500	19.84	19.97	1.2	1.8	1.8	57	32	31	6	30	30
	10	1505	23.00	23.27	1.1	1.6	1.6	67	46	32	5		
	15	1510	26.35	26.62	1.2	1.8	1.7	53	52	34	5		
	20	1515	29.89	29.99	1.2	1.9	1.8	41	59	36	5		
	25	1520	33.42	33.49	1.3	1.9	1.8	37	63	38	6		
	30	1525	36.95	37.05	1.3	1.9	1.8	40	68	41	6		
	35	1530	40.51	40.59	1.2	1.9	1.85	34	70	44	6		
	40	1535	44.05	42.75	1.3	1.9	1.6	35	67	47	6		
	45	1540	47.75	46.75	1.4	2.1	2.1	32	71	48	15		
	50	1545	51.32	—	1.3	1.9	1.9	30	74	50	18		
	55	1550	54.73	54.18	1.2	1.8	2.1	33	82	52	20		
	60	1555	58.15	58.4	1.2	1.8	2.1	30	74	52	6		
			41.9 =	Vm	$\Delta p_{(s)}$ 1.25	ΔH AVE = 1.84		T_s AVE = 40.7	Tm AVE = 52.6				

COMMENTS: @ nozzle plugged

EPA (Dun 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number Dust-1-4

Date 12-3-80
Initial DU

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	40.7
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	43.07
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	~~1.0~~ .99
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.73
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.19
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$	Vs	3721.8
Total sample time, minutes	θ	60
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (41 + 460)(43.07)}{(3722)(60)(29.19)(.99)(.183^2)}$	% I	103.7

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer
Run No.: Dust-1-4
Sample Location: Dust Collector
Sample Date: 12-3-80
Sample Box No.: 8
Recovery Date:
Sample Type: Mass
Cleanup Person:

Filter No.: 63
Sample No.:
Sample Material Description:

MOISTURE AND/OR SAMPLE

Impinger Sequence	1	2	3	4	5
Impinger Type a/					
Impinger Solution					
Final Volume (wt) b/		N/A			
Initial Volume (wt) b/					
Net Volume (wt) b/					
Sample No.(s)					

Combined impinger contents, Sample No.:
Liquid Level Marked: Container(s) Sealed:
Description of Impinger Solution:
Total Moisture, gm: Assumed 1%

SILICA GEL

N/A

Silica Gel
Color:

a/ S = Greenburg-Smith standard, M = Modified, O = Other
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No. 119
Liquid Level Marked:
Sealed:

Impinger Rinse: Sample No.:
Liquid Level Marked:
Sealed:

Water Blank: Sample No.:
Liquid Level Marked:

Dry Catch: Sample No.:
Description:
Sealed:

Acetone Blank: Sample No. 121
Liquid Level Marked:
Sealed:

Filter Blank: Sample No.:
Sealed:

Sample Disposition:
Carrier: Date Shipped:
Remarks:

Date of laboratory custody: Seal(s) broken by:
Personnel accepting custody: Date broken:
Remarks:

MIDWEST RESEARCH INSTITUTE

Run No. Quest-1-4 PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

	1	2	3	4	5	6
Impinger Sequence						
Impinger Type*						
Final Volume**						
Initial Volume**						
Difference						

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
119		5	88.03765	85.90721	130		
	63	6	1.11533	0.78933			
		6					
		6					
		7					
		8					
		9					
121		10	95.51~~256~~ 922	45.51~~922~~ 546	130		

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-293

Source Identification Dust Collector

Test Run Number Dust-1-4

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	12-3-80	1455-1533		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	12-3-80	1555-1610	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-15-80		PAVELONIS	
Write Up				

FILE NAME - BAG0441
RUN # - BAG-0-4-4-(1)
LOCATION - PFIZER
DATE - 10-24-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	445.600
FINAL METER VOLUME (CUBIC FEET)=	542.810
METER FACTOR= 1	
NET METER VOLUME (CUBIC FEET)=	97.210
GAS VOLUME (DRY STANDARD CUBIC FEET)=	95.362
BAROMETRIC PRESSURE (IN. HG)=	29.41
STATIC PRESSURE (INCHES H20)=	0.44
PERCENT OXYGEN=	13.17
PERCENT CARBON DIOXIDE=	14.33
MOISTURE COLLECTED (ML)=	104.3
PERCENT WATER=	4.90
AVERAGE METER TEMPERATURE (F.)=	70.2
AVERAGE DELTA H (IN. H20)=	1.05
AVERAGE DELTA P (IN. H20)=	0.39
AVERAGE STACK TEMPERATURE (F.)=	353.3
DRY MOLECULAR WEIGHT=	30.820
WET MOLECULAR WEIGHT=	30.192
AVERAGE SQUARE ROOT OF DELTA P (IN. H20)=	0.6213
% ISOKINETIC=	99.9
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	180.0
NOZZLE DIAMETER (INCHES)=	0.2500
STACK AXIS #1 (INCHES)=	33.25
STACK AXIS #2 (INCHES)=	33.25
CIRCULAR STACK	
STACK AREA (SQUARE FEET)=	6.030
STACK VELOCITY (ACTUAL, FEET/MIN)=	2,560
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	15,438
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	9,862
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	~~9,769~~ 9378

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	0.0162
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.0026
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.0016
EMISSION RATE (LB/HR)=	~~0.22~~ .21

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	0.0162
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.0026
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.0016
EMISSION RATE (LB/HR)=	~~0.22~~ .21
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - BAG044
RUN # - BAG-0-4-4
LOCATION - PFIZER
DATE - 10-24-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	12.618
FINAL METER VOLUME (CUBIC METERS)=	15.370
METER FACTOR= 1	
NET METER VOLUME (CUBIC METERS)=	2.753
GAS VOLUME (DRY STANDARD CUBIC METERS)=	2.700
BAROMETRIC PRESSURE (MM HG)=	747.01
STATIC PRESSURE (MM H2O)=	11.2
PERCENT OXYGEN=	13.17
PERCENT CARBON DIOXIDE=	14.33
MOISTURE COLLECTED (ML)=	104.3
PERCENT WATER=	4.90
AVERAGE METER TEMPERATURE (C.)=	21.2
AVERAGE DELTA H (MM H2O)=	26.8
AVERAGE DELTA P (MM H2O)=	10.0
AVERAGE STACK TEMPERATURE (C.)=	178.5
DRY MOLECULAR WEIGHT=	30.820
WET MOLECULAR WEIGHT=	30.192
AVERAGE SQUARE ROOT OF DELTA P (MM H2O)=	3.1312
% ISOKINETIC=	99.9
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	180.0
NOZZLE DIAMETER (MM)=	6.35
STACK AXIS #1 (METERS)=	0.845
STACK AXIS #2 (METERS)=	0.845
CIRCULAR STACK	
STACK AREA (SQUARE METERS)=	0.560
STACK VELOCITY (ACTUAL, M/MIN)=	780
FLOW RATE (ACTUAL, CUBIC M/MIN)=	437
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	279
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	~~277~~ 265

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	0.0162
PARTICULATE LOADING, DRY STD. (G/CU. M)=	0.0060
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	0.0036
EMISSION RATE (KG/HR)=	~~0.10~~ 0.096

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	0.0162
PARTICULATE LOADING, DRY STD. (G/CU. M)=	0.0060
PARTICULATE LOADING, ACTUAL (G/CU. M)=	0.0036
EMISSION RATE (KG/HR)=	~~0.10~~ 0.096
PERCENT IMPINGER CATCH=	0.0

FILE NAME - BAG044
RUN # - BAG-0-4-4
LOCATION - PFIZER
DATE - 10-24-80
PROECT # - 4891-L93

POINT #	DELTA P (IN. H20)	DELTA H (IN. H20)	STACK T (F.)	METER T. IN(F.)	METER T. OUT(F.)
1	0.35	0.90	340	58	56
2	0.55	1.35	356	60	56
3	0.32	0.86	356	63	57
4	0.32	0.90	357	64	58
5	0.50	1.35	357	66	58
6	0.30	0.82	353	67	58
7	0.55	1.40	353	67	59
8	0.35	0.96	340	66	60
9	0.55	1.50	350	68	60
10	0.30	0.85	352	70	61
11	0.48	1.35	355	72	61
12	0.29	0.85	355	72	62
13	0.45	1.25	353	71	62
14	0.50	1.35	352	72	62
15	0.30	0.83	352	69	62
16	0.35	0.95	342	70	64
17	0.55	1.40	352	70	64
18	0.32	0.93	353	72	64
19	0.32	0.95	353	74	64
20	0.48	1.30	357	77	65
21	0.27	0.76	353	78	66
22	0.49	1.35	357	78	66
23	0.35	0.96	340	73	67
24	0.50	1.35	350	74	67
25	0.27	0.73	352	76	67
26	0.51	1.35	356	79	68
27	0.27	0.74	357	80	69
28	0.30	0.82	362	79	69
29	0.50	1.30	357	80	70
30	0.27	0.74	357	75	70
31	0.34	0.89	352	75	70
32	0.49	1.30	355	78	70
33	0.50	1.30	358	79	70
34	0.30	0.82	356	77	70
35	0.47	1.25	355	75	70
36	0.29	0.76	355	74	69
37	0.45	1.20	354	75	69
38	0.35	0.94	340	74	69
39	0.54	1.40	352	74	68
40	0.31	0.84	350	74	68
41	0.52	1.35	353	75	68
42	0.30	0.82	353	76	69
43	0.27	0.73	352	77	69
44	0.47	1.25	352	78	69
45	0.27	0.72	352	76	70
46	0.35	0.96	345	76	70
47	0.50	1.35	350	76	70
48	0.50	1.35	353	77	70
49	0.28	0.76	352	77	70
50	0.48	1.30	357	78	70
51	0.30	0.82	357	79	70
52	0.45	1.20	355	80	70
53	0.35	0.95	344	77	70
54	0.47	1.20	357	77	70

55	0.31	0.84	357	79	71
56	0.52	1.35	362	80	71
57	0.29	0.80	362	80	71
58	0.27	0.74	362	78	71
59	0.47	1.25	360	77	71
60	0.27	0.71	358	76	70

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	0.3099	0.3084	0.0004	0.0011

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	84.9681	84.9529	170.0	0.0151
IMPINGERS	0.0000	0.0000	0.0	0.0000

PROBE RINSE BLANK (MG/ML)= 4.25532E-04
IMPINGER BLANK (MG/ML)= 0

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MIDWEST RESEARCH INSTITUTE

RUN Bag-0-4-4

MRI Project Number 1
Field Dates 10-15
Plant Pfizer
Sampling Location Baghouse Outlet
Sampling Date 10-24-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Hansen
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-24-80

SAMPLING LOCATION Baghouse Outlet Bag-0-4-4

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	60
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	4.25
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.41
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.44
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	~~365~~ ~~334~~
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	~~.3~~ .31
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.45
C FACTOR	.98	
CALCULATED NOZZLE DIAMETER, in.	~~5/16"~~ ~~.25~~	5/16"
ACTUAL NOZZLE DIAMETER, in.	.25	
REFERENCE Δp, in. H_2O	.70	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Baghouse Outlet
Test Number Bay-O-4-4

Date 10-24-80
Initial MH

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where:

$$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	60
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.954
Nozzle diameter, inches	Dn	.25
Barometric pressure, inches Hg	Pb	29.41
$\frac{5.168\ (60 + 460)\ (.84)\ (3)\ (.954)\ (.25^2)}{\sqrt{29.41}}$	K	74.46

FIELD DATA

PLANT: Pfizer
DATE: 10-24-80
SAMPLING LOCATION: Baghouse Outlet
SAMPLE TYPE: Particulate
RUN NUMBER: Bag-0-4-4
OPERATOR: M. Hansen
AMBIENT TEMPERATURE: 64°F
BAROMETRIC PRESSURE: 29.41
STATIC PRESSURE, (P_s): -.44
FILTER NUMBER (s): 27

SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE: 3' SS
NOZZLE I.D.: .25
ASSUMED MOISTURE, %: 4.6
SAMPLE BOX NUMBER: 12
METER BOX NUMBER: 4-3
METER $\Delta H_@$: 1.84
C FACTOR: .98
PROBE HEATER SETTING: No. 9
HEATER BOX SETTING: 550
REFERENCE Δp: .70

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 10" Hg, CFM 0.0

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 74.46 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min (0 → 1144)	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 445.6 Desired	Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
4 quad.	3	1147	447.16	447.13	.35	.90	.90	340	58	56	4.5	202	56
	6	1150	449.09	448.90	.55	1.35	1.35	356	60	56	5.0	206	55
	9	1153	450.56	450.42	.32	.84	.86	356	63	57	5.0	—	58
	12	1156	452.03	451.92	.32	.84	.90	357	64	58	5.0	203	58
	15	1159	453.87	453.69	.50	1.30	1.35	357	66	58	5.0	207	58
	18	1202	455.30	455.21	.30	.78	.82	353	67	58	4.5	210	60
	21	1205	457.24	457.03	.55	1.35	1.40	353	67	59	6.25	210	60
	Stop 1205				~~.30~~	~~.78~~		~~3~~					
	Start 1208				~~.35~~	~~.90~~		~~340~~					
	24	1210	458.80	458.57	.35	.90	.96	340	66	60	4.5	228	62
	27	1213	460.74	460.44	.55	1.35	1.50	350	68	60	6.5	230	61
	30	1216	462.17	461.97	.30	.78	.85	352	70	61	5.0	232	61
	33	1219	463.98	463.73	.48	1.25	1.35	355	72	61	5.0	—	62
	36	1222	465.38	465.27	.29	.77	.85	355	72	62	4.75	234	62
	39	1225	467.13	466.86	.45	1.20	1.25	353	71	62	5.0	233	63
	42	1228	468.98	468.71	.50	1.30	1.35	352	72	62	5.5	232	61
	~~45~~	Stop 1230	~~470.41~~		~~.30~~	~~.78~~		~~352~~					
		Start 1233											
	45	1234	470.41	470.20	.30	.78	.83	352	69	62	5.5	—	64
	48	1237	471.97	471.75	.35	.90	.95	342	70	64	5.5	238	61
	51	1240	473.91	473.58	.55	1.35	1.40	352	70	64	5.75	235	58
	54	1243	475.39	475.15	.32	.84	.93	353	72	64	4.5	240	60
	57	1246	476.87	476.71	.32	.84	.95	353	74	64	4.75	—	61

COMMENTS: - Impinger temps are wind chilled.

EPA (Dun 235

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TRAVERSE POINT NUMBER	SAMPLING TIME min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
4 quad ~~60~~	60	1249	478.67	478.44	.48	1.25	1.30	357	77	65	5.25	—	60
	63	1252	480.03	479.93	.27	.70	.76	353	78	66	4.5	243	63
	66	1255	481.85	481.66	.49	1.28	1.35	357	78	66	6.25	—	60
	stop 1255				~~.27~~	.70							
	start 1258												
	69	1301	483.41	483.23	.35	.90	.96	340	73	67	5.0	246	62
	72	1304	485.08	485.03	.50	1.30	1.35	350	74	67	6.25	245	59
	75	1307	486.44	486.45	.27	.70	.73	352	76	67	5.0	248	62
	78	1310	488.30	488.18	.51	1.35	1.35	356	79	68	6.0	—	62
	81	1313	489.65	489.63	.27	.70	.74	357	80	69	4.75	252	63
	84	1316	491.07	491.08	.30	.78	.82	362	79	69	5.0	252	64
	87	1319	492.91	492.88	.50	1.30	1.30	357	80	70	6.0	252	62
	stop 1320		~~494.26~~		~~.27~~	~~.70~~		~~359~~					
	start 1323												
	90	1324	494.26	494.34	.27	.70	.74	357	75	70	4.25	250	67
	93	1327	495.78	495.83	.34	.87	.89	352	75	70	5.0	251	63
	96	1330	497.61	497.59	.49	1.28	1.30	355	78	70	5.5	260	60
	99	1333	499.45	499.40	.50	1.30	1.30	358	79	70	5.5	244	60
	102	1336	500.88	500.90	.30	.78	.82	356	77	70	5.0	237	61
	105	1339	502.67	502.63	.47	1.22	1.25	355	75	70	5.0	237	59
	108	1342	504.07	504.12	.29	.75	.76	355	74	69	4.5	238	60
	~~HH~~ stop 1345		~~505.82~~		~~.45~~	~~1.18~~	~~1.20~~	~~354~~	~~75~~	~~69~~	~~6.0~~	~~240~~	~~60~~
	start 1348												
	111	1348	505.82	505.78	.45	1.18	1.20	354	75	69	6.0	240	60
	114	1351	507.38	507.36	.35	.92	.94	340	74	69	4.5	245	62
	117	1354	509.30	509.17	.54	1.40	1.40	352	74	68	6.5	237	60
	120	1357	510.76	510.70	.31	.82	.84	350	74	68	5.0	242	61
	123	1400	512.64	512.47	.52	1.35	1.35	353	75	68	6.25	244	61
	126	1403	514.07	513.97	.30	.78	.82	353	76	69	4.75	250	63
	129	1406	515.43	515.37	.27	.70	.73	352	77	69	4.50	251	65
	132	1409	517.22	517.06	.47	1.22	1.25	352	78	69	6.25	257	65
	stop 1410		~~518.58~~		~~.27~~	~~.70~~		~~352~~					

Run Number Bag-0-4-4 Date 10-24-80 Sampling Location Bag-0-

Comments:

EPA (Out) 236
4 72

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
4quad.		Stop 1410											
		Start 1413											
	135	1414	518.58	518.48	.27	.70	.72	352	76	70	5.0	260	70
	138	1417	520.13	520.03	.35	.93	.96	345	76	70	5.5	252	65
	141	1420	521.98	521.84	.50	1.30	1.35	350	76	70	6.25	250	62
	144	1423	523.83	523.68	.50	1.30	1.35	353	77	70	6.25	250	62
	147	1426	525.21	525.16	.28	.72	.76	352	77	70	4.25	249	64
	150	1429	527.01	526.93	.48	1.25	1.30	357	78	70	6.0	247	64
	153	1432	528.44	528.45	.30	.78	.82	357	79	70	4.75	248	65
		Stop 1435	~~530.19~~		~~.45~~	~~1.18~~	~~1.20~~	~~355~~	~~80~~	~~70~~	~~5.25~~	~~252~~	~~65~~
		Start 1438											
	156	1438	530.19	530.14	.45	1.18	1.20	355	80	70	5.25	252	65
	159	1441	531.74	531.70	.35	.93	.95	344	77	70	5.25	256	67
	162	1444	533.53	533.41	.47	1.22	1.20	357	77	70	6.25	258	65
	165	1447	534.98	534.94	.31	.80	.84	357	79	71	5.0	260	67
168	~~168~~	1450	536.85	536.74	.52	1.35	1.35	362	80	71	6.25	259	66
	171	1453	538.25	538.20	.29	.75	.80	362	80	71	4.25	258	67
	174	1456	539.60	539.62	.27	.70	.74	362	78	71	4.25	256	66
	177	1459	541.38	541.37	.47	1.22	1.25	360	77	71	6.25	250	65
		stop 1500	~~542.72~~		~~.27~~	~~.70~~		~~358~~					
		start 1503											
	180	1504	542.72	542.81	.27	.70	.71	358	76	70	5.0	256	70
											70.24		
			V_m = 97.21		Δp = .382	ΔH = 1.055		T_s = 353.3	T_m = 60.87				

Run Number Bag-0-4-4 Date 10-24-80 Sampling Location Bag Outlet

Comments:

EPA (Dur) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Baghouse Outlet
Test Number Bag-0-4-4

Date 10-24-80
Initial A.C.

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	353.3
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1.055$, $Pb = 29.41$, $Vm = 97.21$, $Tm + 460 = 530.24$	Vm_{std}	95.36
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 4.91$	Mf	.951
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$ 14.33 13.17 72.5 0	Md	30.82
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.19
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) + .44	Ps	29.44
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .392$, $C_p = .84$	Vs	2580
Total sample time, minutes	θ	180
Nozzle diameter, inches	Dn	.25
$\frac{1{,}039\ (353.3 + 460)(95.36)}{(2580)(180)(29.44)(.951)(.25^2)}$	% I	99.16

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer
Sample Location: Baghouse Outlet
Sample Box No.: 12
Sample Type: Particulate

Run No.: Bag-0-4-4
Sample Date: 10-24-80
Recovery Date: 10-24-80
Cleanup Person: _____

Filter No.: 27
Sample No.: _____
Sample Material Description: _____

MOISTURE AND/OR SAMPLE

Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	Dry		
Final Volume (wt) b/	169	114	1		
Initial Volume (wt) b/	100	100	~~100~~		
Net Volume (wt) b/	69	14	1		
Sample No.(s)					

Combined impinger contents, Sample No. _____
Liquid Level Marked _____ Container(s) Sealed _____
Description of Impinger Solution _____
Total Moisture, gm: 104.3

SILICA GEL

665.8	
645.5	
20.3	

Silica Gel Color _____

a/ S = Greenburg-Smith standard, M = Modified, O = Other _____
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No. 54
Liquid Level Marked _____
Sealed _____

Impinger Rinse: Sample No. _____
Liquid Level Marked _____
Sealed _____

Water Blank: Sample No. _____
Liquid Level Marked _____

Dry Catch: Sample No. _____
Description _____
Sealed _____

Acetone Blank: Sample No. 39
Liquid Level Marked _____
Sealed _____

Filter Blank: Sample No. _____
Sealed _____

Sample Disposition _____
Carrier _____ Date Shipped: _____
Remarks: _____

Date of laboratory custody _____ Seal(s) broken by _____
Personnel accepting custody _____ Date broken _____
Remarks: ON SITE

MIDWEST RESEARCH INSTITUTE

Run No. Bag-0-4-4 PARTICULATE CLEAN-UP AND ANALYSIS

Date 10-27-80 FIELD ANALYSIS Performed by J.J.

	1	2	3	4	5	6
Impinger Sequence						
Impinger Type*						
Final Volume**						
Initial Volume**						
Difference						

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
54		5	84.96810	84.95288	170	J.J.	10-23-80
	27	6	0.30989	0.30844		J.J.	10-21
		6					
		6					
		7					
		8					
		9					
39		10	88.57768	88.57758	235	J.J.	10-24

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L93

Source Identification Baghouse-Outlet

Test Run Number Bag-0-4-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-24-80	1144-1504		
Probe Technician				
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	10-24-80	1504-1520	Whitel, Hansen, Kaja	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

FILE NAME - BAGI341
RUN # - BAG-I-3-4-(1)
LOCATION - PFIZER
DATE - 10-23-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	679.076
FINAL METER VOLUME (CUBIC FEET)=	689.992
METER FACTOR= 1	
NET METER VOLUME (CUBIC FEET)=	10.916
GAS VOLUME (DRY STANDARD CUBIC FEET)=	11.045
BAROMETRIC PRESSURE (IN. HG)=	29.70
STATIC PRESSURE (INCHES H20)=	-30.60
PERCENT OXYGEN=	13.17
PERCENT CARBON DIOXIDE=	18.83
MOISTURE COLLECTED (ML)=	12.8
PERCENT WATER=	5.18
AVERAGE METER TEMPERATURE (F.)=	60.2
AVERAGE DELTA H (IN. H20)=	1.88
AVERAGE DELTA P (IN. H20)=	0.40
AVERAGE STACK TEMPERATURE (F.)=	409.2
DRY MOLECULAR WEIGHT=	31.540
WET MOLECULAR WEIGHT=	30.839
AVERAGE SQUARE ROOT OF DELTA P (IN. H20)=	0.6292
% ISOKINETIC=	106.2
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	15.0
NOZZLE DIAMETER (INCHES)=	0.2960
STACK AXIS #1 (INCHES)=	46.75
STACK AXIS #2 (INCHES)=	72.00
RECTANGULAR STACK	
STACK AREA (SQUARE FEET)=	23.375
STACK VELOCITY (ACTUAL, FEET/MIN)=	2,747
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	64,205
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	35,782
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	~~35,443~~ 33,929

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	3.0434
PARTICULATE LOADING, DRY STD. (GR./SCF)=	4.2434
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	2.2416
EMISSION RATE (LB/HR)=	~~1288.91~~ 1233.83

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	3.0434
PARTICULATE LOADING, DRY STD. (GR./SCF)=	4.2434
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	2.2416
EMISSION RATE (LB/HR)=	~~1288.91~~ 1233.83
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - BAGI34
RUN # - BAG-I-3-4
LOCATION - PFIZER
DATE - 10-23-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	19.229
FINAL METER VOLUME (CUBIC METERS)=	19.538
METER FACTOR= 1	
NET METER VOLUME (CUBIC METERS)=	0.309
GAS VOLUME (DRY STANDARD CUBIC METERS)=	0.313
BAROMETRIC PRESSURE (MM HG)=	754.38
STATIC PRESSURE (MM H2O)=	-777.2
PERCENT OXYGEN=	13.17
PERCENT CARBON DIOXIDE=	18.83
MOISTURE COLLECTED (ML)=	12.8
PERCENT WATER=	5.18
AVERAGE METER TEMPERATURE (C.)=	15.7
AVERAGE DELTA H (MM H2O)=	47.8
AVERAGE DELTA P (MM H2O)=	10.1
AVERAGE STACK TEMPERATURE (C.)=	209.6
DRY MOLECULAR WEIGHT=	31.540
WET MOLECULAR WEIGHT=	30.839
AVERAGE SQUARE ROOT OF DELTA P (MM H2O)=	3.1710
% ISOKINETIC=	106.2
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	15.0
NOZZLE DIAMETER (MM)=	7.52
STACK AXIS #1 (METERS)=	1.187
STACK AXIS #2 (METERS)=	1.829
RECTANGULAR STACK	
STACK AREA (SQUARE METERS)=	2.172
STACK VELOCITY (ACTUAL, M/MIN)=	837
FLOW RATE (ACTUAL, CUBIC M/MIN)=	1,818
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	1,013
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	~~1,004~~ 961

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	3.0434
PARTICULATE LOADING, DRY STD. (G/CU. M)=	9.7311
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	5.1405
EMISSION RATE (KG/HR)=	~~585.16~~ 560.16

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	3.0434
PARTICULATE LOADING, DRY STD. (G/CU. M)=	9.7311
PARTICULATE LOADING, ACTUAL (G/CU. M)=	5.1405
EMISSION RATE (KG/HR)=	~~585.16~~ 560.16
PERCENT IMPINGER CATCH=	0.0

FILE NAME - BAGI34
RUN # - BAG-I-3-4
LOCATION - PFIZER
DATE - 10-23-80
PROECT # - 4891-L93

POINT #	DELTA P (IN. H20)	DELTA H (IN. H20)	STACK T (F.)	METER T. IN(F.)	METER T. OUT(F.)
1	0.41	1.80	409	58	58
2	0.41	1.90	410	60	58
3	0.40	2.00	413	62	58
4	0.38	1.85	405	64	58
5	0.38	1.85	409	67	59

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	2.1709	0.7797	-0.0030	1.3942

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	1.6488	0.0000	300.0	1.6492
IMPINGERS	0.0000	0.0000	0.0	0.0000

PROBE RINSE BLANK (MG/ML)=-1.36364E-03
IMPINGER BLANK (MG/ML)= 0

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MIDWEST RESEARCH INSTITUTE

RUN Bag-I-2-04

MRI Project Number 4891-L(93)
Field Dates 10-15 through
Plant Pfizer
Sampling Location Baghouse Inlet
Sampling Date 10-23-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Whited
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-23-80

SAMPLING LOCATION Baghouse Inlet, Bag-I-3-~~4~~

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	60 ~~75~~
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.70
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	27.45
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.92
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	400
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.31
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	.86	
CALCULATED NOZZLE DIAMETER, in.	.32	
ACTUAL NOZZLE DIAMETER, in.	.296	
REFERENCE Δp, in. H_2O	.42	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Baghouse Inlet
Test Number Bag-I-3-4

Date 10-23-80
Initial RCS

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where:

$$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

ΔPs = Velocity head of S pitot, inches H_2O

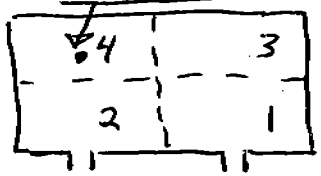
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	45
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	15
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.296
Barometric pressure, inches Hg	Pb	29.70
$\frac{5.168\ (45 + 460)\ (.84)\ (3)\ (.95)\ (.296^2)}{\sqrt{29.70}}$	K	100.45

FIELD DATA

PLANT Pfizer
DATE 10-23-80
SAMPLING LOCATION Baghouse Inlet
SAMPLE TYPE Particulate
RUN NUMBER Bag-I-3-4
OPERATOR RCS
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.70
STATIC PRESSURE, (P_s) -2.25" Hg
FILTER NUMBER (s) 25

Sample Point



TOP VIEW

PROBE LENGTH AND TYPE 4' SS
NOZZLE I.D. .296
ASSUMED MOISTURE, % 5
SAMPLE BOX NUMBER 8
METER BOX NUMBER ~~8~~ 5
METER $\Delta H_@$ 1.84
C FACTOR .86
PROBE HEATER SETTING 90
HEATER BOX SETTING 400
REFERENCE Δp .42

Leak CK: Initial at 15" Hg, CFM .004
8" Hg Final at Hg, CFM .001

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 100.45 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1436		679.076 ~~678.820~~									
Bag-I-3-4	3	1439	681.26	681.01	0.41	1.80	1.80	409	58	58	7	250	
	6	1442	683.44	683.22	0.41	1.80	1.90	410	60	58	7.5	255	
	9	1445	685.59	685.45	0.40	1.78	2.00	413	62	58	8	253	
	12	1448	687.70	687.63	0.38	1.68	1.85	405	64	58	8	257	60
	15	1451	689.80	689.892	0.38	1.68	1.85	409	67	59	8	260	
						Avg ΔH =	1.88						
			V_m = 10.926		Δp_s = 0.396			Avg T_s = 407.2	Avg T_m = 60.2		Avg $T_{\square}$ = 255		

COMMENTS

$\sqrt{\Delta p_s}$ = 0.629

EPA (Dur) 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant: Pfizer
Sampling Location: Baghouse Inlet
Test Number: Bag-I-3-4

Date: 10-23-86
Initial: RCS

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	409.2
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.88, Pb = 29.7, Vm = 10.916, Tm+460 = 520.2	Vm_{std}	11.045
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 5.19	Mf	.948
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$ 18.83 13.17 68 0	Md	31.54
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.840
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) P_s = -2.25" Hg	Ps	27.45
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ Δp = .396, C_p = .84	Vs	~~2763.05~~ 2747
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	0.296
$\frac{1{,}039\ (409.2 + 460)(11.045)}{(2747.0)(15)(27.45)(0.948)(.296^2)}$	% I	106.2

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer
Sample Location: Baghouse Inlet
Sample Box No.: 8
Sample Type: Particulate

Run No.: Bag-I-3-4
Sample Date: 10-23-80
Recovery Date:
Cleanup Person:

Filter No.: #25
Sample No.: Bag-I-3-4
Sample Material Description: Ca particulate

MOISTURE AND/OR SAMPLE

	1	2	3	4	5
Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	O		
Final Volume (wt) b/	108	102.0			
Initial Volume (wt) b/	100	100.0	0		
Net Volume (wt) b/	8	2			
Sample No.(s)					

Combined impinger contents, Sample No.:
Liquid Level Marked: Container(s) Sealed:
Description of Impinger Solution: D. H_2O
Total Moisture, gm: 12.8

SILICA GEL

	649.9	
	647.1	
	2.8	

Silica Gel Color:

a/ S = Greenburg-Smith standard, M = Modified, O = Other
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: Sample No. 31 + 35
Liquid Level Marked:
Sealed:

Impinger Rinse: Sample No.:
Liquid Level Marked:
Sealed:

Water Blank: Sample No.:
Liquid Level Marked:

Dry Catch: Sample No.:
Description:
Sealed:

Acetone Blank: Sample No. 23
Liquid Level Marked:
Sealed:

Filter Blank: Sample No.:
Sealed:

Sample Disposition:
Carrier: Date Shipped:
Remarks:

Date of laboratory custody: Seal(s) broken by:
Personnel accepting custody: Date broken:
Remarks: LAB ANALYSIS ON SITE

MIDWEST RESEARCH INSTITUTE

Run No. Bay-F-3-4 PARTICULATE CLEAN-UP AND ANALYSIS

Date 10- FIELD ANALYSIS Performed by CW

Impinger Sequence	1	2	3	4	5	6
Impinger Type*						
Final Volume**	108	102	0	649.9		
Initial Volume**	100	100	0	647.1		
Difference	8	2	0	2.8		

* S = Greenburg-Smith standard, M = modified, O = Other S

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
31 ~~335~~		5	90.74296 90.06806	89.63350 89.52870	300	JJ	10/22
		5			~~300~~		
	~~25,34~~	6		~~87.63350-31~~ ~~87.52870-35~~		~~J.J.~~	~~10-22~~
	25	6	2.17085	0.77967		J.J.	10-21
		6					
		7					
		8					
		9					
23		10	82.56312	82.56336	176	J.J.	10-23-80

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L (93)

Source Identification Baghouse Inlet

Test Run Number Bag-I-3-4

Pollutant(s) in Sample Particulate, Mass

Task	Date	Time	Personnel	Remarks
Sampling				
Probe Technician	10-23-80	1600	Whited	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	1600	1620	Roja, Stultz, Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

FILE NAME - ESP0431
RUN # - ESP-0-4-3-(1)
LOCATION - PFIZER
DATE - 11-4-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	80.596
FINAL METER VOLUME (CUBIC FEET)=	100.475
METER FACTOR= 1.015	
NET METER VOLUME (CUBIC FEET)=	20.177
GAS VOLUME (DRY STANDARD CUBIC FEET)=	20.259
BAROMETRIC PRESSURE (IN. HG)=	29.03
STATIC PRESSURE (INCHES H20)=	-0.52
PERCENT OXYGEN=	11.83
PERCENT CARBON DIOXIDE=	17.00
MOISTURE COLLECTED (ML)=	30.0
PERCENT WATER=	6.52
AVERAGE METER TEMPERATURE (F.)=	52.1
AVERAGE DELTA H (IN. H20)=	1.61
AVERAGE DELTA P (IN. H20)=	0.13
AVERAGE STACK TEMPERATURE (F.)=	505.0
DRY MOLECULAR WEIGHT=	31.193
WET MOLECULAR WEIGHT=	30.333
AVERAGE SQUARE ROOT OF DELTA P (IN. H20)=	0.3612
% ISOKINETIC=	109.6
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	30.0
NOZZLE DIAMETER (INCHES)=	0.3740
STACK AXIS #1 (INCHES)=	39.00
STACK AXIS #2 (INCHES)=	36.00
RECTANGULAR STACK	
STACK AREA (SQUARE FEET)=	9.750
STACK VELOCITY (ACTUAL, FEET/MIN)=	1,630
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	15,893
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	8,426
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	~~8,347~~ 7876

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	0.5713
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.4342
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.2151
EMISSION RATE (LB/HR)=	~~31.06~~ 29.3

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	0.5713
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.4342
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.2151
EMISSION RATE (LB/HR)=	~~31.06~~ 29.3
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - ESP0431
RUN # - ESP-0-4-3-(1)
LOCATION - PFIZER
DATE - 11-4-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	2.282
FINAL METER VOLUME (CUBIC METERS)=	2.845
METER FACTOR= 1.015	
NET METER VOLUME (CUBIC METERS)=	0.571
GAS VOLUME (DRY STANDARD CUBIC METERS)=	0.574
BAROMETRIC PRESSURE (MM HG)=	737.36
STATIC PRESSURE (MM H20)=	-13.2
PERCENT OXYGEN=	11.83
PERCENT CARBON DIOXIDE=	17.00
MOISTURE COLLECTED (ML)=	30.0
PERCENT WATER=	6.52
AVERAGE METER TEMPERATURE (C.)=	11.2
AVERAGE DELTA H (MM H20)=	40.9
AVERAGE DELTA P (MM H20)=	3.3
AVERAGE STACK TEMPERATURE (C.)=	262.8
DRY MOLECULAR WEIGHT=	31.193
WET MOLECULAR WEIGHT=	30.333
AVERAGE SQUARE ROOT OF DELTA P (MM H20)=	1.8203
% ISOKINETIC=	109.6
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	30.0
NOZZLE DIAMETER (MM)=	9.50
STACK AXIS #1 (METERS)=	0.991
STACK AXIS #2 (METERS)=	0.914
RECTANGULAR STACK	
STACK AREA (SQUARE METERS)=	0.906
STACK VELOCITY (ACTUAL, M/MIN)=	497
FLOW RATE (ACTUAL, CUBIC M/MIN)=	450
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	239
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	~~236~~ 223.

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	0.5713
PARTICULATE LOADING, DRY STD. (G/CU. M)=	0.9958
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	0.4933
EMISSION RATE (KG/HR)=	~~14.10~~ 13.31

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	0.5713
PARTICULATE LOADING, DRY STD. (G/CU. M)=	0.9958
PARTICULATE LOADING, ACTUAL (G/CU. M)=	0.4933
EMISSION RATE (KG/HR)=	~~14.10~~ 13.31
PERCENT IMPINGER CATCH=	0.0

FILE NAME - ESP0431
RUN # - ESP-0-4-3-(1)
LOCATION - PFIZER
DATE - 11-4-80
PROECT # - 4891-L93

POINT #	DELTA P (IN. H2O)	DELTA H (IN. H2O)	STACK T (F.)	METER T. IN(F.)	METER T. OUT(F.)
1	0.14	1.70	505	48	48
2	0.14	1.70	500	51	48
3	0.14	1.70	500	53	50
4	0.14	1.70	500	54	50
5	0.14	1.70	515	55	50
6	0.13	1.70	510	56	51
7	0.13	1.65	510	56	51
8	0.13	1.45	500	56	51
9	0.13	1.35	500	56	51
10	0.13	1.45	510	56	51

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	0.6048	0.3079	0.0004	0.2966

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	90.4600	90.1859	225.0	0.2747
IMPINGERS	0.0000	0.0000	0.0	0.0000

PROBE RINSE BLANK (MG/ML)=-2.6E-03
IMPINGER BLANK (MG/ML)= 0

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MIDWEST RESEARCH INSTITUTE

RUN ESP-0-4-3(1)

MRI Project Number 4891-L-93
Field Dates 10-4-80
Plant Pfizer
Sampling Location ESP Outlet
Sampling Date 10-2-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whited
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 11-4-80

SAMPLING LOCATION ESP Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	75
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	0.5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.03
STATIC PRESSURE IN STACK, in. Hg - 0.52 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.99
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.9987
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	500
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.156
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	0.375	
ACTUAL NOZZLE DIAMETER, in.	0.374	
REFERENCE Δp, in. H_2O	0.160	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP - 0 - 4 - 3

Date 11-4-80
Initial CC

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where:

$$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

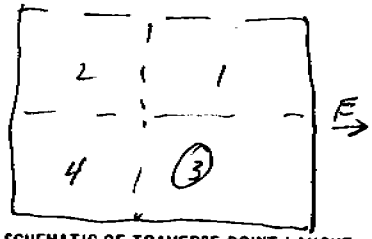
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	75
Pitot coefficient	Cp	0.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	0.95
Nozzle diameter, inches	Dn	0.374
Barometric pressure, inches Hg	Pb	29.03
$\frac{5.168\ (75 + 460)\ (.84)\ (3)\ (.95)\ (.374^2)}{\sqrt{29.03}}$	K	171.84

FIELD DATA

PLANT Pfizer
DATE 11-4-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-0-4-3
OPERATOR Whited
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 28.03
STATIC PRESSURE, (P_s) 0.52" H_2O
FILTER NUMBER (s) 74



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 4' SS
NOZZLE I.D. 0.324
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING 78
HEATER BOX SETTING 400
REFERENCE Δp 0.16

Leak CK: Initial at 15" Hg, CFM 0.005
Final at Hg, CFM 0.007

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 17.84 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	0918	80.596										
	3	0921	82.63	82.58	0.135	1.56	1.7	505	48	48	7	185	48
	6	0924	84.67	84.62	0.135	1.56	1.7	500	51	48	7	190	
	9	0927	86.71	86.62	0.135	1.56	1.7	500	53	50	7	190	
	12	0930	88.75	88.63	0.135	1.56	1.7	500	54	50	7	205	48
	15	0933	90.77	90.82	0.135	1.56	1.7	515	55	50	8	205	
	18	0936	92.72	92.78	0.125	1.45	1.7	510	56	51	8	210	
	21	0939	94.71	94.75	0.130	1.50	1.65	510	56	51	8	210	
	24	0942	96.67	96.71	0.125	1.45	1.45	500	56	51	7½	210	
	27	0945	98.63	98.52	0.125	1.45	1.35	500	56	51	7	220	
	30	0948	100.58	100.47	0.125	1.45	1.45	510	56	51	7½	225	
			Final = 100.475										
			Vm = 19.879		Δp = 0.130	ΔH = 1.61		Ts = 505	Tm = 52.1				

COMMENTS

EPA (Dur) 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP OUTLET
Test Number ESP-0-4-3

Date 11-4-80
Initial CC

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	505
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ DH = 1.61, Pb = 29.03, Vm = 19.879, Tm = 52.1	Vm_{std}	19.96
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	0.95
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.20 ~~31.14~~
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.54 ~~30.49~~
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	28.99
Stack velocity, fpm $\sqrt{\Delta P} = 0.361$ $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$	Vs	~~1625~~ 1624
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	0.374
$\frac{1{,}039\ (505 + 460)(19.96)}{(\cancel{1625}\ 1624)(30)(28.99)(.95)(.374^2)}$	% I	106

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location ESP Outlet
Sample Box No. 12
Sample Type Particulate

Run No. ESP-0-4-3(1)
Sample Date 11-4-80
Recovery Date 11/4/80
Cleanup Person [illegible]

Filter No. 7#
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

	1	2	3	4	5
Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	Dry		
Final Volume (wt) b/	119	104	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	19	4	1		
Sample No.(s)					

SILICA GEL

671.5	
671.5	
0	
Silica Gel	
Color	

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 30.0

a/ S = Greenburg-Smith standard, M = Modified, O = Other
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 46
Liquid Level Marked
Sealed

Impinger Rinse: Sample No.
Liquid Level Marked
Sealed

Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed

Acetone Blank: ~~Sample~~ Beaker No. 114
Liquid Level Marked
Sealed

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

Date of laboratory custody Seal(s) broken by
Personnel accepting custody Date broken
Remarks:

ESP-0-43(1)

Run No. _____

MIDWEST RESEARCH INSTITUTE

PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

	1	2	3	4	5	6
Impinger Sequence						
Impinger Type*						
Final Volume**						
Initial Volume**						
Difference						

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
46		5	90.45996	90.18585	225		
	74	6	0.60481	0.30788			
		6					
		6					
		7					
		8					
		9					
114		10	83.65408	83.65438	115		

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-C-83

Source Identification ESP Outlet

Test Run Number ESP-O-4-3(1)

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	11-4-80	0918-0948	Whited	
Probe Technician				
Meter Technician			Whited	
Other				
Transport of Train to Cleanup Site	11-4-80	0950	Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

FILE NAME - ESP0121
RUN # - ESP-0-1-2-(1)
LOCATION - PFIZER
DATE - 10-28-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	715.600
FINAL METER VOLUME (CUBIC FEET)=	734.880
METER FACTOR= 1.015	
NET METER VOLUME (CUBIC FEET)=	19.569
GAS VOLUME (DRY STANDARD CUBIC FEET)=	20.206
BAROMETRIC PRESSURE (IN. HG)=	29.18
STATIC PRESSURE (INCHES H2O)=	-0.52
PERCENT OXYGEN=	8.00
PERCENT CARBON DIOXIDE=	19.67
MOISTURE COLLECTED (ML)=	27.8
PERCENT WATER=	6.09
AVERAGE METER TEMPERATURE (F.)=	40.4
AVERAGE DELTA H (IN. H2O)=	1.51
AVERAGE DELTA P (IN. H2O)=	0.07
AVERAGE STACK TEMPERATURE (F.)=	461.7
DRY MOLECULAR WEIGHT=	31.467
WET MOLECULAR WEIGHT=	30.648
AVERAGE SQUARE ROOT OF DELTA P (IN. H2O)=	0.2626
% ISOKINETIC=	104.0
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	30.0
NOZZLE DIAMETER (INCHES)=	0.4440
STACK AXIS #1 (INCHES)=	39.00
STACK AXIS #2 (INCHES)=	36.00
RECTANGULAR STACK	
STACK AREA (SQUARE FEET)=	9.750
STACK VELOCITY (ACTUAL, FEET/MIN)=	1,149
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	11,206
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	6,252
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	~~6,194~~ 5871

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	0.4663
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.3554
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.1861
EMISSION RATE (LB/HR)=	~~18.86~~ 17.88

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	0.4663
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.3554
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.1861
EMISSION RATE (LB/HR)=	~~18.86~~ 17.88
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - ESP0121
RUN # - ESP-0-1-2-(1)
LOCATION - PFIZER
DATE - 10-28-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	20.263
FINAL METER VOLUME (CUBIC METERS)=	20.809
METER FACTOR= 1.015	
NET METER VOLUME (CUBIC METERS)=	0.554
GAS VOLUME (DRY STANDARD CUBIC METERS)=	0.572
BAROMETRIC PRESSURE (MM HG)=	741.17
STATIC PRESSURE (MM H2O)=	-13.2
PERCENT OXYGEN=	8.00
PERCENT CARBON DIOXIDE=	19.67
MOISTURE COLLECTED (ML)=	27.8
PERCENT WATER=	6.09
AVERAGE METER TEMPERATURE (C.)=	4.7
AVERAGE DELTA H (MM H2O)=	38.2
AVERAGE DELTA P (MM H2O)=	1.8
AVERAGE STACK TEMPERATURE (C.)=	238.7
DRY MOLECULAR WEIGHT=	31.467
WET MOLECULAR WEIGHT=	30.648
AVERAGE SQUARE ROOT OF DELTA P (MM H2O)=	1.3235
% ISOKINETIC=	104.0
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	30.0
NOZZLE DIAMETER (MM)=	11.28
STACK AXIS #1 (METERS)=	0.991
STACK AXIS #2 (METERS)=	0.914
RECTANGULAR STACK	
STACK AREA (SQUARE METERS)=	0.906
STACK VELOCITY (ACTUAL, M/MIN)=	350
FLOW RATE (ACTUAL, CUBIC M/MIN)=	317
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	177
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	~~175~~ 166

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	0.4663
PARTICULATE LOADING, DRY STD. (G/CU. M)=	0.8149
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	0.4268
EMISSION RATE (KG/HR)=	~~8.56~~ 8.11

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	0.4663
PARTICULATE LOADING, DRY STD. (G/CU. M)=	0.8149
PARTICULATE LOADING, ACTUAL (G/CU. M)=	0.4268
EMISSION RATE (KG/HR)=	~~8.56~~ 8.11
PERCENT IMPINGER CATCH=	0.0

FILE NAME - ESP0121
RUN # - ESP-0-1-2-(1)
LOCATION - PFIZER
DATE - 10-28-80
PROECT # - 4891-L93

POINT #	DELTA P (IN. H20)	DELTA H (IN. H20)	STACK T (F.)	METER T. IN(F.)	METER T. OUT(F.)
1	0.06	1.20	465	35	37
2	0.07	1.40	462	38	37
3	0.07	1.45	462	41	37
4	0.07	1.50	462	42	37
5	0.07	1.60	462	44	38
6	0.07	1.60	460	44	38
7	0.07	1.70	460	45	39
8	0.07	1.65	460	46	39
9	0.07	1.45	462	47	39
10	0.07	1.50	462	46	39

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	0.6274	0.2984	0.0004	0.3287

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	90.1595	90.0129	170.0	0.1376
IMPINGERS	0.0000	0.0000	0.0	0.0000

PROBE RINSE BLANK (MG/ML)= .053
IMPINGER BLANK (MG/ML)= 0

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MIDWEST RESEARCH INSTITUTE

RUN ESP-0-1-2 (1)

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP Outlet
Sampling Date 10-28-80

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

Lab Technician 1 T. Walker
2 J. Pavelonis
3 J. Johnson

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-28-80

SAMPLING LOCATION ESP-Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	40
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5.9
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.18
STATIC PRESSURE IN STACK, in. Hg — *0.52 (MΔH) (P_m ±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	29.22
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	488
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.11
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.14
C FACTOR	0.92	
CALCULATED NOZZLE DIAMETER, in.	~~.375~~ .422 (3/8")	
ACTUAL NOZZLE DIAMETER, in.	.444 (Probe nozzle #19)	
REFERENCE Δp, in. H_2O	~~.125~~ 0.09	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP-Outlet
Test Number ESP-O-1-2 (1)

Date 10-28-80
Initial MDH

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where:

$$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

ΔPs = Velocity head of S pitot, inches H_2O

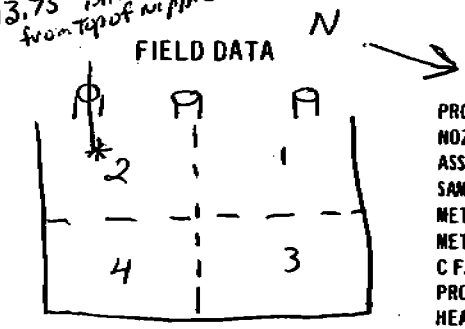
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	40
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.941
Nozzle diameter, inches	Dn	.444
Barometric pressure, inches Hg	Pb	29.18
$\frac{5.168\ (40 + 460)\ (.84)\ (3)\ (.941)\ (.444^2)}{\sqrt{29.18}}$	K	223.62

13.75" into stack from top of nipple

FIELD DATA

PLANT Pfizer
DATE 10-28-80
SAMPLING LOCATION ESP-Outlet
SAMPLE TYPE Mass
RUN NUMBER ESP-O-1-2(1)
OPERATOR M. Hansen
AMBIENT TEMPERATURE 34.0°F
BAROMETRIC PRESSURE 29.18
STATIC PRESSURE, (P_s) -0.52
FILTER NUMBER (s) 17



PROBE LENGTH AND TYPE 3ft, SS
NOZZLE I.D. .444
ASSUMED MOISTURE, % 5.9
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR 0.92
PROBE HEATER SETTING 100°F
HEATER BOX SETTING 550°F
REFERENCE Δp ~~.25~~ .09

Leak CK: Initial at 15" Hg, CFM 0.005
Final at 15" Hg, CFM 0.0

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 223.62 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 715.60 Desired	Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1008											
2quad	3	1011	717.40	717.40	.06	1.2	1.2	465	35	37	6.0	226	46
	6	1014	719.35	719.24	.07	1.4	1.4	462	38	37	7.0	—	—
	9	1017	721.30	721.12	.07	1.4	1.45	462	41	37	7.0	—	—
	12	1020	723.25	723.04	.07	1.4	1.50	462	42	37	8.0	223	46
	15	1023	725.20	725.00	.07	1.4	1.60	462	44	38	8.0	—	—
	18	1026	727.15	726.96	.07	1.4	1.60	460	44	38	8.5	225	48
	21	1029	729.10	728.98	.07	1.4	1.70	460	45	39	8.5	—	—
	24	1032	731.05	730.01	.07	1.4	1.65	460	46	39	9.0	—	—
	27	1035	732.00	732.92	.07	1.4	1.45	462	47	39	8.0	232	50
	30	1038	734.95	734.88	.07	1.4	1.50	462	46	39	8.0	—	—
			V_m = 19.28		Δp = .07		ΔH = 1.505						
							T_s =	461.7	T_m =	40.4			

COMMENTS

EPA (Dun 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP - Outlet
Test Number ESP-O-1-2 (1)

Date 10-28-80
Initial MDH

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	461.7
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ pb=29.18 ΔH=1.505 Vm=19.28 Tm=40.4	Vm_{std}	19.91
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ 6.2% H_2O	Mf	.938
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.37
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.54
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) +0.52	Ps	29.22
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔPs=.07	Vs	1,158
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.444
$\frac{1{,}039\ (461.7 + 460)(19.91)}{(1{,}158)(30)(29.22)(.938)(.444)}$	% I	101.6

PARTICULATE SAMPLE RECOVERY AND INTEGRITY ESPO-1-2(1)

Plant Pfizer
Sample Location ESP-Outlet
Sample Box No. 12
Sample Type Mass

Run No. ESP-O-1-2
Sample Date 10-28-80
Recovery Date 10-28-80
Cleanup Person J. Pavelonis

Filter No. 17
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

	1	2	3	4	5
Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	DRY		
Final Volume (wt) b/	116	106	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	16	6	1		
Sample No.(s)					

SILICA GEL

691.3	
686.5	
4.8	
Silica Gel	
Color	

Combined impinger contents, Sample No.
Liquid Level Marked
Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 27.9

a/ S = Greenburg-Smith standard, M = Modified, O = Other
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 96
Liquid Level Marked
Sealed

Impinger Rinse: Sample No.
Liquid Level Marked
Sealed

Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed

Acetone Blank: ~~Sample~~ Beaker No. 83
Liquid Level Marked
Sealed

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier
Date Shipped:
Remarks:

Date of laboratory custody
Personnel accepting custody
Seal(s) broken by
Date broken
Remarks:

MIDWEST RESEARCH INSTITUTE ESP 0-1-2(1)

Run No. _____ PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

	1	2	3	4	5	6
Impinger Sequence						
Impinger Type*						
Final Volume**						
Initial Volume**						
Difference						

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ BLACK No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
96		5	90.15951	90.01292	170		
	17	6	0.62744	0.29841			
		6		~~0.62744~~			
		6					
		7					
		8					
		9					
83		10	89.91564	89.91034	100		

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Outlet

Test Run Number ESP-O-1-2 ESP O-1-2(1)

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1008-1038	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	10-28-80	1008-1038	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	10-28-80	1045	D. Vogel	
Train Disassembly	10-28-80	1050	J. Pavelonis	
Train Cleanout	10-28-80	1100	J. Pavelonis	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

FILE NAME - ESP0111
RUN # - ESP-0-1-1 (1)
LOCATION - PFIZER
DATE - 10-27-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	696.600
FINAL METER VOLUME (CUBIC FEET)=	715.410
METER FACTOR= 1.015	
NET METER VOLUME (CUBIC FEET)=	19.092
GAS VOLUME (DRY STANDARD CUBIC FEET)=	19.371
BAROMETRIC PRESSURE (IN. HG)=	29.34
STATIC PRESSURE (INCHES H20)=	-0.52
PERCENT OXYGEN=	13.66
PERCENT CARBON DIOXIDE=	17.66
MOISTURE COLLECTED (ML)=	25.3
PERCENT WATER=	5.80
AVERAGE METER TEMPERATURE (F.)=	51.9
AVERAGE DELTA H (IN. H20)=	1.41
AVERAGE DELTA P (IN. H20)=	0.14
AVERAGE STACK TEMPERATURE (F.)=	487.6
DRY MOLECULAR WEIGHT=	31.372
WET MOLECULAR WEIGHT=	30.597
AVERAGE SQUARE ROOT OF DELTA P (IN. H20)=	0.3728
% ISOKINETIC=	106.4
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	30.0
NOZZLE DIAMETER (INCHES)=	0.3620
STACK AXIS #1 (INCHES)=	39.00
STACK AXIS #2 (INCHES)=	36.00
RECTANGULAR STACK	
STACK AREA (SQUARE FEET)=	9.750
STACK VELOCITY (ACTUAL, FEET/MIN)=	1,651
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	16,099
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	8,785
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	8,702 8275

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	0.7821
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.6218
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.3195
EMISSION RATE (LB/HR)=	~~46.37~~ 44.10

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	0.7821
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.6218
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.3195
EMISSION RATE (LB/HR)=	~~46.37~~ 44.10
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - ESP0111
RUN # - ESP-0-1-1 (1)
LOCATION - PFIZER
DATE - 10-27-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	19.725
FINAL METER VOLUME (CUBIC METERS)=	20.258
METER FACTOR= 1.015	
NET METER VOLUME (CUBIC METERS)=	0.541
GAS VOLUME (DRY STANDARD CUBIC METERS)=	0.549
BAROMETRIC PRESSURE (MM HG)=	745.24
STATIC PRESSURE (MM H2O)=	-13.2
PERCENT OXYGEN=	13.66
PERCENT CARBON DIOXIDE=	17.66
MOISTURE COLLECTED (ML)=	25.3
PERCENT WATER=	5.80
AVERAGE METER TEMPERATURE (C.)=	11.1
AVERAGE DELTA H (MM H2O)=	35.7
AVERAGE DELTA P (MM H2O)=	3.5
AVERAGE STACK TEMPERATURE (C.)=	253.1
DRY MOLECULAR WEIGHT=	31.372
WET MOLECULAR WEIGHT=	30.597
AVERAGE SQUARE ROOT OF DELTA P (MM H2O)=	1.8789
% ISOKINETIC=	106.4
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	30.0
NOZZLE DIAMETER (MM)=	9.19
STACK AXIS #1 (METERS)=	0.991
STACK AXIS #2 (METERS)=	0.914
RECTANGULAR STACK	
STACK AREA (SQUARE METERS)=	0.906
STACK VELOCITY (ACTUAL, M/MIN)=	503
FLOW RATE (ACTUAL, CUBIC M/MIN)=	456
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	249
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	~~246~~ 235

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	0.7821
PARTICULATE LOADING, DRY STD. (G/CU. M)=	1.4258
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	0.7327
EMISSION RATE (KG/HR)=	~~21.05~~ 20.02

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	0.7821
PARTICULATE LOADING, DRY STD. (G/CU. M)=	1.4258
PARTICULATE LOADING, ACTUAL (G/CU. M)=	0.7327
EMISSION RATE (KG/HR)=	~~21.05~~ 20.02
PERCENT IMPINGER CATCH=	0.0

FILE NAME - ESP0111
RUN # - ESP-0-1-1 (1)
LOCATION - PFIZER
DATE - 10-27-80
PROECT # - 4891-L93

POINT #	DELTA P (IN. H20)	DELTA H (IN. H20)	STACK T (F.)	METER T. IN(F.)	METER T. OUT(F.)
1	0.13	1.30	487	44	46
2	0.14	1.40	488	48	47
3	0.14	1.45	490	50	46
4	0.14	1.40	488	54	47
5	0.14	1.40	488	56	47
6	0.14	1.40	485	57	48
7	0.14	1.40	489	59	48
8	0.14	1.40	487	61	50
9	0.14	1.45	487	63	50
10	0.14	1.45	487	66	51

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	0.6102	0.1084	0.0004	0.5015

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	85.5082	85.2241	160.0	0.2806
IMPINGERS	0.0000	0.0000	0.0	0.0000

PROBE RINSE BLANK (MG/ML)= .0219048
IMPINGER BLANK (MG/ML)= 0

(40)

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RUN ESP-O-1-1(1)

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP-Outlet
Sampling Date 10-27-80

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

Lab Technician 1 T. Walker
2 J. Pavelonis
3 J. Johnson

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-27-80

SAMPLING LOCATION ESP-Outlet-1-1

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	70
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	7.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.34
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O) ~~-.52~~ -0.52	P_s	29.38
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	493
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	~~.24~~ .20
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.21
C FACTOR	.96	
CALCULATED NOZZLE DIAMETER, in.	3/8" ~~(.360)~~	(.360)
ACTUAL NOZZLE DIAMETER, in.	.362	
REFERENCE Δp, in. H_2O	.19	

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ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-O-1-1

Date 10-27-80
Initial MDH

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where:

$$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

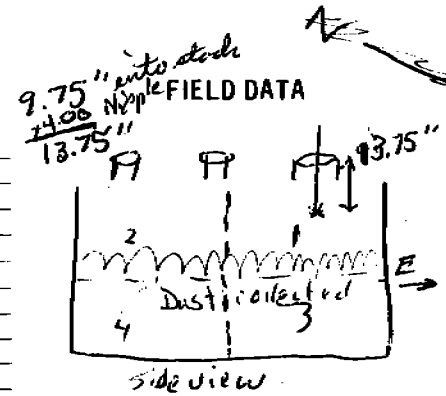
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	70
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.93
Nozzle diameter, inches	Dn	.362
Barometric pressure, inches Hg	Pb	29.34
$\frac{5.168\ (\cancel{55}\ 70 + 460)\ (.84)\ (3)\ (.93)\ (.362^2)}{\sqrt{29.34}}$	K	~~150.90~~ 155.3

FIELD DATA

PLANT Pfizer
DATE 10-27-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE Mass
RUN NUMBER ESP-O-1-1
OPERATOR Hansen
AMBIENT TEMPERATURE 50°F
BAROMETRIC PRESSURE 29.34
STATIC PRESSURE, (P_s) +.52
FILTER NUMBER (s) 5



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 3 ft, SS.
NOZZLE I.D. .362
ASSUMED MOISTURE, % 7
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .96
PROBE HEATER SETTING 80°F
HEATER BOX SETTING 550°F
REFERENCE Δp .19

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 8" Hg, CFM 0.005

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 155.3 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1704	696.60										
Aquad	3	1707	698.42	698.43	.13	1.3	1.3	487	44	46	7.0	238	49
	6	1710	700.31	700.29	.14	1.4	1.4	488	48	47	7.25	235	49
	9	1713	702.20	702.19	.14	1.4	1.45	490	50	46	7.5	236	47
	12	1716	704.09	704.08	.14	1.4	1.4	488	54	47	7.5	238	—
	15	1719	705.98	705.97	.14	1.4	1.4	488	56	47	7.5	—	48
	18	1722	707.87	707.84	.14	1.4	1.4	485	57	48	7.5	245	—
	21	1725	709.76	709.70	.14	1.4	1.4	489	59	48	7.5	—	—
	24	1728	711.65	711.58	.14	1.4	1.4	487	61	50	8.0	247	50
	27	1731	713.54	713.47	.14	1.4	1.45	487	63	50	8.0	248	50
	30	1734	715.43	715.41	.14	1.4	1.45	487	66	51	8.0	250	50
			V_m = 18.81		Δp_s = 0.139								
									T_m =	51.9			
						ΔH =	1.405						
								T_s = 487.6					

COMMENTS.

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ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP-Outlet
Test Number ESP-O-1-1

Date 10-27-80
Initial MDH

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	487.6
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H_{avg}=1.405$, $T_m=51.9$, $V_m=18.81$, $Pb=29.34$	Vm_{std}	19.08
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.93
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.37
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.43
Static pressure in stack, absolute, in. Hg — 0.52 (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.38
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P_{s\,avg}=.139$	Vs	1,654
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.362
$\frac{1{,}039\ (487.6 + 460)(19.08)}{(1{,}654)(30)(29.38)(.93)(.362^2)}$	% I	105.7

PARTICULATE SAMPLE RECOVERY AND INTEGRITY ESP-O-1-1(1)

Plant Pfizer
Sample Location ESP Outlet
Sample Box No. 12
Sample Type Mass

Run No. ESP-O-1-1
Sample Date 10-27-80
Recovery Date 10-27-80
Cleanup Person J. Pavelonis

Filter No. 5
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	Dry		
Final Volume (wt) b/	115	103	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	15	3	1		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 25.3 gm

SILICA GEL

686.5	
680.2 g	
6.3 g	

Silica Gel
Color

a/ S = Greenburg-Smith standard, M = Modified, O = Other
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 34
Liquid Level Marked
Sealed
Impinger Rinse: Sample No.
Liquid Level Marked
Sealed
Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed
Acetone Blank: ~~Sample~~ Beaker No. 49
Liquid Level Marked
Sealed
Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

Date of laboratory custody Seal(s) broken by
Personnel accepting custody Date broken
Remarks:

MIDWEST RESEARCH INSTITUTE ESP 0-1-1 (1)

Run No. _____ PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

Impinger Sequence	1	2	3	4	5	6
Impinger Type*						
Final Volume**						
Initial Volume**						
Difference						

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ SEARCH No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
34		5	85.50820	85.22 ~~410~~ 414	160	JJ	10-22
	5	6	0.61020	0.30835			
		6					
		6					
		7					
		8					
		9					
49		10	86.67467	86.67237	105		
~~[illegible]~~							

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number: 4891-L(93)

Source Identification: ESP Outlet

Test Run Number: ESP-O-1-1 ESPO-1-1 (1)

Pollutant(s) in Sample: Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-27-80	1704-1734	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	10-27-80	1704-1734	M. Hansen	
Other				
Transport of Train to Cleanup Site	10-27-80	1745	J. Johnson	
Train Disassembly	10-27-80	1815	J. Pavelonis	
Train Cleanout	10-27-80	1815	J. Pavelonis	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

FILE NAME - ESPI411
RUN # - ESP-I-4-1-(1)
LOCATION - PFIZER
DATE - 11-4-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	937.211
FINAL METER VOLUME (CUBIC FEET)=	950.735
METER FACTOR= 1.001	
NET METER VOLUME (CUBIC FEET)=	13.537
GAS VOLUME (DRY STANDARD CUBIC FEET)=	13.583
BAROMETRIC PRESSURE (IN. HG)=	29.02
STATIC PRESSURE (INCHES H2O)=	-0.38
PERCENT OXYGEN=	9.33
PERCENT CARBON DIOXIDE=	18.83
MOISTURE COLLECTED (ML)=	18.5
PERCENT WATER=	6.03
AVERAGE METER TEMPERATURE (F.)=	54.0
AVERAGE DELTA H (IN. H2O)=	2.94
AVERAGE DELTA P (IN. H2O)=	0.09
AVERAGE STACK TEMPERATURE (F.)=	634.8
DRY MOLECULAR WEIGHT=	31.386
WET MOLECULAR WEIGHT=	30.579
AVERAGE SQUARE ROOT OF DELTA P (IN. H2O)=	0.3016
% ISOKINETIC=	104.3
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	15.0
NOZZLE DIAMETER (INCHES)=	0.5010
STACK AXIS #1 (INCHES)=	52.50
STACK AXIS #2 (INCHES)=	36.00
RECTANGULAR STACK	
STACK AREA (SQUARE FEET)=	13.125
STACK VELOCITY (ACTUAL, FEET/MIN)=	1,444
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	18,954
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	8,858
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	~~8,774~~ 8324

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	16.9318
PARTICULATE LOADING, DRY STD. (GR./SCF)=	19.1969
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	8.4270
EMISSION RATE (LB/HR)=	~~1443.55~~ 1369.49

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	16.9318
PARTICULATE LOADING, DRY STD. (GR./SCF)=	19.1969
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	8.4270
EMISSION RATE (LB/HR)=	~~1443.55~~ 1369.49
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - ESPI411
RUN # - ESP-I-4-1-(1)
LOCATION - PFIZER
DATE - 11-4-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	26.538
FINAL METER VOLUME (CUBIC METERS)=	26.921
METER FACTOR= 1.001	
NET METER VOLUME (CUBIC METERS)=	0.383
GAS VOLUME (DRY STANDARD CUBIC METERS)=	0.385
BAROMETRIC PRESSURE (MM HG)=	737.11
STATIC PRESSURE (MM H20)=	-9.7
PERCENT OXYGEN=	9.33
PERCENT CARBON DIOXIDE=	18.83
MOISTURE COLLECTED (ML)=	18.5
PERCENT WATER=	6.03
AVERAGE METER TEMPERATURE (C.)=	12.2
AVERAGE DELTA H (MM H20)=	74.7
AVERAGE DELTA P (MM H20)=	2.3
AVERAGE STACK TEMPERATURE (C.)=	334.9
DRY MOLECULAR WEIGHT=	31.386
WET MOLECULAR WEIGHT=	30.579
AVERAGE SQUARE ROOT OF DELTA P (MM H20)=	1.5202
% ISOKINETIC=	104.3
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	15.0
NOZZLE DIAMETER (MM)=	12.73
STACK AXIS #1 (METERS)=	1.334
STACK AXIS #2 (METERS)=	0.914
RECTANGULAR STACK	
STACK AREA (SQUARE METERS)=	1.219
STACK VELOCITY (ACTUAL, M/MIN)=	440
FLOW RATE (ACTUAL, CUBIC M/MIN)=	537
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	251
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	~~248~~ 236

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	16.9318
PARTICULATE LOADING, DRY STD. (G/CU. M)=	44.0229
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	19.3249
EMISSION RATE (KG/HR)=	~~655.37~~ 621.747

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	16.9318
PARTICULATE LOADING, DRY STD. (G/CU. M)=	44.0229
PARTICULATE LOADING, ACTUAL (G/CU. M)=	19.3249
EMISSION RATE (KG/HR)=	~~655.37~~ 621.747
PERCENT IMPINGER CATCH=	0.0

FILE NAME - ESPI411
RUN # - ESP-I-4-1-(1)
LOCATION - PFIZER
DATE - 11-4-80
PROJECT # - 4891-L93

POINT #	DELTA P (IN. H2O)	DELTA H (IN. H2O)	STACK T (F.)	METER T. IN(F.)	METER T. OUT(F.)
1	0.09	2.80	635	51	51
2	0.09	2.80	642	54	51
3	0.09	2.90	630	57	51
4	0.10	3.10	640	60	51
5	0.09	3.10	627	62	52

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	1.2702	0.7819	0.0030	0.4853

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	106.1950	89.7491	230.0	16.4465
IMPINGERS	0.0000	0.0000	0.0	0.0000

PROBE RINSE BLANK (MG/ML)=-2.6E-03
IMPINGER BLANK (MG/ML)= 0

110

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-4-1(1)

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 11-4-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Rajd
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 11-4-80

SAMPLING LOCATION ESP Inlet, ESP-I-4/-1

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m\,avg.}$	65
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.02
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.99
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	613
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.085
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	.96	
CALCULATED NOZZLE DIAMETER, in.	.458	
ACTUAL NOZZLE DIAMETER, in.	.501	
REFERENCE Δp, in. H_2O	.06	

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ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Inlet
Test Number ESP-I-4-1

Date 11-4-80
Initial RCS

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where:

$$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

ΔPs = Velocity head of S pitot, inches H_2O

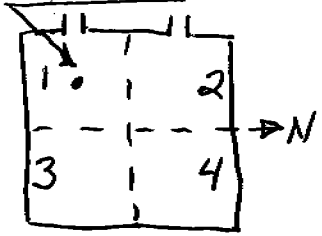
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	65
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.94
Nozzle diameter, inches	Dn	.501
Barometric pressure, inches Hg	Pb	29.02
$\frac{5.168\ (65 + 460)\ (.84)\ (3)\ (.94)\ (.501^2)}{\sqrt{29.02}}$	K	299.46

FIELD DATA

PLANT: Pfizer
DATE: 11-4-80
SAMPLING LOCATION: ESP Inlet
SAMPLE TYPE: Particulate
RUN NUMBER: ESP-I-4-1
OPERATOR: RCS
AMBIENT TEMPERATURE: 60
BAROMETRIC PRESSURE: 29.02
STATIC PRESSURE, (P_s): -.38" H_2O
FILTER NUMBER (s): 54

Sample Point



PROBE LENGTH AND TYPE: 3' SS
NOZZLE I.D.: .591
ASSUMED MOISTURE, %: 6
SAMPLE BOX NUMBER: 6
METER BOX NUMBER: 6
METER $\Delta H_@$: 1.84
C FACTOR: .86
PROBE HEATER SETTING: 80
HEATER BOX SETTING: 400
REFERENCE Δp: .06

Leak CK: Initial at 15" Hg, CFM .003
12" Hg Final at Hg, CFM .003

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 29.46 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	0921		937.211									
ESP-I-4-1	3	0924	939.92	937.87	.090	2.7	2.8	635	51	51	8	246	
	6	0927	942.63	942.50	.09	2.7	2.8	642	54	51	8	243	
	9	0930	945.35	945.18	.09	2.7	2.9	630	57	51	10	248	
	12	0933	948.13	947.96	.095	2.8	3.1	640	60	51	11	242	
	15	0936	950.85	950.735	.090	2.7	3.1	627	62	52	12	248	
				13.524	.091		2.94	635		54			

COMMENTS

EPA Form 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Inlet
Test Number ESP-I-4-1

Date 11-4-80
Initial RCS

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	635
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.02, ΔH = 2.94, Vm = 13.524, Tm = 54	Vm_{std}	13.569 ~~13.607~~
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	28.99
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .091	Vs	1444
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (635 + 460)(13.569\ \cancel{13.607})}{(1444)(15)(28.99)(.94)(.501^2)}$	% I	104.2 ~~104.5~~

Note: Actual moisture for this test = 6.03 %

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer
Sample Location: ESP Inlet
Sample Box No.: 6
Sample Type: Particulate

Run No.: ESP-I-4-1(1)
Sample Date: 11-4-80
Recovery Date: 11-4-80
Cleanup Person: Reja

Filter No.: 54
Sample No.:
Sample Material Description:

MOISTURE AND/OR SAMPLE

	1	2	3	4	5
Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	Dry		
Final Volume (wt) b/	112	102	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	12	2	1		
Sample No.(s)					

Combined impinger contents, Sample No.:
Liquid Level Marked: Container(s) Sealed:

SILICA GEL

	678.5
~~678.5~~	674.0
~~674.0~~	3.5

Silica Gel Color:

Description of Impinger Solution:
Total Moisture, gm: 18.5

a/ S = Greenburg-Smith standard, M = Modified, O = Other
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 92
Liquid Level Marked:
Sealed:

Impinger Rinse: Sample No.:
Liquid Level Marked:
Sealed:

Water Blank: Sample No.:
Liquid Level Marked:

Dry Catch: Sample No.:
Description:
Sealed:

Acetone Blank: ~~Sample~~ Beaker No. 114
Liquid Level Marked:
Sealed:

Filter Blank: Sample No.:
Sealed:

Sample Disposition:
Carrier: Date Shipped:
Remarks:

Date of laboratory custody: Seal(s) broken by:
Personnel accepting custody: Date broken:
Remarks:

ESP-I-44(1)

Run No. _____

MIDWEST RESEARCH INSTITUTE

PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

	1	2	3	4	5	6
Impinger Sequence						
Impinger Type*						
Final Volume**						
Initial Volume**						
Difference						

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
92		5	106.1953	89.74913	230 ml		
	54	6	1.27021	0.78191			
		6					
		6					
		7					
		8					
		9					
114		10	83.65408	83.65438	115 ml		

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Inlet

Test Run Number ESP-I-4-1(1)

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	11-4-80	0921-0936		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other			Raja	
Transport of Train to Cleanup Site	11-4-80	0945	Raja	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

FILE NAME - ESPI141
RUN # - ESP-I-1-4-(1)
LOCATION - PFIZER
DATE - 10-28-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	737.888
FINAL METER VOLUME (CUBIC FEET)=	749.004
METER FACTOR= 1.001	
NET METER VOLUME (CUBIC FEET)=	11.127
GAS VOLUME (DRY STANDARD CUBIC FEET)=	11.133
BAROMETRIC PRESSURE (IN. HG)=	29.18
STATIC PRESSURE (INCHES H20)=	-0.38
PERCENT OXYGEN=	10.33
PERCENT CARBON DIOXIDE=	18.67
MOISTURE COLLECTED (ML)=	9.2
PERCENT WATER=	3.75
AVERAGE METER TEMPERATURE (F.)=	57.1
AVERAGE DELTA H (IN. H20)=	2.02
AVERAGE DELTA P (IN. H20)=	0.07
AVERAGE STACK TEMPERATURE (F.)=	633.0
DRY MOLECULAR WEIGHT=	31.400
WET MOLECULAR WEIGHT=	30.898
AVERAGE SQUARE ROOT OF DELTA P (IN. H20)=	0.2625
% ISOKINETIC=	96.1
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	15.0
NOZZLE DIAMETER (INCHES)=	0.5010
STACK AXIS #1 (INCHES)=	52.50
STACK AXIS #2 (INCHES)=	36.00
RECTANGULAR STACK	
STACK AREA (SQUARE FEET)=	13.125
STACK VELOCITY (ACTUAL, FEET/MIN)=	1,246
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	16,351
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	7,696
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	~~7,622~~ 7407

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	15.9362
PARTICULATE LOADING, DRY STD. (GR./SCF)=	22.0449
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	9.9833
EMISSION RATE (LB/HR)=	~~1439.97~~ 1399.43

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	15.9362
PARTICULATE LOADING, DRY STD. (GR./SCF)=	22.0449
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	9.9833
EMISSION RATE (LB/HR)=	~~1439.97~~ 1399.43
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - ESPI141
RUN # - ESP-I-1-4-(1)
LOCATION - PFIZER
DATE - 10-28-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	20.894
FINAL METER VOLUME (CUBIC METERS)=	21.209
METER FACTOR= 1.001	
NET METER VOLUME (CUBIC METERS)=	0.315
GAS VOLUME (DRY STANDARD CUBIC METERS)=	0.315
BAROMETRIC PRESSURE (MM HG)=	741.17
STATIC PRESSURE (MM H2O)=	-9.7
PERCENT OXYGEN=	10.33
PERCENT CARBON DIOXIDE=	18.67
MOISTURE COLLECTED (ML)=	9.2
PERCENT WATER=	3.75
AVERAGE METER TEMPERATURE (C.)=	13.9
AVERAGE DELTA H (MM H2O)=	51.3
AVERAGE DELTA P (MM H2O)=	1.8
AVERAGE STACK TEMPERATURE (C.)=	333.9
DRY MOLECULAR WEIGHT=	31.400
WET MOLECULAR WEIGHT=	30.898
AVERAGE SQUARE ROOT OF DELTA P (MM H2O)=	1.3230
% ISOKINETIC=	96.1
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	15.0
NOZZLE DIAMETER (MM)=	12.73
STACK AXIS #1 (METERS)=	1.334
STACK AXIS #2 (METERS)=	0.914
RECTANGULAR STACK	
STACK AREA (SQUARE METERS)=	1.219
STACK VELOCITY (ACTUAL, M/MIN)=	380
FLOW RATE (ACTUAL, CUBIC M/MIN)=	463
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	218
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	~~216~~ 210

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	15.9362
PARTICULATE LOADING, DRY STD. (G/CU. M)=	50.5541
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	22.8939
EMISSION RATE (KG/HR)=	~~653.75~~ 635.343

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	15.9362
PARTICULATE LOADING, DRY STD. (G/CU. M)=	50.5541
PARTICULATE LOADING, ACTUAL (G/CU. M)=	22.8939
EMISSION RATE (KG/HR)=	~~653.75~~ 635.343
PERCENT IMPINGER CATCH=	0.0

FILE NAME - ESPI141
RUN # - ESP-I-1-4-(1)
LOCATION - PFIZER
DATE - 10-28-80
PROJECT # - 4891-L93

POINT #	DELTA P (IN. H20)	DELTA H (IN. H20)	STACK T (F.)	METER T. IN(F.)	OUT(F.)
1	0.06	2.00	630	52	54
2	0.07	2.00	660	56	54
3	0.07	1.80	635	60	55
4	0.07	2.00	625	63	55
5	0.08	2.30	615	66	56

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	10.8341	0.7880	0.0030	10.0431

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	189.4230	183.5150	280.0	5.8932
IMPINGERS	0.0000	0.0000	0.0	0.0000

PROBE RINSE BLANK (MG/ML)= .053
IMPINGER BLANK (MG/ML)= 0

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MIDWEST RESEARCH INSTITUTE

RUN ESP-I-1-4(1)

MRI Project Number 4891-L-93
Field Dates 10-28-80
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-28-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whited
2
3

Engr. Technician 1 Stultz
2
3

Lab Technician 1 Raja
2 Walker
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-28-80

SAMPLING LOCATION ESP- Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	51
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.18
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.15
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.99
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	610
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.09
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.98	
CALCULATED NOZZLE DIAMETER, in.	0.44	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.057	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP - Inlet
Test Number ESP- I-1-4

Date 10-28-80
Initial CC

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where:

$$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	51
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.501
Barometric pressure, inches Hg	Pb	29.18
$\frac{5.168\ (51 + 460)\ (.84)\ (3)\ (.95)\ (.501^2)}{\sqrt{29.18}}$	K	293.76

FIELD DATA

PLANT Pfizer
DATE 10-28-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Total Particulate
RUN NUMBER ESP-I-1-4(1)
OPERATOR CWhited
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 29.18
STATIC PRESSURE, (P_s) 0.38" H_2O
FILTER NUMBER (s) 32

PROBE LENGTH AND TYPE 4' (37.37")
NOZZLE I.D. 0.501
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 8
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.96
PROBE HEATER SETTING 85
HEATER BOX SETTING 400
REFERENCE Δp 0.057

Leak CK: Initial at 15" Hg, CFM 0.006
Final at Hg, CFM 0.001

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 29.376 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	0925	737.888										
	3	0928	740.07	740.03	0.06	1.35	2.0	630	52	54	4	250	
	6	0931	742.39	742.24	0.07	1.60	2.0	660	56	54	5	265	
	9	0934	744.74	744.42	0.07	1.60	1.8	635	60	55	5	260	
	12	0937	747.10	746.62	0.07	1.60	2.0	625	63	55	6	265	
	15	0940	749.55	749.00	0.075	1.70	2.3	615	66	56	6.5	250	
			Final -	749.004									
			$\Sigma \frac{\cancel{\Delta t}}{V_m}$ =	11.116									
Final, Average					Δp_s = 0.069		ΔH = 2.02	T_s = 633	T_m = 57.1				

COMMENTS

EPA (Dun 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer Ind
Sampling Location ESP- Inlet
Test Number ESP- I- 1-4

Date 10-28-80
Initial CW

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	633
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 2.02, Pb = 29.18, Tm = 57.1, Vm = 11.116	Vm_{std}	11.12
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	0.95
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.73
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.15
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ Ts = 633, $\sqrt{\Delta Ps}$ = 0.2626	Vs	1250
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	0.501
$\frac{1{,}039\ (633 + 460)(11.12)}{(1250)(15)(29.15)(.95)(.501^2)}$	% I	97

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location ~~ESP-I-1-3~~ ESP-I-1-4 (1)
Sample Box No. 8
Sample Type Total Particulate

Run No. ESP-I-1-4 (1)
Sample Date
Recovery Date
Cleanup Person

Filter No. 32
Sample No. ESP-I-1-4
Sample Material Description Particulate

MOISTURE AND/OR SAMPLE

	1	2	3	4	5
Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	Dry		
Final Volume (wt) b/	102	104	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	2	4	0		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 9.2

SILICA GEL

703.2	
700.0	
3.2	

Silica Gel
Color

a/ S = Greenburg-Smith standard, M = Modified, O = Other
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 94, 102
Liquid Level Marked
Sealed
Impinger Rinse: Sample No.
Liquid Level Marked
Sealed
Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed
Acetone Blank: ~~Sample~~ Beaker No. 83
Liquid Level Marked
Sealed
Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

Date of laboratory custody Seal(s) broken by
Personnel accepting custody Date broken
Remarks:

MIDWEST RESEARCH INSTITUTE ESP-I-1-4(1)

Run No. ESP-I-1-4(1)

PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

Impinger Sequence	1	2	3	4	5	6
Impinger Type*						
Final Volume**						
Initial Volume**						
Difference						

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ Broken No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
94 102		94 5 102	99.03029 90.39277	95.46189 88.05337	280		
	32	6	10.83405	0.78803			
		6					
		6					
		7					
		8					
		9					
83		10	89.91564	89.91034	100		

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L-93

Source Identification ESP Inlet

Test Run Number ESP-I-1-4 ESP-I-1-4(1)

Pollutant(s) in Sample _____

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	0940		
Probe Technician	10-28-80	0940	Stultz	
Meter Technician	10-28-80	0940	White &	
Other			Raja	
Transport of Train to Cleanup Site				
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

FILE NAME - ESPI131
RUN # - ESP-I-1-3-(1)
LOCATION - PFIZER
DATE - 10-27-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	726.381
FINAL METER VOLUME (CUBIC FEET)=	737.130
METER FACTOR= 1.001	
NET METER VOLUME (CUBIC FEET)=	10.760
GAS VOLUME (DRY STANDARD CUBIC FEET)=	10.937
BAROMETRIC PRESSURE (IN. HG)=	29.32
STATIC PRESSURE (INCHES H20)=	-0.38
PERCENT OXYGEN=	10.33
PERCENT CARBON DIOXIDE=	18.67
MOISTURE COLLECTED (ML)=	14.1
PERCENT WATER=	5.72
AVERAGE METER TEMPERATURE (F.)=	51.5
AVERAGE DELTA H (IN. H20)=	2.08
AVERAGE DELTA P (IN. H20)=	0.07
AVERAGE STACK TEMPERATURE (F.)=	602.0
DRY MOLECULAR WEIGHT=	31.400
WET MOLECULAR WEIGHT=	30.633
AVERAGE SQUARE ROOT OF DELTA P (IN. H20)=	0.2646
% ISOKINETIC=	93.6
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	15.0
NOZZLE DIAMETER (INCHES)=	0.5010
STACK AXIS #1 (INCHES)=	52.50
STACK AXIS #2 (INCHES)=	36.00
RECTANGULAR STACK	
STACK AREA (SQUARE FEET)=	13.125
STACK VELOCITY (ACTUAL, FEET/MIN)=	1,240
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	16,275
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	7,922
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	~~7,847~~ 7468.

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	17.3498
PARTICULATE LOADING, DRY STD. (GR./SCF)=	24.4307
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	11.2062
EMISSION RATE (LB/HR)=	~~1642.99~~ 1563.82

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	17.3498
PARTICULATE LOADING, DRY STD. (GR./SCF)=	24.4307
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	11.2062
EMISSION RATE (LB/HR)=	~~1642.99~~ 1563.82
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - ESPI131
RUN # - ESP-I-1-3-(1)
LOCATION - PFIZER
DATE - 10-27-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	20.568
FINAL METER VOLUME (CUBIC METERS)=	20.873
METER FACTOR= 1.001	
NET METER VOLUME (CUBIC METERS)=	0.305
GAS VOLUME (DRY STANDARD CUBIC METERS)=	0.310
BAROMETRIC PRESSURE (MM HG)=	744.73
STATIC PRESSURE (MM H20)=	-9.7
PERCENT OXYGEN=	10.33
PERCENT CARBON DIOXIDE=	18.67
MOISTURE COLLECTED (ML)=	14.1
PERCENT WATER=	5.72
AVERAGE METER TEMPERATURE (C.)=	10.8
AVERAGE DELTA H (MM H20)=	52.8
AVERAGE DELTA P (MM H20)=	1.8
AVERAGE STACK TEMPERATURE (C.)=	316.7
DRY MOLECULAR WEIGHT=	31.400
WET MOLECULAR WEIGHT=	30.633
AVERAGE SQUARE ROOT OF DELTA P (MM H20)=	1.3334
% ISOKINETIC=	93.6
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	15.0
NOZZLE DIAMETER (MM)=	12.73
STACK AXIS #1 (METERS)=	1.334
STACK AXIS #2 (METERS)=	0.914
RECTANGULAR STACK	
STACK AREA (SQUARE METERS)=	1.219
STACK VELOCITY (ACTUAL, M/MIN)=	378
FLOW RATE (ACTUAL, CUBIC M/MIN)=	461
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	224
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	~~222~~ 211

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	17.3498
PARTICULATE LOADING, DRY STD. (G/CU. M)=	56.0251
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	25.6983
EMISSION RATE (KG/HR)=	~~745.92~~ 709.975

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	17.3498
PARTICULATE LOADING, DRY STD. (G/CU. M)=	56.0251
PARTICULATE LOADING, ACTUAL (G/CU. M)=	25.6983
EMISSION RATE (KG/HR)=	~~745.92~~ 709.975
PERCENT IMPINGER CATCH=	0.0

FILE NAME - ESPI131
RUN # - ESP-I-1-3-(1)
LOCATION - PFIZER
DATE - 10-27-80
PROJECT # - 4891-L93

POINT #	DELTA P (IN. H20)	DELTA H (IN. H20)	STACK T (F.)	METER T. IN(F.)	METER T. OUT(F.)
1	0.07	1.40	600	47	47
2	0.07	1.70	600	50	48
3	0.07	2.20	600	54	48
4	0.07	2.40	600	60	50
5	0.07	2.70	610	61	50

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	11.8988	0.7854	0.0030	11.1105

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	89.1346	82.8898	250.0	6.2393
IMPINGERS	0.0000	0.0000	0.0	0.0000

PROBE RINSE BLANK (MG/ML)= .0219048
IMPINGER BLANK (MG/ML)= 0

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MIDWEST RESEARCH INSTITUTE

RUN ESP-I-1-3(1)

MRI Project Number 4891-L-93
Field Dates 10-27-80
Plant Pfizer Ind
Sampling Location ESP-Inlet
Sampling Date 10-27-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 R. Stultz
2
3

Engr. Technician 1 E Whited
2
3

Lab Technician 1 Rajan
2 Walker
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-27-80

SAMPLING LOCATION ESP Inlet

Sp. No. 4

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84	
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	60	
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	7.0	
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.34	
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.31	
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.999	
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	614	
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.074	Sp. No 4 .09
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.09	
C FACTOR	.93		
CALCULATED NOZZLE DIAMETER, in.	.48		
ACTUAL NOZZLE DIAMETER, in.	.501		
REFERENCE Δp, in. H_2O	~~.062~~ .070		

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Inlet
Test Number ESP-I-1-3

Date 10-27-80
Initial RCB

Isokinetic sampling equation:

$$Vm_i = K \sqrt{\frac{\Delta Ps}{Ts + 460}}$$

Where:

$$K = \frac{5.168\ (Tm_{avg} + 460)\ (Cp)\ (\theta i)\ (Mf)\ (Dn^2)}{\sqrt{Pb}}$$

Vm_i = Volume of the meter per sampling interval, ft^3

K = Constant of fixed and assumed parameters, dimensionless

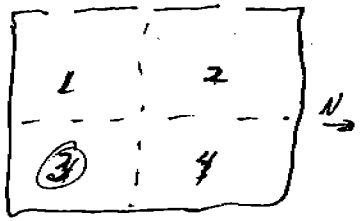
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	60
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.93
Nozzle diameter, inches	Dn	.501
Barometric pressure, inches Hg	Pb	29.32
$\frac{5.168\ (60 + 460)\ (.84)\ (3)\ (.93)\ (.501^2)}{\sqrt{29.32}}$	K	291.9

FIELD DATA

PLANT Pfizer
DATE 10-27-80
SAMPLING LOCATION Precip - Inlet
SAMPLE TYPE Particulate
RUN NUMBER ESP I-1-3
OPERATOR Whitel, Stutte
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 29.32
STATIC PRESSURE, (P_s) 0.38
FILTER NUMBER (s) 31



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 39.37
NOZZLE I.D. 0.501"
ASSUMED MOISTURE, % 2%
SAMPLE BOX NUMBER 8
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.93
PROBE HEATER SETTING 850
HEATER BOX SETTING 400
REFERENCE Δp 0.07

Leak CK: Initial at 15" Hg, CFM 0.001
Final at Hg, CFM 0.002

READ AND RECORD ALL DATA EVERY _____ MINUTES

$VM = 29.19 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1655		726.381									
	3	1658	728.75	728.16	0.07	~~1.8~~ 1.3	1.4	600	47	47	3	255	
	6	1701	731.12	730.21	0.07	1.4	1.7	600	50	48	3	265	
	9	1704	733.49	732.57	0.07	1.95	2.2	600	54	48	3		
	12	1707	735.86	734.85	0.07	1.35	2.4	600	60	50	6		
	15	1710	738.23	737.13	0.07	1.35	2.1	610	61	50	6 1/2		
			Final	737.130			2.08						
			$\Sigma Ft.^3 = 10.749$										
	Average				0.07	ΔH 1.35		T_s 600	51.2				

COMMENTS.

EPA (Dun 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer Ind
Sampling Location ESP - ~~I-3~~ Inlet
Test Number ESP - I - 1 - 3

Date 10-27-80
Initial CV

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	600
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = ~~1.35~~ 2.08, Tm = 61.2, Vm 10.749	Vm_{std}	~~10.88~~ 10.932
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.93
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.80 31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.46 30.46
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.31 29.31
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ 600 = Ts, ΔP = 0.07, Cp = .84	Vs	1242 1242
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (600 + 460)(\cancel{10.88}\ 10.932)}{(1242)(15)(29.31)(.93)(.501^2)}$	% I	94 ~~94.5~~

94.45

PARTICULATE SAMPLE RECOVERY AND INTEGRITY ESP I-1-3 (1)

Plant Pfizer Ind
Sample Location ESP Inlet
Sample Box No. 8
Sample Type Particulate

Run No. ESP-I-1-3
Sample Date 10-27-80
Recovery Date 10-27-80
Cleanup Person

Filter No. 31
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	Dry		
Final Volume (wt) b/	98	114	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	-2	14	0		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 14.1

SILICA GEL

700.0	
697.9	
2.1	

Silica Gel Color

a/ S = Greenburg-Smith standard, M = Modified, O = Other
b/ Indicate value in units, ml or gm

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 110
Liquid Level Marked
Sealed
Impinger Rinse: Sample No.
Liquid Level Marked
Sealed
Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed
Acetone Blank: ~~Sample~~ Beaker No. 49
Liquid Level Marked
Sealed
Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

Date of laboratory custody Seal(s) broken by
Personnel accepting custody Date broken
Remarks:

ESP-I-1-3

Run No. _____

MIDWEST RESEARCH INSTITUTE

ESP-I-1-3 (1)

PARTICULATE CLEAN-UP AND ANALYSIS

Date _____

FIELD ANALYSIS

Performed by _____

Impinger Sequence	1	2	3	4	5	6
Impinger Type*						
Final Volume**						
Initial Volume**						
Difference						

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ BLANK No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
110		5	89.13456	82.88975	250		
	31	6	11.89877	0.78536			
		6					
		6					
		7					
		8					
		9					
49		10	86.67467	86.67237	105		

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-6-93

Source Identification ESP Inlet

Test Run Number ESP-I-1-3 ESP-I-1-3 (1)

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-27-80	1700	E. Whited	
Probe Technician	10-27-80	1700	R. Stultz	
Meter Technician	10-27-80	1700	E. Whited	
Other				
Transport of Train to Cleanup Site				
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

INPUT DATA FOR FILE BAG0321
TEST DATE - 10-23-80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - BAG-0-3-2-(1)

% WATER= 4.59
% CARBON DIOXIDE= 16.33
% CARBON MONOXIDE= 0.00
% OXYGEN= 16.00

ANDERSEN IMPACTOR WITH CYCLONE

STACK TEMPERATURE= 290.0 DEGREES F.
BAR. PRESSURE= 29.90 INCHES HG
STATIC PRESSURE= 0.44 INCHES H20
AVE. DELTA P= 0.32 INCHES H20
PITOT COEFF.= .84
METER TEMP.= 58.9 DEGREES F.
PROBE DIA.= 0.195 INCHES

SAMPLING TIME= 180.0 MIN.
PRESSURE DROP= 0.00 INCHES HG
SAMPLER TEMP. = 290.0 DEGREES F.
PARTICLE DENS= 1
METER VOL.= 54.351 CUBIC FEET
DELTA H= 0.30 INCHES H20

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.= 55.290 CU. FT.
SAMPLE VOL.-WET STD.= 57.950 CU. FT.
STACK VELOCITY= 2189.9 FT./MIN.
NOZZLE VELOCITY= 2205.0 FT./MIN.
MASS COLLECTED= 12.320 MG.
LOADING= 0.00328 GRAIN/SCF
LOADING(DRY)= 0.00344 GRAIN/SCF
RATE FOR 15 MICRON CYCLONE CUTOFF= 0.506 CU. FT/MIN

DRY MOLECULAR WT.= 31.25
WET MOLECULAR WT.= 30.64
% ISOKINETIC= 100.7
SAMPLING RATE-ACTUAL= 0.457 CU. FT/MIN
CYCLONE BLANK= 0.035 MG.
STAGE BLANK= -0.150 MG.
FILTER BLANK= 0.025 MG.

STAGE #	CYCLONE	0	1	2	3	4	5	6	7	FILTER
FINAL WT (MG)	255.03	437.73	422.84	441.31	447.39	445.80	425.44	435.16	461.96	454.03
TARE WT (MG)	254.27	436.37	421.68	440.06	446.12	444.41	424.12	434.04	461.04	453.40
NET WT (MG) CORRECTED	0.73	1.51	1.31	1.40	1.42	1.54	1.47	1.27	1.07	0.60
FRACTION % OF TOTAL	5.88	12.26	10.63	11.36	11.53	12.50	11.93	10.31	8.69	4.91
CUM. % WITH FILTER	5.88	18.14	28.77	40.14	51.66	64.16	76.10	86.40	95.09	100.00
FRACTION % WITHOUT FILTER	6.19	12.89	11.18	11.95	12.12	13.15	12.55	10.84	9.13	
CUM. % WITHOUT FILTER	6.19	19.08	30.26	42.21	54.33	67.48	80.02	90.87	100.00	
JET VEL. (CM/SEC)	0	35	66	110	181	322	779	1420	2840	
D50 SIZE (MICRONS)	16.56	16.56	10.33	7.00	4.77	3.05	1.52	0.93	0.63	<0.63

D50 FOR STAGE 0 EXCEEDS THE ESTIMATED CYCLONE D50 VALUE OF 15.99 MICRONS.

DM/DLOGD (GRAINS/SCF)	0.00170	0.00221	0.00226	0.00212	0.00129	0.00158	0.00166
GEO MEAN (MICRONS)	13.08	8.50	5.78	3.82	2.15	1.19	0.76 <0.76
PARTICLE COUNT	1.6D+04	3.2D+04	4.9D+04	6.9D+04	7.4D+04	1.6D+05	2.7D+05

THE D50 VALUE SHOWN FOR THE CYCLONE IS AN ESTIMATE ASSUMING THE (-.63) POWER OF FLOW RATE OF SRI CYCLONE I.

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Particle Sizing - Andersen

RUN Bag-0-3-2

MRI Project Number 4891-L(93)
Field Dates 16-
Plant Pfizer
Sampling Location Bag-Outlet
Sampling Date 10-23-80

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 D. Vogel
2
3

Engr. Technician 1
2
3

Lab Technician 1 T. Walker
2 J. Pavalonis
3 J. Johnson

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pf.-zer
Sampling Location Baghouse - Outlet
Test No. Bag-0-3-2

Date 10-23-80
Initial DV

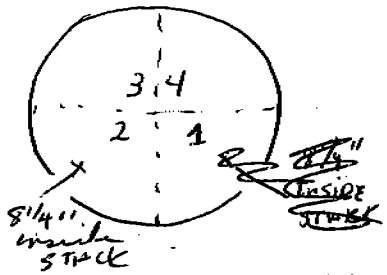
Velocity head at sampling location, in. H_2O	ΔPs	.31
Stack temperature at sample point, °F	Ts	290
Barometric pressure, in. Hg	Pb	29.67
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.70
Percent moisture in gas stream by volume	% H_2O	4.25
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	Mf	.957
Molecular wt. dry stack gas, lb/lb-mole (% CO_2 x 0.44) + (% O_2 x 0.32) + (% N_2 + % CO x 0.28)	Md	31.25
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.68
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	2176
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.203
Actual nozzle diameter, in.	D_{n_a}	.195
Assumed meter temperature, °F	Tm	65
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.451
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.302

FIELD DATA - ANDERSEN

flow: min: 0
max: .65 in H2O

PLANT Pfizer
DATE 10-23-80
SAMPLING LOCATION Bag outlet
SAMPLE TYPE Particle size
RUN NUMBER Bag-0-3-2
OPERATOR Vogel
AMBIENT TEMPERATURE 65
BAROMETRIC PRESSURE 29.90
STATIC PRESSURE, (P_s) +.44
Filter Set 6

Leak CK: Inital at 15" Hg, CFM _____
Final at ____ Hg, CFM _____



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) .302
Probe Tip Diameter .195
CO_2 16.3
O_2 16.0
CO 0
N_2 67.7
% H_2O 4.25

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1405	383.00										
2 quad.	5	1410	384.51	384.46	.31	.28	.31	290	60	58	3	NA	NA
	10	1415	386.02	385.91	.30		.30		62	59	3		
	15	1420	387.53	387.45	.26		.31		64	61	3		
	20	1425	389.04	389.00	.30		.31		62	60	3		
	25	1430	390.55	390.55	.33		.30		62	61	3		
	30	1435	392.06	392.07	.28		.30		62	61	3		
	35	1440	393.57	393.61	.28		.30		62	61	3		
	40	1445	395.08	395.10	.30		.30		60	60	3		
STOP 1450	45	1450	396.59	396.60	.34		.31		62	60	3		
8" 1452	50	1457 1455	398.10	398.10	.61		.30		62	60	3		
15 02 ~~1457~~	55	~~1459~~ 1500	399.61	399.60	.49		.30		61	60	3		
	60	1507 1505	401.12	401.13	.30		.30		62	60	3		
	65	1512 1510	402.63	402.63	.29		.29		62	60	3		
STARTUP 1517 STOP 1515	70	1519 1515	404.14	404.15	.31		.30		62	60	3		
	75	1524 1520	405.65	405.69	.29		.31		62	61	3		
	80	1529 1525	407.16	407.21	.29		.30		60	60	3		
	85	1534 1530	408.67	408.72	.27		.30		58	59	3		
	90	1539 1535	410.18	410.17	.28		.30		58	58	3		
1540 stop START 1542	95	1546 1540	411.69	411.75	.33		.29		59	58	3		
1551	100	~~1546~~ 1545	413.20	413.15	.33		.29		59	58	3		
	105	1556 1550	414.71	414.64	.28 (.29)		.30		59	59	3		
	110	1601 1555	416.22	416.17	.28		.30		59	58	3		
off 1605	115	1606 1607	417.73	417.71	.30		.30		60	59	3		

COMMENTS

EPA (Dur) 235
4 72

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
			419.241										
2 quad	120	1613	~~418.81~~	419.24	.31	.28	.31	290	57	58	3	NT	NA
	125	1618	420.75	420.76	.30		.29		58	57	3		
	130	1623	422.26	422.28	.33		.30		59	57	3		
9/1 1630 →	135	1628	423.77	423.78	.43		.30		58	57	3		
1633	140	1636	425.28	425.29	.31		.29		56	56	3		
	145	1641	426.79	426.78	.30		.30		56	56	3		
	150	1646	428.30	428.26	.30		.30		56	56	3		
	155	1651	429.81	429.76	.30		.31		56	56	3		
1550 ← on	160	1657	431.32	431.32	.29		.31		56	56	3		
	165	1703	432.83	432.87	.30		.31		56	56	3		
	170	1708	434.34	434.35	.33		.30		56	56	3		
	175	1713	435.85	435.85	.30		.29		56	56	3		
	180	1718	437.360	437.35	.31		.30		56	56	3		
				437.351									
			Total Volume		Ave Δp_s = .316	Ave ΔH = .30 .309		Ave T_s = 290°	Ave T_m = 58.86		Pump Vac = 3 Ave.		
	Total Time 180 min.		V_m 54.351				.301						

Run Number Bag-0-3-2 Date 10-23-80 Sampling Location Bag Outlet

Comments: Console #3

EPA (Dun) 236
4 72

D-108

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Bag Outlet
Test Number Bag-0-3-2

Date 10-23-80
Initial DV

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	290
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .301, Pb = 29.9, Vm = 54.351, Tm + 460 = 518.9	Vm_{std}	55.29 ~~54.8~~
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 4.6	Mf	.954
Molecular wt. dry stack gas, lb/lb-mole ($\%CO_2$ x 0.44) + ($\%O_2$ x 0.32) + ($\%N_2$ + %CO x 0.28)	Md	31.54
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.92 ~~30.68~~
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.70
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ Ts = 290, Δp = .316	Vs	2189 ~~2176~~
Total sample time, minutes	θ	180
Nozzle diameter, inches	Dn	.195
$\frac{1{,}039\ (290 + 460)(55.29)}{(2189)(180)(29.7)(.954)(.195^2)}$	% I	~~100.87~~ 101.49

58.86

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 6

Test No. Bag-0-3-2
Date 10-23-80
Time
Location Bag Outlet

Final Weights
By J.P. Date 10-25-80
Location ON-SITE LAB

Tare Weights
By J.P. Date 10-16-80
Location ON-SITE LAB

PRES. 255.03 254.27 0.76

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)[a]	% of total wt[c]	Cumulative % of total wt[c]	Dp μ
0	6-0	437.73	436.37	1.36			
1	6-1	422.84	421.68	1.16			
2	6-2	441.31	440.06	1.25			
3	6-3	447.39	446.12	1.27			
4	6-4	445.80	444.41	1.39			
5	6-5	425.44	424.12	1.32			
6	6-6	435.16	434.04	1.12			
7	6-7	461.96	461.04	0.92			
F	6-F	454.03	453.40	0.63			
			Total with filter	~~10.42~~ 11.18			
			Total without filter				

Note: Andersen flow rate =

a/ ~~Includes blank correction~~.

b/ Value used for calculations.

c/ Calculations based on total sample weight with filter are entered on first line; calculations based on total sample weight without filter are entered on second line for each stage.

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification Baghouse-Outlet

Test Run Number Bag-0-3-2

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-23-80	1405-1716	Vogel	
Probe Technician	10-23-80		Vogel	
Meter Technician			Vogel	
Other				
Transport of ~~Train~~ ANDERSEN to Cleanup Site	10-28-80	1215-1240	[illegible]	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	10-27-80	10:30 AM	PAVELONIS	
Write Up				

INPUT DATA FOR FILE ESPI421
TEST DATE - 11-4-80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - ESP-I-4-2-(1)

% WATER= 6.03
% CARBON DIOXIDE= 18.83
% CARBON MONOXIDE= 0.00
% OXYGEN= 9.33

BRINK IMPACTOR WITH CYCLONE

STACK TEMPERATURE= 590.0 DEGREES F.
BAR. PRESSURE= 29.02 INCHES HG
STATIC PRESSURE= -0.38 INCHES H20
AVE. DELTA P= 0.09 INCHES H20
PITOT COEFF.= .84
METER TEMP.= 63.0 DEGREES F.
PROBE DIA.= 0.115 INCHES

SAMPLING TIME= 4.0 MIN.
PRESSURE DROP= 2.20 INCHES HG
SAMPLER TEMP. = 590.0 DEGREES F.
PARTICLE DENS= 1
METER VOL.= 0.187 CUBIC FEET
DELTA H= 0.00 INCHES H20

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.= 0.183 CU. FT.
SAMPLE VOL.-WET STD.= 0.195 CU. FT.
STACK VELOCITY= 1366.9 FT./MIN.
NOZZLE VELOCITY= 1386.0 FT./MIN.
MASS COLLECTED= 299.210 MG.
LOADING= 23.70626 GRAIN/SCF
LOADING(DRY)= 25.22747 GRAIN/SCF

DRY MOLECULAR WT.= 31.39
WET MOLECULAR WT.= 30.58
% ISOKINETIC= 101.4
SAMPLING RATE-ACTUAL= 0.100 CU. FT/MIN
CYCLONE BLANK= 0.665 MG.
STAGE BLANK= 0.268 MG.
FILTER BLANK= 0.185 MG.

STAGE #	CYCLONE	1	2	3	4	5	FILTER
FINAL WT (MG)	511.68	374.53	419.86	421.43	433.30	407.12	281.44
TARE WT (MG)	234.15	358.40	414.96	420.54	432.76	406.74	280.41
NET WT (MG) CORRECTED	276.87	15.86	4.63	0.62	0.27	0.11	0.84
FRACTION % OF TOTAL	92.53	5.30	1.55	0.21	0.09	0.04	0.28
CUM. % WITH FILTER	92.53	97.83	99.38	99.59	99.68	99.72	100.00
FRACTION % WITHOUT FILTER	92.79	5.32	1.55	0.21	0.09	0.04	
CUM. % WITHOUT FILTER	92.79	98.11	99.66	99.87	99.96	100.00	
JET VEL. (CM/SEC)	0	969	1907	3083	6713	11243	
D50 SIZE (MICRONS)	7.00	4.30	2.52	1.70	0.87	0.53	<0.53
DM/DLOGD (GRAINS/SCF)		5.94910	1.57835	0.29049	0.07431	0.04146	
GEO MEAN (MICRONS)		5.49	3.29	2.07	1.22	0.68	<0.68
PARTICLE COUNT		1.3D+08	5.9D+07	1.7D+07	7.5D+06	7.5D+06	

THE CYCLONE D50 VALUE IS ASSUMED TO BE 7 MICRONS.

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MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-4-2 (1)

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 11-4-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. ESP-I-4-2(1) DATE 11-4-80

Flue Gas Temperature 590 °F

Static Pressure - .38 " H_2O

Barometric Pressure 29.02 " Hg

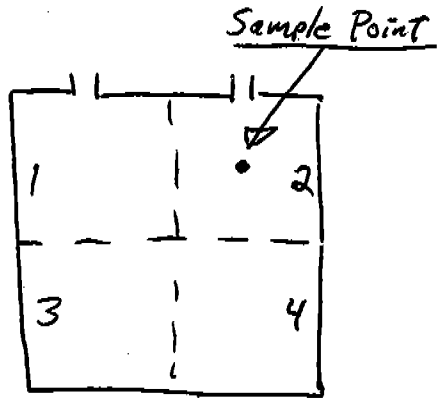
Sample Time 4 min

Probe Tip Diameter .115

Velocity at Sample Point 1406 FPS

Sample Rate .105 CFM

ΔP_s = .09



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .085 at 0947 Filter Set #31

Gas Composition

CO_2 18.8

O_2 9.3

CO 0

N_2 71.9

H_2O 6 %

Md = 31.40

Preheat Started -

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
0953	2.25	2.2	63	Start	0
0954		2.2	63		.048
0955		2.2	63		.092
0956		2.2	63		.140
0957		2.2	63	Stop	.187

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Inlet
Test Number ESP-I-4-2 (1)

Date 11-4-80
Initial RCS

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	590
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.00 Vm = .187 Tm = 63	Vm_{std}	.183
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	28.99
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .085	Vs	1367
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (590 + 460)(.183)}{(1367)(4)(28.99)(.94)(.115^2)}$	% I	101.3

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-42 BRINK Date 11-5-80

MRI Project No. 4841-L93 Particle Size Analysis Recorded by JP

ANALYSIS

Final Weights	Tare Weights
By: Boomer Date: 11-4-80	By: JP Date: 10-31-80
Location: On Site Lab	Location: On Site Lab

Set # 31

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	31-C	.51168	.23415	.27753	* **	* **	
1	31-1	.37453	.35840	.01613			
2	31-2	.41986	.41496	.00490			
3	31-3	.42143	.42054	.00089			
4	31-4	.43330	.43276	.00054			
5	31-5	.40712	.40674	.00038			
Filter	31-F	.28144	.28041	.00103			
			Total	* **			

CONCENTRATION CALCULATION

Sampling Duration _____ min

Flow Rate (Brink) _____ cfm

Baro. Pressure _____ in. Hg

Temperature _____ °F

Particulate Concentration _____ μg/m^3, actual conditions

_____ μg/m^3, standard conditions (77°F, 29.92 in. Hg)

* With filter

** Without filter

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Inlet

Test Run Number ESP-I-4-2

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	11-4-80	0953-0957		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	11-4-80	1005	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site			—	
Lab Analysis	11-5-80	1620	Pawlowski	
Write Up				

INPUT DATA FOR FILE ESPI141
TEST DATE - 10/27/80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - ESP-I-1-4-(1)

% WATER= 5.72
% CARBON DIOXIDE= 18.67
% CARBON MONOXIDE= 0.00
% OXYGEN= 10.33

BRINK IMPACTOR WITH CYCLONE

STACK TEMPERATURE= 610.0 DEGREES F.
BAR. PRESSURE= 29.34 INCHES HG
STATIC PRESSURE= -0.38 INCHES H20
AVE. DELTA P= 0.09 INCHES H20
PITOT COEFF.= .84
METER TEMP.= 84.3 DEGREES F.
PROBE DIA.= 0.116 INCHES

SAMPLING TIME= 4.0 MIN.
PRESSURE DROP= 2.60 INCHES HG
SAMPLER TEMP. = 610.0 DEGREES F.
PARTICLE DENS= 1
METER VOL.= 0.212 CUBIC FEET
DELTA H= 0.00 INCHES H20

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.= 0.202 CU. FT.
SAMPLE VOL.-WET STD.= 0.214 CU. FT.
STACK VELOCITY= 1410.9 FT./MIN.
NOZZLE VELOCITY= 1507.3 FT./MIN.
MASS COLLECTED= 259.395 MG.
LOADING= 18.72053 GRAIN/SCF
LOADING(DRY)= 19.85632 GRAIN/SCF

DRY MOLECULAR WT.= 31.40
WET MOLECULAR WT.= 30.63
% ISOKINETIC= 106.8
SAMPLING RATE-ACTUAL= 0.111 CU. FT/MIN
CYCLONE BLANK= 0.665 MG.
STAGE BLANK= 0.268 MG.
FILTER BLANK= 0.185 MG.

STAGE #	CYCLONE	1	2	3	4	5	FILTER
FINAL WT (MG)	450.78	417.46	414.79	400.01	423.24	396.10	246.84
TARE WT (MG)	207.95	404.99	410.66	398.97	422.83	395.58	246.84
NET WT (MG) CORRECTED	242.17	12.20	3.86	0.77	0.14	0.25	0.00
FRACTION % OF TOTAL	93.36	4.70	1.49	0.30	0.05	0.10	0.00
CUM. % WITH FILTER	93.36	98.06	99.55	99.85	99.90	100.00	100.00
FRACTION % WITHOUT FILTER	93.36	4.70	1.49	0.30	0.05	0.10	
CUM. % WITHOUT FILTER	93.36	98.06	99.55	99.85	99.90	100.00	
JET VEL. (CM/SEC)	0	1072	2110	3411	7428	12440	
D50 SIZE (MICRONS)	7.00	4.11	2.40	1.62	0.83	0.50	<0.50
DM/DLOGD (GRAINS/SCF)		3.81173	1.19517	0.32689	0.03504	0.08341	
GEO MEAN (MICRONS)		5.37	3.14	1.98	1.16	0.64	<0.64
PARTICLE COUNT		8.8D+07	4.7D+07	2.0D+07	3.7D+06	1.6D+07	

THE CYCLONE D50 VALUE IS ASSUMED TO BE 7 MICRONS.

(41)

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-1-4 (1)

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-27-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1
2
3

Lab Technician 1
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Inlet
Test Number ESP-I-1-4 (1)

Date 10-27-80
Initial RCS

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	610
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ (.212, 29.34, 84.2)	Vm_{std}	.202
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.93
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.46
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.31
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ (.09)	Vs	1415
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\ (610 + 460)(.202)}{(1415)(4)(29.31)(.93)(.116^2)}$	% I	108.2

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-1-4 (1)
MRI Project No. 4891-L93

BRINK
Particle Size Analysis

Date 10/27/80
Recorded by JP

ANALYSIS

Final Weights

By: J.P Date: 10-29-80

Location: ON SITE LAB

Tare Weights

By: J.P. Date: 10-20-80

Location: ON SITE LAB

Filter Set # 11

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	11-C	.45078	.20795	.24283	* **	* **	
1	11-1	.41746	.40499	.01247			
2	11-2	.41479	.41066	.00413			
3	11-3	.40001	.39897	.00104			
4	11-4	.42324	.42283	.00041			
5	11-5	.39610	.39558	.00052			
Filter	11-F	.24684	.24684	.00000			
			Total	* **			

CONCENTRATION CALCULATION

Sampling Duration _____ min
Flow Rate (Brink) _____ cfm
Baro. Pressure _____ in. Hg
Temperature _____ °F

Particulate Concentration _____ $\mu g/m^3$, actual conditions
_____ $\mu g/m^3$, standard conditions (77°F, 29.92 in. Hg)

* With filter
** Without filter

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Inlet

Test Run Number ESP-I-1-4 ESP-I-1-4 (1)

Pollutant(s) in Sample _____

Task	Date	Time	Personnel	Remarks
Sampling	10-27-80	1701-1705		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-27-80	1740	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site	11-5-80	1:00 pm	I. Pavlovas	
Lab Analysis				
Write Up				

INPUT DATA FOR FILE ESPII131
TEST DATE - 10-28-80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - ESP-I-1-3-(1)

% WATER= 6.01
% CARBON DIOXIDE= 18.67
% CARBON MONOXIDE= 0.00
% OXYGEN= 10.33

BRINK IMPACTOR WITH CYCLONE

STACK TEMPERATURE= 660.0 DEGREES F.
BAR. PRESSURE= 29.19 INCHES HG
STATIC PRESSURE= -0.38 INCHES H20
AVE. DELTA P= 0.06 INCHES H20
PITOT COEFF.= .84
METER TEMP.= 82.0 DEGREES F.
PROBE DIA.= 0.115 INCHES

SAMPLING TIME= 4.0 MIN.
PRESSURE DROP= 1.27 INCHES HG
SAMPLER TEMP. = 660.0 DEGREES F.
PARTICLE DENS= 1
METER VOL.= 0.169 CUBIC FEET
DELTA H= 0.00 INCHES H20

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.= 0.161 CU. FT.
SAMPLE VOL.-WET STD.= 0.171 CU. FT.
STACK VELOCITY= 1132.0 FT./MIN.
NOZZLE VELOCITY= 1289.0 FT./MIN.
MASS COLLECTED= 202.755 MG.
LOADING= 18.31750 GRAIN/SCF
LOADING(DRY)= 19.48878 GRAIN/SCF

DRY MOLECULAR WT.= 31.40
WET MOLECULAR WT.= 30.60
% ISOKINETIC= 113.9
SAMPLING RATE-ACTUAL= 0.093 CU. FT/MIN
CYCLONE BLANK= 0.665 MG.
STAGE BLANK= 0.268 MG.
FILTER BLANK= 0.185 MG.

STAGE #	CYCLONE	1	2	3	4	5	FILTER	
FINAL WT (MG)	410.70	400.50	423.30	401.33	413.64	375.02	261.40	
TARE WT (MG)	220.49	398.50	412.71	400.21	413.20	374.62	261.61	
NET WT (MG) CORRECTED	189.55	1.73	10.32	0.85	0.17	0.13	0.00	
FRACTION % OF TOTAL	93.48	0.85	5.09	0.42	0.08	0.07	0.00	
CUM. % WITH FILTER	93.48	94.34	99.43	99.85	99.93	100.00	100.00	
FRACTION % WITHOUT FILTER	93.48	0.85	5.09	0.42	0.08	0.07		
CUM. % WITHOUT FILTER	93.48	94.34	99.43	99.85	99.93	100.00		
JET VEL. (CM/SEC)	0	901	1773	2867	6243	10456		
D50 SIZE (MICRONS)	7.00	4.58	2.68	1.81	0.93	0.57		<0.57
DM/DLOGD (GRAINS/SCF)		0.84744	4.00739	0.45318	0.05350	0.05603		
GEO MEAN (MICRONS)		5.66	3.50	2.20	1.30	0.73		<0.73
PARTICLE COUNT		1.9D+07	1.4D+08	2.5D+07	5.1D+06	9.5D+06		

THE CYCLONE D50 VALUE IS ASSUMED TO BE 7 MICRONS.

Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. ESP-I-1-3 DATE 10-28-80

Flue Gas Temperature 660 °F

Static Pressure -0.38 " H_2O

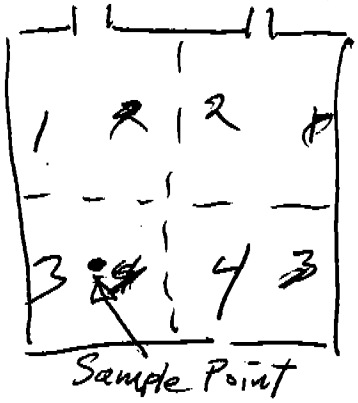
Barometric Pressure 29.19 " Hg

Sample Time 4 min

Probe Tip Diameter ~~.116~~ .115

Velocity at Sample Point 1079 FPS

Sample Rate .080 CFM



Schematic of Traverse Point Layout with Dimensions

Pitot ΔPs at 1100 = .055" H_2O

Gas Composition

CO_2 18.7

O_2 10.3

CO 0

N_2 71

H_2O 6 %

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1115 ~~1104~~ ~~1108~~	1.27	1.27	82	start	0
1116		1.27	82		.044
1117		1.27	82		.084
1118		1.27	82		.121
1119		1.27	82	STOP	.169

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Inlet
Test Number ESP-I-1-3

Date 10-28-80
Initial RCS

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	660
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ (Vm = .169, Tm = 82, Pb = 29.19)	Vm_{std}	.161
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole ($\%CO_2$ x 0.44) + ($\%O_2$ x 0.32) + ($\%N_2$ + %CO x 0.28)	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.16
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ (ΔPs_{avg} = .055)	Vs	1132
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.115 ~~.116~~
$\frac{1{,}039\ (660 + 460)(.161)}{(1132)(4)(29.16)(.94)(.115^2)}$	% I	~~[illegible]~~ 114.1

Particulate Concentration _____ μg/m³, actual conditions
_____ μg/m³, standard conditions (77°F, 29.92 in. Hg)

* With filter
** Without filter

SAMPLE HANDLING LOG

Project Number 4891-L (93)

Source Identification ESP Inlet

Test Run Number ESP-I-1-3 ESP-I-1-3(1)

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1115-1119		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-28-80	1125	Whited ~~Stultz~~	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1449	Pavlomis	
Write Up				

INPUT DATA FOR FILE BAG041

TEST DATE - 10-24-80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - BAG-0-4-1-(1)

% WATER= 4.90
% CARBON DIOXIDE= 14.33
% CARBON MONOXIDE= 0.00
% OXYGEN= 13.17

ANDERSEN IMPACTOR WITH CYCLONE

STACK TEMPERATURE= 347.0 DEGREES F.
BAR. PRESSURE= 29.41 INCHES HG
STATIC PRESSURE= 0.44 INCHES H20
AVE. DELTA P= 0.33 INCHES H20
PITOT COEFF.= .84
METER TEMP.= 67.2 DEGREES F.
PROBE DIA.= 0.195 INCHES

SAMPLING TIME= 180.0 MIN.
PRESSURE DROP= 0.00 INCHES HG
SAMPLER TEMP. = 347.0 DEGREES F.
PARTICLE DENS= 1
METER VOL.= 59.451 CUBIC FEET
DELTA H= 0.32 INCHES H20

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.= 58.550 CU. FT.
SAMPLE VOL.-WET STD.= 61.567 CU. FT.
STACK VELOCITY= 2358.1 FT./MIN.
NOZZLE VELOCITY= 2562.6 FT./MIN.
MASS COLLECTED= 11.005 MG.
LOADING= 0.00276 GRAIN/SCF
LOADING(DRY)= 0.00290 GRAIN/SCF
RATE FOR 15 MICRON CYCLONE CUTOFF= 0.571 CU. FT/MIN

DRY MOLECULAR WT.= 30.82
WET MOLECULAR WT.= 30.19
% ISOKINETIC= 108.7
SAMPLING RATE-ACTUAL= 0.531 CU. FT/MIN
CYCLONE BLANK= 0.035 MG.
STAGE BLANK= -0.150 MG.
FILTER BLANK= 0.025 MG.

STAGE #	CYCLONE	0	1	2	3	4	5	6	7	FILTER
FINAL WT (MG)	481.08	463.60	422.00	437.63	413.19	439.85	427.94	425.10	460.56	437.53
TARE WT (MG)	481.22	462.70	420.91	436.27	411.84	438.39	426.50	424.34	459.67	436.95
NET WT (MG) CORRECTED	0.00	1.05	1.24	1.51	1.50	1.61	1.59	0.91	1.04	0.55
FRACTION % OF TOTAL	0.00	9.54	11.27	13.72	13.63	14.63	14.45	8.27	9.45	5.04
CUM. % WITH FILTER	0.00	9.54	20.81	34.53	48.16	62.79	77.24	85.51	94.96	100.00
FRACTION % WITHOUT FILTER	0.00	10.05	11.87	14.45	14.35	15.41	15.22	8.71	9.95	
CUM. % WITHOUT FILTER	0.00	10.05	21.91	36.36	50.72	66.12	81.34	90.05	100.00	
JET VEL. (CM/SEC)		0	41	76	127	210	374	905	1650	3300
D50 SIZE (MICRONS)		15.76	15.76	9.83	6.65	4.52	2.89	1.43	0.87	0.58	<0.58
DM/DLOGD (GRAINS/SCF)			0.00152	0.00223	0.00224	0.00208	0.00130	0.00105	0.00148	
GEO MEAN (MICRONS)			12.44	8.08	5.48	3.62	2.03	1.11	0.71	<0.71
PARTICLE COUNT			1.5D+04	3.4D+04	5.1D+04	7.1D+04	7.9D+04	1.2D+05	2.6D+05	

D50 FOR STAGE 0 EXCEEDS THE ESTIMATED CYCLONE D50 VALUE OF 15.70 MICRONS.

THE D50 VALUE SHOWN FOR THE CYCLONE IS AN ESTIMATE ASSUMING THE (-.63) POWER OF FLOW RATE OF SRI CYCLONE I.

27

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Bag-0-4-1

MRI Project Number 4891-L(93)
Field Dates
Plant PFIZER
Sampling Location Baghouse outlet
Sampling Date 10/24/80

FIELD CREW

Crew Chief G. Cobb.

Testing Engineer 1 Daniel Vogel
2
3

Engr. Technician 1
2
3

Lab Technician 1 T. Walker
2 J. Johnson
3 J. Pavelonis

Process Engineer 1
2

Other 1 E.O.
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant PFIZER
Sampling Location Baghouse Outlet
Test No. Bag-0-J 4-1

Date 10-24-80
Initial D.U.

Velocity head at sampling location, in. H_2O	ΔPs	.40
Stack temperature at sample point, °F	Ts	340
Barometric pressure, in. Hg	Pb	29.42
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.45
Percent moisture in gas stream by volume	% H_2O	4.25
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	Mf	.957
Molecular wt. dry stack gas, lb/lb-mole (% CO_2 x 0.44) + (% O_2 x 0.32) + (% N_2 + % CO x 0.28)	Md	31.25
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.68
Stack velocity, fpm $5{,}128.8\ (Cp) \cdot \left(\sqrt{\Delta Ps}\right) \cdot \sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	~~2174~~ 2564
Calculated nozzle diameter, in. FS = .535 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	~~.345~~ ~~.244~~ .195
Actual nozzle diameter, in.	D_{n_a}	.195
Assumed meter temperature, °F	Tm	60
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.531
Calculated meter flow rate, ft^3/min $Fs \left(\frac{Tm+460}{Ts+460}\right) \left(\frac{Ps}{Pb}\right)$ (Mf)	Fm	.330

1.65
.0825 .5 sec

ISOKINETIC PERFORMANCE WORKSHEET

Plant PFIZER
Sampling Location Baghouse Outlet
Test Number Bag - 0-4-1

Date 10-24-80
Initial D. Vaqsl

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	347
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .322, Pb = 29.41, Vm = 59.451, Tm+460 = 527.2	Vm_{std}	58.54
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 4.91	Mf	.951 ~~.957~~
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	~~31.25~~ 30.82
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	~~30.68~~ 30.19
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	~~29.45~~ 29.44
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ Δp = .33, C_p = .84	Vs	2358 ~~2564~~
Total sample time, minutes	θ	180
Nozzle diameter, inches	Dn	.1952
$\frac{1{,}039\ (.347 + 460)(58.54)}{(2358)(180)(29.44)(.951)(.1952)}$	% I	~~97.30~~ 108.65

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
			133.260										
	120	1329	134.91	134.94	.36	.31	.34	365	73	70	4	NA	NA
	125	1334	136.56	136.59	.30		.31	361	75	71	4		
off 1345	130	1339	138.21	138.25	.30		.33	361	77	72	4		
on 1347	135	1344	139.86	139.87	.34		.32	361	75	72	4		
	140	1352	141.51	141.51	.35		.32	340	75	72	4		
	145	1357	143.16	143.14	.36		.32	363	75	72	4		
	150	1402	144.81	144.80	.35		.33	360	76	72	4		
	155	1407	146.46	146.46	.30		.33	360	77	73	4		
1410 off 1412 on	160	1414	148.11	148.11	.33		.33	295	76	73	4		
	165	1419	149.76	149.76	.34		.33	361	76	74	4		
	170	1424	151.41	151.42	.35		.33	361	75	74	4		
	175	1429	153.06	153.09	.24		.33	360	76	74	4		
	180	1434	154.71	154.761	.29								
					ΔP_s AVE = .33		ΔH .322	T_s = 347	AVE T_m 67.2				
			V_m = 59.451										

Run Number BAY-0-4-1

Date 10-24-80

console #4

Sampling Location Baghouse out

Comments:

By Vogel

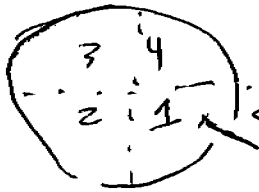
EPA (Dun 236
4 72

1.65 @ 5min
.0825 @ 15min

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10-24-80
SAMPLING LOCATION Baghouse Outlet
SAMPLE TYPE Particulate
RUN NUMBER B49-0-4-1
OPERATOR Vogel
AMBIENT TEMPERATURE 57
BAROMETRIC PRESSURE ~~57~~ 29.41
STATIC PRESSURE, (P_s) -7.44
Filter Set 7

Leak CK: Inital at 15" Hg, CFM NA
Final at ____ Hg, CFM NA



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired)	330
Probe Tip Diameter	.195
CO_2	14.33
O_2	13.17
CO	0
N_2	72.5
% H_2O	4.25

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1115	95.310										
1116 off 0.1	5	1122	1098.46	99.66	.34	.31	.33	356	59	59	4	NA	NA
on 1117	10	1127	1098.61	99.64	.29		.34	362	62	60	4		
	15	1132	100.26	100.28	.35		.33	370	65	60	4		
	20	1137	101.91	101.91	.34		.32	365	66	61	4		
off 1140 - on 1142	25	1142	103.56	103.56	.34		.32	340	66	~~63~~ 62	4		
	30	1149	105.21	105.19	.46		.32	362	67	63	4		
	35	1154	106.86	106.82	.35		.33	362	68	64	4		
	40	1159	108.51	108.44	.34		.32	362	67	64	4		
	45	1204	110.16	110.11	.27		.33	362	67	65	4		
1205 off	50	1207 on 1212	111.81	111.78	.30		.34	340	66	64	4		
	55	1217	113.46	113.46	.32		.34	355	67	65	4		
	60	1222	115.11	115.11	.38		.34	360	69	66	4		
	65	1227	116.76	116.78	.33	(.34)	.34	362	70	66	4		
off 1230	70	1232 on 1234	118.41	118.41	.34		.33	334	68	66	4		
	75	1239	120.06	120.06	.30		.33	364	69	66	4		
	80	1244	121.71	121.70	.34		.33	345	69	67	4		
	85	1249	123.36	123.33	.33		.33	365	70	67	4		
	90	1254	125.01	124.99	.35		.33	365	72	68	4		
off 1255 / 1257 on	95	1302	126.66	126.61	.34		.33	345	70	68	4		
	100	1307	128.31	128.28	.34		.34	364	71	69	4		
	105	1312	129.96	129.96	.34	(.34)	.34	370	72	69	4		
	110	1317	131.61	131.61	.35		.34	370	73	70	4.5		
off 1320 - on 1322	115	1324	133.260	133.260	.37		.34	340	72	70	4.5	✓	✓

COMMENTS:

133.

D-135

EPA (Dur) 235
4 72

ANDERSEN PARTICLE SIZE ANALYSIS

FILTER SET # 7

Test No. Bag-0-4-1
Date 10-24-80
Time
Location Baghouse-Outlet

Final Weights
By J.P Date 10-25-80
Location ON-SITE LAB

Tare Weights
By J.P Date 10-17-80
Location ON-SITE LAB

PRES. 481.08 481.22 -0.14

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)[a]	% of total wt[c]	Cumulative % of total wt[c]	Dp μ
0	7-0	463.60	462.70	0.90			
1	7-1	422.00	420.91	1.09			
2	7-2	437.63	436.27	1.36			
3	7-3	413.19	411.84	1.35			
4	7-4	439.85	438.39	1.46			
5	7-5	427.94	426.50	1.44			
6	7-6	425.10	424.34	0.76			
7	7-7	460.56	459.67	0.89			
F	7-F	437.53	436.95	0.58			
		Total with filter		9.83			
		Total without filter					

Note: Andersen flow rate =

a/ ~~Includes blank correction~~.

b/ Value used for calculations.

c/ Calculations based on total sample weight with filter are entered on first line; calculations based on total sample weight without filter are entered on second line for each stage.

SAMPLE HANDLING LOG

Project Number 4891-L93

Source Identification Baghouse-Outlet

Test Run Number Bag-0-4-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-24-80	1115-1434		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-24-80	1434-1500	Vogel, Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	10-27-80	10:30 AM	PAVELONIS	
Write Up				

INPUT DATA FOR FILE BAGI44(1)
TEST DATE - 10-24-80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - BAG-I-4-4(1)

% WATER= 5.48
% CARBON DIOXIDE= 19.66
% CARBON MONOXIDE= 0.00
% OXYGEN= 12.17

BRINK IMPACTOR WITH CYCLONE

STACK TEMPERATURE= 400.0 DEGREES F.
BAR. PRESSURE= 29.41 INCHES HG
STATIC PRESSURE= -30.60 INCHES H20
AVE. DELTA P= 0.32 INCHES H20
PITOT COEFF.= .84
METER TEMP.= 73.0 DEGREES F.
PROBE DIA.= 0.078 INCHES

SAMPLING TIME= 4.0 MIN.
PRESSURE DROP= 1.74 INCHES HG
SAMPLER TEMP. = 400.0 DEGREES F.
PARTICLE DENS= 1
METER VOL.= 0.197 CUBIC FEET
DELTA H= 0.00 INCHES H20

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.= 0.192 CU. FT.
SAMPLE VOL.-WET STD.= 0.203 CU. FT.
STACK VELOCITY= 2467.6 FT./MIN.
NOZZLE VELOCITY= 2743.5 FT./MIN.
MASS COLLECTED= 71.870 MG.
LOADING= 5.46729 GRAIN/SCF
LOADING(DRY)= 5.78426 GRAIN/SCF

DRY MOLECULAR WT.= 31.63
WET MOLECULAR WT.= 30.89
% ISOKINETIC= 111.2
SAMPLING RATE-ACTUAL= 0.091 CU. FT/MIN
CYCLONE BLANK= 0.665 MG.
STAGE BLANK= 0.268 MG.
FILTER BLANK= 0.185 MG.

STAGE #	CYCLONE	1	2	3	4	5	FILTER
FINAL WT (MG)	244.02	338.02	402.52	400.62	414.39	412.55	260.26
TARE WT (MG)	211.43	334.95	393.64	396.74	402.11	406.75	252.70
NET WT (MG) CORRECTED	31.93	2.80	8.61	3.61	12.01	5.53	7.38
FRACTION % OF TOTAL	44.42	3.90	11.98	5.03	16.71	7.70	10.26
CUM. % WITH FILTER	44.42	48.32	60.30	65.33	82.04	89.74	100.00
FRACTION % WITHOUT FILTER	49.50	4.34	13.35	5.60	18.62	8.58	
CUM. % WITHOUT FILTER	49.50	53.84	67.20	72.80	91.42	100.00	
JET VEL. (CM/SEC)	0	882	1736	2807	6113	10237	
D50 SIZE (MICRONS)	7.00	4.20	2.47	1.68	0.87	0.54	<0.54
DM/DLOGD (GRAINS/SCF)		0.96182	2.83972	1.63927	3.21955	2.04943	
GEO MEAN (MICRONS)		5.42	3.22	2.04	1.21	0.69	<0.69
PARTICLE COUNT		2.2D+07	1.1D+08	10.0D+07	3.3D+08	3.7D+08	

THE CYCLONE D50 VALUE IS ASSUMED TO BE 7 MICRONS.

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MIDWEST RESEARCH INSTITUTE

BRINK

RUN Bag-I-4-4

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Baghouse Inlet
Sampling Date 10-24-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

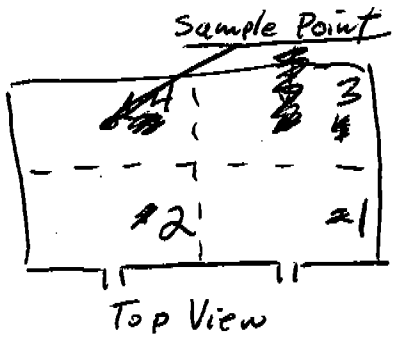
Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. Bag-I-4-4 DATE 10-24-80

Flue Gas Temperature	400	°F
Static Pressure	-2.25" Hg ~~" H_2O~~	
Barometric Pressure	29.41	" Hg
Sample Time	4	min
Probe Tip Diameter	.078"	
Velocity at Sample Point	2430	FPS
Sample Rate	.081	CFM



Schematic of Traverse Point Layout with Dimensions

Gas Composition

CO_2 18.83

O_2 13.17

CO 0

N_2 68

H_2O 5

Time 1226 ΔP_s = 0.32" H_2O

Filter Set #5

Preheat Started 1200

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1230	1.74		72	Start	0 ~~[illegible]~~
1232		1.74	72		.098
1234		1.74	73	Stop	.197

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Baghouse Inlet
Test Number Bag-I-4-4

Date 10-24-80
Initial RCS

Isokinetic equation:

$$\% I = \frac{1{,}039(Ts_{avg}+460)(Vm_{std})}{Vs(\theta)(Ps)(Mf)(Dn^2)}$$

Average stack temperature, °F	Ts_{avg}	400
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ (Vm = .198, Tm = 72.3, ΔH_{avg} = 29.41)	Vm_{std}	.193
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.95
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.63
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.95
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	27.16
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2465
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.078
$\frac{1{,}039\ (400 + 460)(.193)}{(2465)(4)(27.16)(.95)(.078^2)}$	% I	111.4

MIDWEST RESEARCH INSTITUTE

Run No. Bag-I-4-4 | BRINK | Date 10-24-80

MRI Project No. 4891-L93 | Particle Size Analysis | Recorded by

Filter Set #5

ANALYSIS

Final Weights	Tare Weights
By: J.P. Date: 10-25-80	By: JP Date: 10-18-80
Location: ON SITE LAB	Location: ON-SITE LAB

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	5-C	.24402	.21143	0.03259	* **	* **	
1	5-1	.33802	.33495	0.00307			
2	5-2	.40252	.39364	0.00888			
3	5-3	.40062	.39674	0.00388			
4	5-4	.41439	.40211	0.01228			
5	5-5	.41255	.40675	0.00580			
Filter	5-F	.26026	.25270	0.00756			
			Total	.07406 * **			

CONCENTRATION CALCULATION

Sampling Duration _____ min
Flow Rate (Brink) _____ cfm
Baro. Pressure _____ in. Hg
Temperature _____ °F

Particulate Concentration _____ $\mu g/m^3$, actual conditions
_____ $\mu g/m^3$, standard conditions (77°F, 29.92 in. Hg)

* With filter
** Without filter

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification Baghouse Inlet

Test Run Number Bag-I-4-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-24-80	1230-1234	Stultz	
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-24-80	1300	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	10-27-80	11:00 AM	PAVELONIS	
Write Up				