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 V
Appendix E

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 E

SUSPECT AND BAD RUNS

(2)

MIDWEST RESEARCH INSTITUTE

RUN Bag-I-0-4

MRI Project Number
Field Dates 10-20-80
Plant Pfizer Ind.
Sampling Location Baghouse Inlet
Sampling Date 10-20-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Whited
2
3

Lab Technician 1
2
3

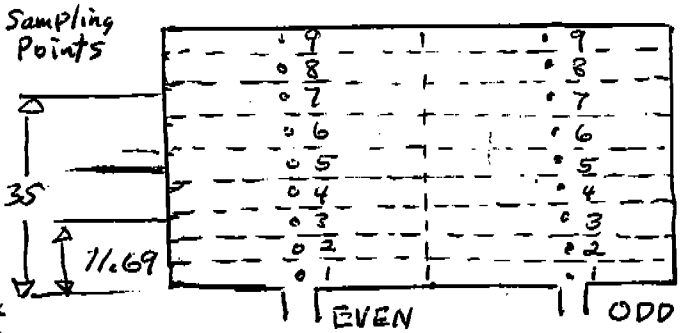
Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Pfizer Ind.
DATE 10-20-80
SAMPLING LOCATION Baghouse Inlet
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) 50 3/4"
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) 4"
STACK I.D., (DISTANCE A - DISTANCE B) 46 3/4"
NEAREST UPSTREAM DISTURBANCE 11 3/4-ft
NEAREST DOWNSTREAM DISTURBANCE 9 1/2-ft
CALCULATOR RCS EW



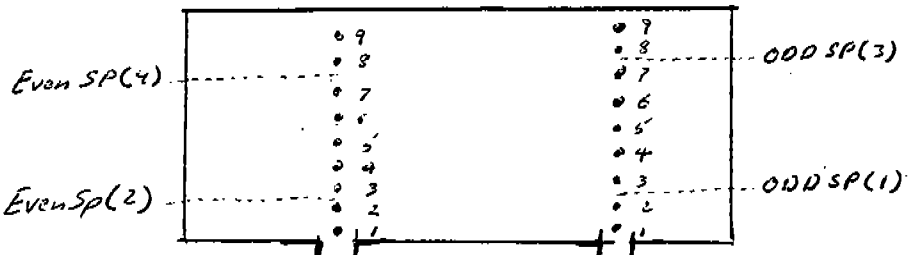
SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
ODD - 1			2.6	4	6.6
2			7.8		11.8
3			12.99		16.99
4			18.17		22.17
5			23.36		27.36
6			28.55		32.55
7			33.74		37.74
8			38.93		42.93
9			44.12		48.12
ODD-SP(1)			11.69		15.69
ODD-SP(3)			35		39
EVEN - 1			2.6		6.6
2			7.8		11.8
3			12.99		16.99
4			18.17		22.17
5			23.36		27.17
6			28.55		32.55
7			33.74		37.74
8			38.93		42.93
9			44.12		48.12
EVEN-SP(2)			11.69		15.69
Even-SP(4)			35		39

EPA (Dur) 232
4 72

PRELIMINARY VELOCITY TRAVERSE

PLANT Pfizer Ind.
DATE 10-20-80
LOCATION Baghouse Inlet
STACK I.D. 48" x 72" Rectangular
BAROMETRIC PRESSURE, in. Hg 29.12
STACK GAUGE PRESSURE, in. H_2O -2.25" Hg
OPERATORS Robert Stulte
Pitot = MRI #1



SCHEMATIC OF TRAVERSE POINT LAYOUT
EVEN ODD

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
ODD 1	0.77	390
2	0.65	397
3	0.63 ~~0.64~~	~~403~~ 407
4	0.58 ~~0.63~~	407
5	0.53 ~~0.56~~	~~407~~ 405
6	0.49 ~~0.53~~	~~405~~ 395
7	0.48 ~~0.45~~	~~395~~ 400
8	0.43	403
9	0.41	395
ODD SP(1)	0.64	403
ODD SP(3)	0.48	400
Static	Press = -2.25" Hg	
at	EVEN - SP(4)	
AVERAGE	$\sqrt{\Delta p_s}$ = .737	400.2

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
Even 1	0.28	265
2	0.38	395
3	0.30 ~~0.32~~	400
4	0.29	403
5	0.29	403
6	0.26	395
7	0.31	390
8	~~0.31~~ 0.30	~~400~~ 390
9	0.26	395
Even SP(2)	0.32	400
Even SP(4)	0.31	400
Static Press	=	
AVERAGE	$\sqrt{\Delta p_s}$ = .547	385.1

EPA (Dur) 233
4 72

Avg T_s = 392.6
$\sqrt{\Delta p_s}$ = 0.642

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Pfizer Ind
DATE 10-20-80
SAMPLING TIME (24-hr CLOCK) 1340 hrs
SAMPLING LOCATION Baghouse Inlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS GRAB) Grab
ANALYTICAL METHOD Fyrite O_2 & CO_2
AMBIENT TEMPERATURE 54°F
OPERATOR Robert Stulte

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	16.9 %		17.0%		17.50		17.1	44/100	7.5
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	14.60		14.20		13.70		14.16	32/100	4.5
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							68.7	28/100	19.25
								TOTAL	31.27

EPA (Dur) 230
4/72

Run Number 0

Date

MIDWEST RESEARCH INSTITUTE
PRELIMINARY
MOISTURE DETERMINATION

Recorded by RS

Assisted by CV

NOTE: Same as Run No. 1

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = 29.12 in. Hg

☐ Barometer Location at site

Reading Time 1300 by CV

☐ Elevation

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final	2000	620.86		70	247
Initial	1300	565.08		54	200
Difference		Vm = 55.78			Wc = 47

Tube No.	Weight (Grams)		
	Final	Initial	Difference
1			669.2
2			653.5
Total Moisture Adsorbed:			Wa = 15.7

Meter Pressure, $P_B \approx Pm$ = 29.12 in. Hg

Average Meter Temperature, Tm = 70 °F

Total Weight of Moisture Collected, Wc + Wa = Wm = 64.2 gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{Pm\,Vm}{(Tm+460)\,Wm}\right]} = 5.29 \text{ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = _____ °F

Wet Bulb Temperature = _____ °F

Moisture Content (from Ref. Table) = _____ % by Volume

C. Predetermined Value

% Moisture _____ Basis _____

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Pfizer Ind.

DATE 10-20-80

SAMPLING LOCATION Baghouse Inlet, Bag-I-0-4

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	80
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	4.5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.12
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	26.87
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.92
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	.92	
CALCULATED NOZZLE DIAMETER, in.	0.316	
ACTUAL NOZZLE DIAMETER, in.	0.296	
REFERENCE Δp, in. H_2O	0.40	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer Ind. Date 10-20-80
Sampling Location Bag-I-D-4 Initial RCS
Test Number Ø

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

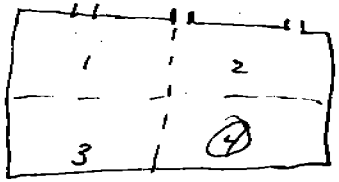
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	80
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.955
Nozzle diameter, inches	Dn	.296
Barometric pressure, inches Hg	Pb	29.12
$\frac{5.168\ (80 + 460)\ (.84)\ (5)\ (.955)\ (.296^2)}{\sqrt{29.12}}$	K	181.7

FIELD DATA

PLANT Pfizer Ind.
DATE 10-20-80
SAMPLING LOCATION Bag-I-0-4
SAMPLE TYPE Particulate
RUN NUMBER 0
OPERATOR RCS
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 29.12
STATIC PRESSURE, (P_s) -2.25" Hg
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 4' SS
NOZZLE I.D. 0.296
ASSUMED MOISTURE, % 4.5
SAMPLE BOX NUMBER 12
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR .92
PROBE HEATER SETTING 75
HEATER BOX SETTING 350
REFERENCE Δp .40

Leak CK: Initial at 15" Hg, CFM .002
14" Hg Final at Hg, CFM .011

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 181.7 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

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 (565.075)	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	1717											
Bag I-1-4	5	1722	569.02	568.84	0.40	1.85	1.85	390	54	54	8		
	10	1727	572.72	572.46	0.35	1.65	1.80	384	60	54	8	165	50
	15		576.44	576.04	0.35	1.65	1.80	375	66	56	8		
	20		580.18	579.01	0.35	1.65	1.65	368	70	57	8	210	
	25		583.67	582.81	0.31	1.46	1.50	378	72	58	8	218	
					~~0.24~~	~~1.44~~		~~365~~	~~72~~	~~59~~	~~8~~	~~218~~	
	30	586.25		586.15	0.24	1.44	1.50	365	72	57	8	218	
	35	590.25	~~586.25~~	586.15	0.30	1.45	1.55	360	74	60	8	230	
	40	593.76	~~590.25~~	589.45	0.31	1.50	1.55	370	75	60	9	220	
	45	597.16	~~593.76~~	592.63	0.29	1.50	1.55	370	76	61	10	225	60
	~~50~~	→	~~597.16~~	~~596.04~~	~~0.28~~	~~1.45~~	~~1.60~~	~~360~~	~~77~~	~~62~~	~~10~~	~~225~~	
	~~40~~												
				~~596.04~~									
	50		600.52	599.30	0.28	1.45	1.60	360	77	62	10	225	60
	55		604.05	602.68	0.31	1.50	1.60	360	78	63	10.5	223	
	60		607.58	606.22	0.31	1.64	1.70	360	78	64	11.0	230	62
	65		611.11	609.90	0.31	1.64	1.90	360	78	64	13		
	70		614.64	613.57	0.31	1.64	1.80	360	78	64	13	235	64
	75		618.15	617.22	0.31	1.64	1.80	369	78	64	13	238	
	80	1737	621.64	620.85	0.31	1.64	1.80	379	82	66	14	238	60
							Av	369.25	~~75~~				
				55.78	$\sqrt{Ps} = 0.56$		1.68			66.68			

COMMENTS

EPA (Dun) 235

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-20-80
Initial

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	369.25
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	53.78
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.948
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.27
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.58
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	26.87
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2435
Total sample time, minutes	θ	80
Nozzle diameter, inches	Dn	0.296
$\frac{1{,}039\ (369.25 + 460)(53.78)}{(2435)(80)(26.87)(.948)(.296^2)}$	% I	107

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer Ind.
Sample Location: Baghouse I-0-4
Sample Box No.: 12
Sample Type: Particulate

Run No.: Bag-I-0-4
Sample Date: 10-20-80
Recovery Date:
Cleanup Person:

Filter No.
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/	136.5	110.5	1.5		
Initial Volume (wt) b/	100	100	0.0		
Net Volume (wt) b/	36.5	10.5	1.5		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked — Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm: 64.2

SILICA GEL

669.2
653.5
15.7
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. / 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. / 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:

SAMPLE HANDLING LOG

Project Number 4891-L (93)

Source Identification Baghouse Inlet

Test Run Number Bag-I-D-4

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-20-80	1717 - 1837		
Probe Technician	Whited			
Meter Technician	Stultz			
Other				
Transport of Train to Cleanup Site	Whited	1850		
Train Disassembly	Whited	1900		
Train Cleanout	Walker			
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

10

MIDWEST RESEARCH INSTITUTE

RUN Bag - I - of 3

MRI Project Number 4591-C-93
Field Dates 10-21-80
Plant Pfizer Ind
Sampling Location Baghouse Inlet
Sampling Date 10-21-80

FIELD CREW

Crew Chief Mr. Cobb

Testing Engineer 1 R. Stultz
2
3

Engr. Technician 1 E. Whited
2
3

Lab Technician 1 Walker
2
3

now no sampling

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-21-80

SAMPLING LOCATION Bay-I-2-3

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	62.0
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	0.95
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.08
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	26.83
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	$\Delta p_{avg.}$	0.48
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	0.275	
ACTUAL NOZZLE DIAMETER, in.	0.246	
REFERENCE Δp, in. H_2O	0.775	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Baghouse Inlet - T3
Test Number Bg - I - 2 - 3

Date 10-21-80
Initial CV

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

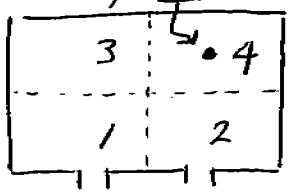
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	65
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.246
Barometric pressure, inches Hg	Pb	29.16
$\frac{5.168\ (65 + 460)\ (.84)\ (5)\ (.95)\ (.246^2)}{\sqrt{29.16}}$	K	121.32

FIELD DATA

PLANT Pfizer
DATE 10-21-80
SAMPLING LOCATION Baghouse Inlet
SAMPLE TYPE Particulate
RUN NUMBER ~~1-3~~ Bag-I-1-3
OPERATOR R. Stultz
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 29.08
STATIC PRESSURE, (P_s) -2.25" Hg
FILTER NUMBER (s) 11

Sample Point



PROBE LENGTH AND TYPE 4 ft. S.S.
NOZZLE I.D. 0.246
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 8
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING 100
HEATER BOX SETTING 400
REFERENCE Δp 0.775

Leak CK: Initial at 15" Hg, CFM .001 SCHEMATIC OF TRAVERSE POINT LAYOUT
10" Hg Final at Hg, CFM .008 READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = \cancel{123.22} \times 121.32 \sqrt{\frac{Ps}{Ts + 460}}$

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	1617		650.849									
Bag-I-1-3	5	1622	653.69	653.80	0.48	1.15	1.15	415	60	60	5	235	
	10	1627	656.51	656.64	0.48	1.15	1.05	426	64	61	5	235	60
	15	1632	659.38	659.47	0.48	1.15	1.00	396	67	62	5	237	
					Avg = 0.48	Avg = 1.07		Avg = 412.3	Avg 62.33			236	

COMMENTS 8.6 a/ft

EPA (Dur) 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Baghouse
Test Number 1-3

Date 10-21-80
Initial CL

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	412.
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	~~8.5~~ 8.49
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	31.50
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.83
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	~~27.83~~ 26.83
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$	Vs	3064.6 ~~3023.4~~
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	0.246
$\frac{1{,}039\ (412 + 460)(8.49)}{(3064.6)(15)(26.83)(0.95)(.246^2)}$	% I	~~106~~ 108.5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. 1-3
Sample Date 10-21-80
Recovery Date 10-21-80
Cleanup Person Walker

Filter No. 10
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M		
Impinger Solution	H2O	H2O	Dry		
Final Volume (wt) b/	98	95.75	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	-2.0	-4.25	0		
Sample No.(s)					

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

SILICA GEL

641.8	
638.4	
3.4	

Silica Gel
Color

Total Moisture, gm Negative H2O collection. Assumed 5% for calculations

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

RECOVERED SAMPLE

Probe Rinse: Sample No.
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.
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:

SAMPLE HANDLING LOG

Project Number 4891-L-93

Source Identification Baghouse Inlet

Test Run Number Deg-I-1-3

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-21-80	1617 - 1632		
Probe Technician			Whited	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-21-80	1640	Whited	
Train Disassembly	10-21-80	1700	Whited	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

(6)

MIDWEST RESEARCH INSTITUTE

RUN Berg - I - 1 - 4

MRI Project Number 4881-L-93
Field Dates 10-21-80
Plant Pfizer Ind
Sampling Location Baghouse Inlet
Sampling Date 10-21-80

FIELD CREW

Crew Chief ~~Robert Stultz~~ Mr. Cobb

Testing Engineer 1 ~~Ed Whited~~ R. Stultz
2
3

Engr. Technician 1 E. Whited
2
3

Lab Technician 1 T. Walker
2
3

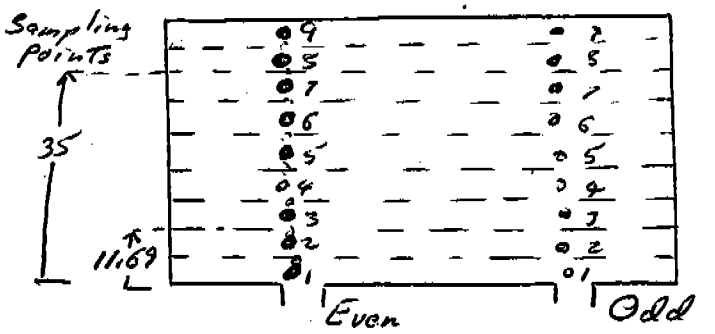
Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Pfizer Ind.
DATE 10-21-80
SAMPLING LOCATION Baghouse Inlet
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE A) 50 3/4"
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE B) 4"
STACK I.D.. (DISTANCE A - DISTANCE B) 46 3/4
NEAREST UPSTREAM DISTURBANCE 11 3/4 ft
NEAREST DOWNSTREAM DISTURBANCE 9 1/2 ft
CALCULATOR RAS + EW.



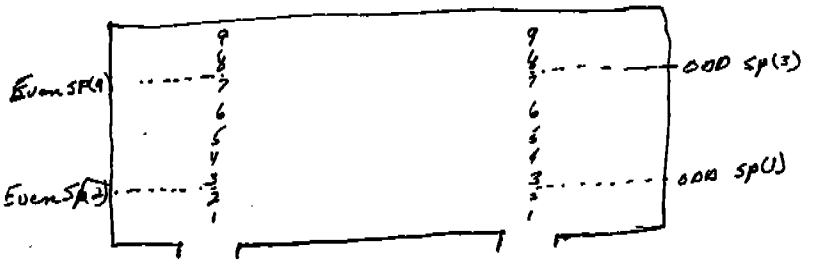
SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
ODD 1			2.6		6.6
2			7.8		11.8
3			12.99		16.99
4			18.17		22.17
5			23.36		27.36
6			28.55		32.55
7			33.74		37.74
8			38.93		42.93
9			44.12		48.12
ODD-SP(1)			11.69		15.69
ODD-SP(3)			35.0		39.0
Even - 1			2.6		6.6
2			7.8		11.8
3			12.99		16.99
4			18.17		22.17
5			23.36		27.17
6			28.55		32.55
7			33.74		37.74
8			38.93		42.93
9			44.12		48.19
Even-SP(2)			11.69		15.69
Even-Sp(4)			35.0		39.0

EPA (Dur) 232
4 72

PRELIMINARY VELOCITY TRAVERSE

PLANT Pfizer Inc.
DATE 10-21-80
LOCATION Bag House Inlet
STACK I.D. 48 x 72" Rectangular Duct
BAROMETRIC PRESSURE, in. Hg 29.08
STACK GAUGE PRESSURE, in. ~~H_2O~~ - 2.25 in. Hg
OPERATORS RCS & EW



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
ODD 1	0.77	390
2	0.65	397
3	0.63	407
4	0.56	407
5	0.53	405
6	0.45	395
7	0.48	400
8	0.43	403
9	0.41	395
ODD SP(1)	0.64	403
ODD SP(3)	0.48	400
AVERAGE	.737	400.2

T_s = 392.6
Δp = 0.642

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
Even 1	0.28	265
2	0.38	395
3	0.30	400
4	0.29	403
5	0.29	403
6	0.26	395
7	0.31	390
8	0.30	390
9	0.26	395
Even sp(2)	0.32	400
Even sp(4)	0.31	400
AVERAGE	.547	385.1

EPA (Dur) 233
4 72

MIDWEST RESEARCH INSTITUTE

Run Number Bag-D I-1-4 PRELIMINARY Recorded by RS

Date 10-21-80 MOISTURE DETERMINATION Assisted by CW

NOTE: Same as Run No. 0

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = 29.12 in. Hg

☐ Barometer Location Lab

Reading Time 1300 by CW

☐ Elevation _____

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final	2000	620.86		70	247
Initial	1300	565.08		54	200
Difference		Vm = 55.78			Wc = 47

Tube No.	Weight (Grams)		
	Final	Initial	Difference
			669.2
			653.5
Total Moisture Adsorbed:			Wa = 15.7

Meter Pressure, $P_B \approx Pm$ = 29.12 in. Hg

Average Meter Temperature, Tm = 70 °F

Total Weight of Moisture Collected, Wc + Wa = Wm = ~~669~~ 64.2 gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{Pm\,Vm}{(Tm+460)\,Wm}\right]} = 5.29 \text{ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = _____ °F

Wet Bulb Temperature = _____ °F

Moisture Content (from Ref. Table) = _____ % by Volume

C. Predetermined Value

% Moisture _____ Basis _____

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT Pfizer Ind.

DATE 10-21-80

SAMPLING LOCATION Bag - I - 1 - 4

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	5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.08
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	26.83
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.92
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	370
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.31
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.90	
CALCULATED NOZZLE DIAMETER, in.	.315	
ACTUAL NOZZLE DIAMETER, in.	.296	
REFERENCE Δp, in. H_2O	.385	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer Ind. Date 10-21-80
Sampling Location Baghouse Inlet Initial RCS
Test Number Bag-I-1-4

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

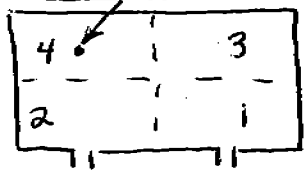
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	75
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.296
Barometric pressure, inches Hg	Pb	29.08
$\frac{5.168\ (75 + 460)\ (.84)\ (5)\ (.95)\ (.296^2)}{\sqrt{29.08}}$	K	179.24

FIELD DATA

PLANT Pfizer Ind.
DATE 10-21-80
SAMPLING LOCATION Baghouse Inlet
SAMPLE TYPE Particulate
RUN NUMBER Bag-I-1-4
OPERATOR RCS - EW
AMBIENT TEMPERATURE 54°F
BAROMETRIC PRESSURE 29.08
STATIC PRESSURE, (P_s) -2.25" Hg
FILTER NUMBER (s) 9

Sample Point



PROBE LENGTH AND TYPE 4' SS
NOZZLE I.D. .296
ASSUMED MOISTURE, % 5
SAMPLE BOX NUMBER 8
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR .90
PROBE HEATER SETTING —
HEATER BOX SETTING —
REFERENCE Δp .385

Leak CK: Initial at 15" Hg, CFM .002 SCHEMATIC OF TRAVERSE POINT LAYOUT

Final at Hg, CFM 0000 READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 179.24 \times \sqrt{\frac{Ps}{Ts + 460}}$

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	1015		621.585									
Bag-I-1-4	5	1020	624.9	624.26	.31	1.5	1.8	456	53	53	7		
	10	1025	628.24	627.88	.31	1.5	1.8	433	58	57	7	220	
	15	1030	631.58	631.41	.31	1.5	1.85	435	63	54	8	227	55
	20	1035	634.91	634.68	.52*	1.5	1.55	440	68	55	8	230	58
	25	1040	638.25	638.04	0.35	1.5	1.55	435	68	55	8½	230	
	30	1045	641.59	641.18	0.55	1.5	1.50	435	68	58	10	233	

COMMENTS $V_{m\,avg} = 19.595$ $\Delta P_{s\,avg} = .31$ $\Delta H_{avg} = 1.68$ $T_{s\,avg} = 439$ $T_{m\,avg} = 59.2$

EPA (Dun 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer Ind.
Sampling Location Baghouse Inlet
Test Number Bag-I-1-4

Date 10-21-80
Initial RCS-EW

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	439
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	19.44
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	31.29
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	30.63
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	26.83
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2508.8
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.296
$\frac{1{,}039\ (439 + 460)(19.44)}{(2508.8)(30)(26.83)(.95)(.296^2)}$	% I	108.0

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: Bag-I-1-4
Sample Date: 10-21-80
Recovery Date: 10-21-80
Cleanup Person: _____

Filter No.: 9
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/	114.0	96.3	0.5		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	14	3.7	.5		
Sample No.(s)					

Combined impinger contents, Sample No. _____
Liquid Level Marked _____ Container(s) Sealed _____
Description of Impinger Solution _____
Total Moisture, gm ~~16.9~~ 24.3 cc

SILICA GEL

656.6
680.5
6.1
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 No. BEAKER #3 ~~#7~~
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. BEAKER #10
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: _____

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification Baghouse Inlet

Test Run Number Bag-I-1-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-21-80 ~~Stultz~~	1015 - 1045	Stultz	
Probe Technician	~~Whited~~		Whited	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-21-80 ~~1100~~	1100	RCS/EW/RR	
Train Disassembly	~~10-21-80 1115~~	1115		
Train Cleanout	~~10-21-80 1120~~	1120	EW	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ONSITE
Write Up				

FILE NAME - BAGIZ11
RUN # - BAG-I-Z-1-(1)
LOCATION - PFIZER
DATE - 12-4-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	11.090
FINAL METER VOLUME (CUBIC FEET)=	21.426
METER FACTOR= 1.0014	
NET METER VOLUME (CUBIC FEET)=	10.350
GAS VOLUME (DRY STANDARD CUBIC FEET)=	10.662
BAROMETRIC PRESSURE (IN. HG)=	29.54
STATIC PRESSURE (INCHES H20)=	-30.60
PERCENT OXYGEN=	12.27
PERCENT CARBON DIOXIDE=	18.07
MOISTURE COLLECTED (ML)=	5.8
PERCENT WATER=	2.50
AVERAGE METER TEMPERATURE (F.)=	48.0
AVERAGE DELTA H (IN. H20)=	1.71
AVERAGE DELTA P (IN. H20)=	0.83
AVERAGE STACK TEMPERATURE (F.)=	438.0
DRY MOLECULAR WEIGHT=	31.382
WET MOLECULAR WEIGHT=	31.048
AVERAGE SQUARE ROOT OF DELTA P (IN. H20)=	0.9098
% ISOKINETIC=	102.1
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	15.0
NOZZLE DIAMETER (INCHES)=	0.2460
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)=	4,035
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	94,321
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	50,583
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	50,090

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	2.0272
PARTICULATE LOADING, DRY STD. (GR./SCF)=	2.9280
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	1.5304
EMISSION RATE (LB/HR)=	1256.92

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	2.0272
PARTICULATE LOADING, DRY STD. (GR./SCF)=	2.9280
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	1.5304
EMISSION RATE (LB/HR)=	1256.92
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - BAGI21
RUN # - BAG-I-2-1
LOCATION - PFIZER
DATE - 12-4-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	0.314
FINAL METER VOLUME (CUBIC METERS)=	0.607
METER FACTOR= 1.0014	
NET METER VOLUME (CUBIC METERS)=	0.293
GAS VOLUME (DRY STANDARD CUBIC METERS)=	0.302
BAROMETRIC PRESSURE (MM HG)=	750.32
STATIC PRESSURE (MM H2O)=	-777.2
PERCENT OXYGEN=	12.27
PERCENT CARBON DIOXIDE=	18.07
MOISTURE COLLECTED (ML)=	5.8
PERCENT WATER=	2.50
AVERAGE METER TEMPERATURE (C.)=	8.9
AVERAGE DELTA H (MM H2O)=	43.4
AVERAGE DELTA P (MM H2O)=	21.0
AVERAGE STACK TEMPERATURE (C.)=	225.6
DRY MOLECULAR WEIGHT=	31.382
WET MOLECULAR WEIGHT=	31.048
AVERAGE SQUARE ROOT OF DELTA P (MM H2O)=	4.5852
% ISOKINETIC=	102.1
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	15.0
NOZZLE DIAMETER (MM)=	6.25
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)=	1,230
FLOW RATE (ACTUAL, CUBIC M/MIN)=	2,671
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	1,432
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	1,418

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	2.0272
PARTICULATE LOADING, DRY STD. (G/CU. M)=	6.7146
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	3.5096
EMISSION RATE (KG/HR)=	570.64

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	2.0272
PARTICULATE LOADING, DRY STD. (G/CU. M)=	6.7146
PARTICULATE LOADING, ACTUAL (G/CU. M)=	3.5096
EMISSION RATE (KG/HR)=	570.64
PERCENT IMPINGER CATCH=	0.0

FILE NAME - BAGI21
RUN # - BAG-I-2-1
LOCATION - PFIZER
DATE - 12-4-80
PROECT # - 4891-L93

POINT #	DELTA P (IN. H20)	DELTA H (IN. H20)	STACK T (F.)	METER T. IN(F.)	METER T. OUT(F.)
1	0.85	1.70	439	44	44
2	0.82	1.70	440	48	44
3	0.82	1.65	440	51	45
4	0.78	1.65	434	55	46
5	0.87	1.85	437	56	47

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	2.8148	0.7844	0.0033	2.0272

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	88.6883	886.7550	208.0	0.0000
IMPINGERS	0.0000	0.0000	0.0	0.0000

PROBE RINSE BLANK (MG/ML)=-4.3662E-03
IMPINGER BLANK (MG/ML)= 0

MIDWEST RESEARCH INSTITUTE

RUN Bag-I-2-1 ~~Bag-2-1-3~~

MRI Project Number 4891-L (93)
Field Dates
Plant Pfizer
Sampling Location Baghouse Inlet
Sampling Date 12-4-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Cobb
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 12-4-80

SAMPLING LOCATION Baghouse Inlet, Bag-I-2-1

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	50
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.92
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	405
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.68
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	.85	
CALCULATED NOZZLE DIAMETER, in.	.265	
ACTUAL NOZZLE DIAMETER, in.	.246	
REFERENCE Δp, in. H_2O	.91	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer

Sampling Location Baghouse Inlet

Test Number Bag-I-2-1

Date 12-4-80

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

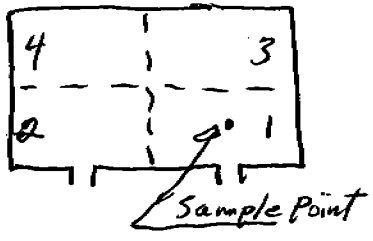
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	50
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.94
Nozzle diameter, inches	Dn	.246
Barometric pressure, inches Hg	Pb	
$\frac{5.168\ (50 + 460)\ (.84)\ (3)\ (.94)\ (.246^2)}{\sqrt{29.54}}$	K	69.52

FIELD DATA

PLANT Pfizer
DATE 12-4-80
SAMPLING LOCATION Baghouse Inlet
SAMPLE TYPE Mass
RUN NUMBER Bag-I-2-1
OPERATOR RCS
AMBIENT TEMPERATURE 45
BAROMETRIC PRESSURE 29.54
STATIC PRESSURE, (P_s) -30.6" H_2O
FILTER NUMBER (s) 68



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 3' SS
NOZZLE I.D. .246
ASSUMED MOISTURE, % 6
SAMPLE BOX NUMBER 12
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR .85
PROBE HEATER SETTING 85
HEATER BOX SETTING 350
REFERENCE Δp .91

Leak CK: Initial at 15" Hg, CFM .001
8" Hg Final at Hg, CFM .002

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 69.52 \times \sqrt{\frac{Ps}{Ts + 460}}$

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	1422		11.040									
Bag-I-2-1	3	1425	13.23	13.20	0.85	1.7	1.7	439	44	44	7	280	
	6	1428	15.23	15.25	0.82	1.69	1.7	440	48	44	7		
	9	1431	17.33	17.28	0.82	1.69	1.65	440	51	45	7	290	68
	12	1434	19.38	19.30	0.78	1.60	1.65	434	55	46	7.5		68
	15	1437	21.54	21.426	0.87	1.80	1.85	437	56	47	8		72
							avg						
			Vm =	10.336	.828 avg		1.71	438 avg	48.6 avg				

COMMENTS

EPA (Dun 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Baghouse Inlet
Test Number Bag-I-2-1

Date 12-4-80
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}	438
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.54, ΔH = 1.71, Vm = 10.336, Tm = 48	Vm_{std}	10.647
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.975
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	31.36
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	31.03
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) -2.25" Hg	Ps	27.29
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .828	Vs	4037
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.246
$\frac{1{,}039\ (438 + 460)(10.647)}{(4037)(15)(27.29)(.975)(.246^2)}$	% I	101.9

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer
Sample Location: Baghouse Inlet
Sample Box No.: 12
Sample Type: Mass

Run No.: Bag-I-2-1
Sample Date: 12-4-80
Recovery Date: 12-4-80
Cleanup Person:

Filter No.: 66
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/	107	94	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	7	-6	1		
Sample No.(s)					

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

SILICA GEL

661.1	
657.3	
3.8	

Silica Gel Color:

Description of Impinger Solution:
Total Moisture, gm: 5.8

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

RECOVERED SAMPLE

Probe Rinse: Sample No. 143
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. 126
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. Bay-I-2-1 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 No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
143		5	88.68826	86.75510	208		
	68	6	2.81483	0.78435			
		6					
		6					
		7					
		8					
		9					
126		10	84.87858	84.87922	125		

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-2-1

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	12-4-80	1422-1437		
Probe Technician			Cobb	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	12-4-80	1450	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

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MIDWEST RESEARCH INSTITUTE

RUN Bag-T-2-3

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Baghouse Inlet
Sampling Date 10-22-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Whited
2
3

Lab Technician 1
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-22-80

SAMPLING LOCATION Baghouse Inlet Bag-I-2-3

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	5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.49
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	27.24
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	$\Delta p_{avg.}$	.48
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	.90	
CALCULATED NOZZLE DIAMETER, in.	.283	
ACTUAL NOZZLE DIAMETER, in.	.246	
REFERENCE Δp, in. H_2O	.85	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Baghouse Inlet
Test Number Pab-I-2-3

Date 10-22-80
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

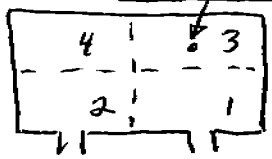
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	75
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.246
Barometric pressure, inches Hg	Pb	29.49
$\frac{5.168\ (75 + 460)\ (.84)\ (5)\ (.95)\ (.246^2)}{\sqrt{29.49}}$	K	122.94

FIELD DATA

PLANT Pfizer
DATE 10-22-80
SAMPLING LOCATION Baghouse Inlet
SAMPLE TYPE Particulate
RUN NUMBER Bag-I-2-3
OPERATOR RCS
AMBIENT TEMPERATURE 65
BAROMETRIC PRESSURE 29.49
STATIC PRESSURE, (P_s) -2.25" Hg
FILTER NUMBER (s) 13

Sample Point



Top View

PROBE LENGTH AND TYPE 4' SS
NOZZLE I.D. .246
ASSUMED MOISTURE, % 5
SAMPLE BOX NUMBER 8
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR .90
PROBE HEATER SETTING 80
HEATER BOX SETTING 400
REFERENCE Δp .85

Leak CK: Initial at 15" Hg, CFM .002
6" Hg Final at Hg, CFM .004

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

$VM = \cancel{122.94} \times \frac{\sqrt{\Delta Ps}}{Ts + 460}$ 73.76

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	1606		670.036									
Bag-I-2-3	3	1609	671.76	671.79	.48	1.05	1.05	420	64	65	5		
	6	1612	673.49	673.48			1.05	409	66	66	5	276	
	9	1615	675.23	675.17			1.05	407	69	66	5	276	62
	12	1618	676.97	476.88			1.10	400	71	66	5.5	278	
	15	1621	678.71	678.~~615~~			1.10	400	72	66	6		
			V_m =	8.61 cuft		ΔH =	1.07	T_s = 407.2	T_m = 67.1				

COMMENTS.

EPA (Dur) 235
4-72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer Ind
Sampling Location Baghouse Inlet
Test Number Bag - I - 2 - 3

Date 10-22-80
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}	407.2	
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	8.52	
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	0.939	
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	31.54 ~~31.44~~	31.54
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.72 ~~30.62~~	30.72
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	27.24 ~~27.23~~ ~~27.23~~	
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	3038.7 ~~3119.2~~	3038.7
Total sample time, minutes	θ	15	
Nozzle diameter, inches	Dn	0.246	
$\frac{1{,}039\ (407 + 460)(8.52)}{(3119.2)(15.0)(27.23)(0.939)(0.246^2)}$	% I	108.8 ~~100~~ %	108.8

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. Bag-I-2-3
Sample Date 10-22-80
Recovery Date 10-22-80
Cleanup Person

Filter No. 13
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/	106	102	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	6	2	0		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution D-H_2O
Total Moisture, gm 11.7

SILICA GEL

647.1	
643.4	
03.7	

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.
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.
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:

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification Baghouse Inlet

Test Run Number Bag-I-2-3

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-22-80	1606-1621		
Probe Technician			whited	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-22-80	1630	whited	
Train Disassembly	10-22-80	1645	whited	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

(14)

MIDWEST RESEARCH INSTITUTE

RUN Bag-I-2-4

MRI Project Number 4891-L93
Field Dates
Plant Pfizer
Sampling Location Baghouse - Inlet
Sampling Date 10-22-80

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 10-22-80

SAMPLING LOCATION Baghouse Inlet

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	5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.48
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	27.23
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	.90	
CALCULATED NOZZLE DIAMETER, in.	.318	
ACTUAL NOZZLE DIAMETER, in.	.296	
REFERENCE Δp, in. H_2O	.405	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Baghouse Inlet
Test Number Bag-I-2-4

Date 10-22-80
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

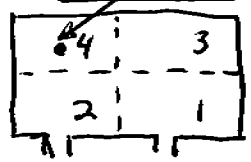
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	60
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.296
Barometric pressure, inches Hg	Pb	29.48
$\frac{5.168\ (60 + 460)\ (.84)\ (5)\ (.95)\ (.296^2)}{\sqrt{29.48}}$	K	173.02

FIELD DATA

PLANT Pfizer
DATE 10-22-80
SAMPLING LOCATION Baghouse Inlet
SAMPLE TYPE Particulate
RUN NUMBER Bag-I-2-4
OPERATOR RCS
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 29.48
STATIC PRESSURE, (P_s) -2.25" Hg
FILTER NUMBER (s) 12

Sample Point



Top View

PROBE LENGTH AND TYPE 4' SS
NOZZLE I.D. .296
ASSUMED MOISTURE, % 5
SAMPLE BOX NUMBER 8
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR .90
PROBE HEATER SETTING 90
HEATER BOX SETTING 400
REFERENCE Δp .405

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

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 173.02 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING 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	1118		654.691 ~~659.631~~									
Bag I-2-4	5	1122	662.94	662.98	.31	1.40	1.50	416	66	69	6	263	60
	10	1128	666.19	666.19	.31	1.40	1.40	420	71	69	6	268	55
	15	1133	669.47	669.558	.31	1.40	1.45	402	77	69	7	272	

COMMENTS

$V_m = 9.87$ $\Delta P_{s_{avg}} = .31$ $\Delta H_{avg} = 1.45$ $T_{m_{avg}} = 70.17$
$T_{s_{avg}} = 412.7$

EPA (Out) 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Baghouse Inlet
Test Number Bag-I-2-4

Date 10-22-80
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}	412.7
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	9.72
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.951
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.50
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.84
Static pressure in stack, absolute, in. Hg (Pb) $\pm$ (0.074 x stack gage pressure, in H_2O)	Ps	27.23
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2445
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.296
$\frac{1{,}039\ (412.7 + 460)(9.72)}{(2445)(15)(27.23)(.951)(.296^2)}$	% I	105.86

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: Bag-I-2-4
Sample Date: 10-22-80
Recovery Date: 10-22-80
Cleanup Person: EW

Filter No.: 12
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/	107	102	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	7	2	0		
Sample No.(s)					

Combined impinger contents, Sample No.:
Liquid Level Marked: Container(s) Sealed:
Description of Impinger Solution:
Total Moisture, gm: 10.6

SILICA GEL

643.4	
641.8	
1.6	

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.:
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.:
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:

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification Baghouse Inlet

Test Run Number Bag-I-2-9

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-22-80	1118-1133		
Probe Technician			Whited	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-22-80	1145	Whited	
Train Disassembly	10-22-80	1200	Whited	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN Bag-I-3-4

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Baghouse Inlet
Sampling Date 1-8-81

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)

NOMOGRAPH DATA

PLANT Pfizer

DATE 1-8-81

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	$T_{m_{avg.}}$	15
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.43
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	27.18
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.92
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	370
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.36
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	.80	
CALCULATED NOZZLE DIAMETER, in.	.310	
ACTUAL NOZZLE DIAMETER, in.	.246	
REFERENCE Δp, in. H_2O	.91	

.37
.32
.40

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 1-8-81
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

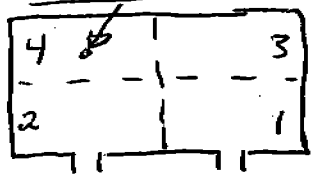
Assumed average meter temperature, °F	Tm_{avg}	15
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.246
Barometric pressure, inches Hg	Pb	29.43
$\frac{5.168\ (15 + 460)\ (.84)\ (3)\ (.95)\ (.246^2)}{\sqrt{29.43}}$	K	75.50

VOID

FIELD DATA

PLANT Pfizer
DATE 1-8-81
SAMPLING LOCATION Baghouse Inlet
SAMPLE TYPE Mass
RUN NUMBER Bag-I-3-4
OPERATOR RCS
AMBIENT TEMPERATURE 10
BAROMETRIC PRESSURE 29.43
STATIC PRESSURE, (P_s) -30.6" H_2O
FILTER NUMBER (s) 127

Sample Point



PROBE LENGTH AND TYPE 4' SS
NOZZLE I.D. .246
ASSUMED MOISTURE, % 5
SAMPLE BOX NUMBER 12
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR .80
PROBE HEATER SETTING 100
HEATER BOX SETTING 300
REFERENCE Δp 0.91

Leak CK: Initial at 15" Hg, CFM .004 SCHEMATIC OF TRAVERSE POINT LAYOUT
5" Hg Final at Hg, CFM Zero READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 75.50 \times \sqrt{\frac{Ps}{Ts + 460}}$

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	0928		77.135									
Bag-I-3-4	3	0931	78.58	78.42	.32	.67	.7	414	19	19	4		
	6	0934	79.94	79.76	.28	.58	.65	405	22	19	4	285	42
	9	0937	81.32	81.10	.29	.60	.65	406	25	20	4		44
	12	0940	[illegible].77	82.55	.32	.67	.75	412	28	21	4.5		45
	15	0943	84.12	83.857	.28	.58	.70	415	31	22	4		
			Vm =	6.722	.298	avg =	.69	410.4	Avg. =	22.6			

COMMENTS

EPA-Durr 235

26

MIDWEST RESEARCH INSTITUTE

RUN Bag - I - 4 - 3

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

FIELD CREW

Crew Chief Mr. Cobb

Testing Engineer 1 R. Stuhtz
2
3

Engr. Technician 1 E. Whited
2
3

Lab Technician 1 ~~[illegible]~~ Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer Ind

DATE 10-24-80

SAMPLING LOCATION Baghouse Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	62
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.42
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	27.17
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.923
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	400
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.48
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	0.92	
CALCULATED NOZZLE DIAMETER, in.	0.282	
ACTUAL NOZZLE DIAMETER, in.	~~0.276~~ ~~0.246~~ 0.246	
REFERENCE Δp, in. H_2O	~~[illegible]~~ 0.83	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Baghouse Inlet
Test Number 4-3

Date 10-24-80
Initial CV

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

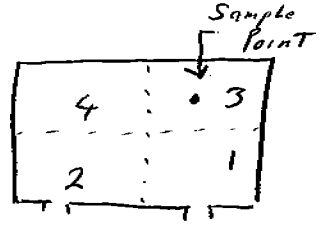
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	60.
Pitot coefficient	Cp	0.844
Sampling time interval, minutes	θi	3.0
Mole fraction dry gas	Mf	0.95
Nozzle diameter, inches	Dn	0.246
Barometric pressure, inches Hg	Pb	29.42
$\frac{5.168\ (60 + 460)\ (.844)\ (3.0)\ (.95)\ (0.246^2)}{\sqrt{29.42}}$	K	72.18

FIELD DATA

PLANT Pfizer Inc
DATE 10-24-90
SAMPLING LOCATION Baghouse Inlet
SAMPLE TYPE Particulate
RUN NUMBER Bg-I-4-3
OPERATOR Whited
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 29.42 "Hg
STATIC PRESSURE, (P_s) -2.25 "Hg
FILTER NUMBER (s) 26



PROBE LENGTH AND TYPE 4'
NOZZLE I.D. 0.246
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 8
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.92
PROBE HEATER SETTING 400
HEATER BOX SETTING 275
REFERENCE Δp 0.83

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

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 72.18 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK) 0 / 1148	GAS METER READING (V_m), ft^3 690.238 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
3	3	692.04	692.18	0.55	~~0.85~~ 1.20	1.30	425	63	64	6		
	6	693.74	693.93	0.49		1.2	425	66	65			
	9	695.51	695.76	0.53	1.2	1.2	425	68	65	6	275	62
	12	697.23	697.52	0.50	1.1	1.1	420	71	65			
	15	699.00	699.34	0.53	1.2	1.15	420	74	65	6		
		Final	699.34									
		V_m = 9.102		Δp = 0.52	ΔH_{avg} = 1.19		Δp = 423	Δp =	66.6			

COMMENTS

EPA (Dun 235

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-24-80
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}	423
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.19, Pb = 29.42, Vm = 9.102, Tm + 460 = 526.6	Vm_{std}	8.998
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ 7.02 % H_2O	Mf	0.93
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	31.63
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.676
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) -2.25" Hg	Ps	27.17
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ Δp = .52	Vs	3198.48
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	0.246
$\frac{1{,}039\ (423 + 460)(8.998)}{(3198)(15)(0.93)(27.17)(.246^2)}$	% I	112.6%

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: Bag-I-4-3
Sample Date: 10-24-80
Recovery Date: 10-24-80
Cleanup Person:

Filter No.: 26
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/	107	103	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	7	3	0		
Sample No.(s)					

Combined impinger contents, Sample No.:
Liquid Level Marked: Container(s) Sealed:
Description of Impinger Solution:
Total Moisture, gm: 14.4

SILICA GEL

694.8 ~~690~~ 4
690.4
4.4
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. 50 & 52
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: LAB ANALYIS ON SITE

MIDWEST RESEARCH INSTITUTE

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

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

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 No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
50+52		5	88.45284 90.67231	87.82047 = 50 89.12965 = 52	310	J.J.	10-23
	26	6	2.18705	0.78038		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 4893-C-93

Source Identification Baghouse Outlet

Test Run Number Ag-I-4-3

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-24-80	1148-1203	~~R. Stutte, E. Whited~~	
Probe Technician	10-24-80	1148-1203	E Whited	
Meter Technician			R. Stutte	
Other			Raja Ka.	
Transport of Train to Cleanup Site	10-24-80	1215	E. Whited	
Train Disassembly		1220	Raja, Walker	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

BAD RUN

RUN Bag-I-D-3

MRI Project Number 4891-L (93)
Field Dates Oct 20, 1980
Plant Pfizer Industries
Sampling Location Baghouse Inlet
Sampling Date 10-20-80

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)

Test #1

BRINKS DATA SHEET

TEST NO. ~~B[illegible]~~ Bag-I-D-3 DATE 10-20-80

Flue Gas Temperature 400 °F

Static Pressure −2.25" Hg

Barometric Pressure 29.12 " Hg

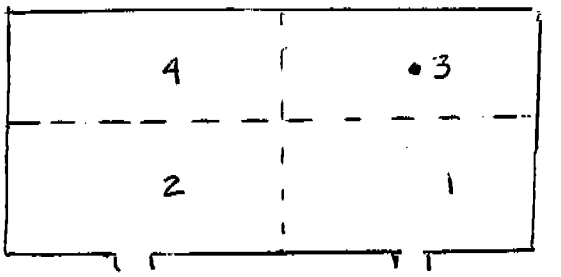
Sample Time 15 min

Nozzle B-2 = .078"
Probe Tip Diameter 2 mm

Velocity at Sample Point 3049 FPS

Sample Rate 0.102 CFM

TOP VIEW



Schematic of Traverse Point Layout with Dimensions

Gas Composition

CO_2 17.1 %

O_2 14.16 %

CO 0

N_2 68.7 %

H_2O 4.5 %

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Temp. DRY METER	Comments	Dry Meter Vol. = Zero
1753	2.86	2.86	60	Start	
1755	2.86	2.86	60		
1757	2.86	2.86	59		.200 CF
1800	2.86	2.86	59		.365 CF
1804	2.86	2.90	59		.575 CF
1808	2.86	2.86	59	End Test	.784

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer Ind.
Sampling Location Bag-I-0-3
Test Number 1

Date 10-20-80
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_{std}	~~.133~~ ~~.716~~ ~~1.408~~ .776
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.955
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	31.29
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	30.69 ~~30.68~~
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	26.87
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	3049
Total sample time, minutes	θ	15
Nozzle diameter, inches ~~.400~~ .776	Dn	2mm / .079" Calib. .078
$\frac{1{,}039\,(400 + 460)(\cancel{.776})}{(3049)(15)(26.87)(.955)(.078^2)}$	% I	~~[illegible]~~ ~~[illegible]~~ 97.1

SAMPLE HANDLING LOG

Project Number 4891-L (93)

Source Identification Baghouse Inlet

Test Run Number Bag-I-D-3

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-20-80	1753 - 1808		
Probe Technician	Stultz			
Meter Technician	Stultz			
Other				
Transport of Train to Cleanup Site	Cobb			
Train Disassembly	Walker			
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

5

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

BAD RUN

RUN Bag-I-1-3

MRI Project Number 4891 - L (93)
Field Dates
Plant Pfizer Ind.
Sampling Location Baghouse Inlet
Sampling Date 10-21-80

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

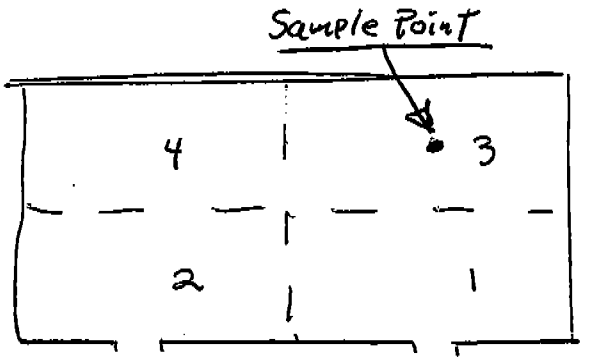
Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. Bag -I-1-3 DATE 10-21-80

Flue Gas Temperature	400	°F
Static Pressure	-2.25" Hg	~~" H_2O~~
Barometric Pressure	29.08	" Hg
Sample Time	5	min
Probe Tip Diameter	.078"	
Velocity at Sample Point	3049	FPS
Sample Rate	0.102	CFM



Top View

Schematic of Traverse Point Layout with Dimensions

Gas Composition

CO_2	17.1 %	N_2	68.7 %
O_2	14.16 %	H_2O	4.5 %
CO	0		

Pre-heat Started 0950

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1036	2.86	2.86	57	Start	0
1038		2.86	57		.097
1040		2.86	57		.197
1041		2.86	57	Stop	.263

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer Ind.
Sampling Location Bag - Inlet
Test Number Bag-I-1-3

Date 10-21-80
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_{std}	.261
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.955
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	31.29
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	30.69
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	~~31.34~~ 26.82
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\frac{\sqrt{\Delta Ps_{avg}}}{.48}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	~~2823~~ ~~3120~~ 3051
Total sample time, minutes	θ	5
Nozzle diameter, inches	Dn	.078
$\frac{1{,}039\,(400 + 460)(.261)}{(\cancel{2823}\ 3120)(5)(\cancel{31.34}\ 26.82)(.955)(.0792)}$	% I	~~97.5~~ 98.1

for: $\frac{1039(400+460)(.261)}{(3051)(5)(26.82)(.955)(.078^2)}$

SAMPLE HANDLING LOG

Project Number 4891-L (93)

Source Identification Bag-I-1-3

Test Run Number Bag-I-1-3

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-21-80	1036 1041	Stultz	
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-21-80	1100	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

(9)

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

BAD RUN

RUN Bag-I-1-4

MRI Project Number 4891-L (93)
Field Dates
Plant Pfizer Ind.
Sampling Location Baghouse Inlet
Sampling Date 10-21-80

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

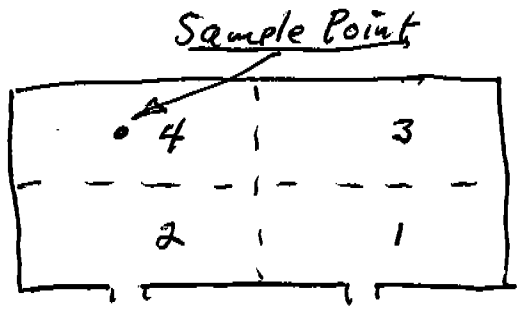
Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. Bag-I-~~1~~-4 DATE 10-21-80

Flue Gas Temperature	400	°F
Static Pressure	-2.25" Hg ~~" H_2O~~	
Barometric Pressure	29.16	" Hg
Sample Time	~~4~~ 5	min
Probe Tip Diameter	.078"	
Velocity at Sample Point	2454	FPS
Sample Rate	.083	CFM



Top View

Schematic of Traverse Point Layout with Dimensions

Gas Composition

CO_2	17.1 %	N_2	68.7 %
O_2	14.16 %	H_2O	4.5 %
CO	0		

Pre-heat Started 1642

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp	Comments	Dry Meter Vol.
1706	1.79	1.8	64	Start	0
1709		1.8	64		.129
1711		1.8	64	Stop	.230

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer Ind.
Sampling Location Baghouse Inlet
Test Number Bag-I-1-4

Date 10-21-80
Initial BCS

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ (.23, 29.16, 64)	Vm_{std}	.226
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.95
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	31.29
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.29
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	26.91
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2464
Total sample time, minutes	θ	5
Nozzle diameter, inches	Dn	.078
$\frac{1{,}039\ (400 + 460)(.226)}{(2464)(5)(26.91)(.95)(.078^2)}$	% I	105.4

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification Baghouse Inlet

Test Run Number Bag-I-~~1~~-4

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-21-80	1706 - 1711		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-21-80	1720	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

INPUT DATA FOR FILE BAGI221
TEST DATE - 12-5-80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - BAG-I-2-2-(1)

% WATER= 5.73
% CARBON DIOXIDE= 18.37
% CARBON MONOXIDE= 0.00
% OXYGEN= 12.43

BRINK IMPACTOR WITH CYCLONE

STACK TEMPERATURE= 414.0 DEGREES F.
BAR. PRESSURE= 29.48 INCHES HG
STATIC PRESSURE= -30.60 INCHES H20
AVE. DELTA P= 0.37 INCHES H20
PITOT COEFF.= .84
METER TEMP.= 80.0 DEGREES F.
PROBE DIA.= 0.078 INCHES

SAMPLING TIME= 4.0 MIN.
PRESSURE DROP= 1.80 INCHES HG
SAMPLER TEMP. = 414.0 DEGREES F.
PARTICLE DENS= 1
METER VOL.= 0.231 CUBIC FEET
DELTA H= 0.00 INCHES H20

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.= 0.222 CU. FT.
SAMPLE VOL.-WET STD.= 0.236 CU. FT.
STACK VELOCITY= 2681.0 FT./MIN.
NOZZLE VELOCITY= 3234.9 FT./MIN.
MASS COLLECTED= 36.520 MG.
LOADING= 2.38832 GRAIN/SCF
LOADING(DRY)= 2.53349 GRAIN/SCF

DRY MOLECULAR WT.= 31.44
WET MOLECULAR WT.= 30.67
% ISOKINETIC= 120.7
SAMPLING RATE-ACTUAL= 0.107 CU. FT/MIN
CYCLONE BLANK= 0.180 MG.
STAGE BLANK= 0.170 MG.
FILTER BLANK= 0.140 MG.

STAGE #	CYCLONE	1	2	3	4	5	FILTER
FINAL WT (MG)	249.03	352.09	419.05	348.80	420.84	345.56	264.40
TARE WT (MG)	226.44	345.86	414.13	346.80	419.87	344.72	264.98
NET WT (MG) CORRECTED	22.41	6.06	4.75	1.83	0.80	0.67	0.00
FRACTION % OF TOTAL	61.36	16.59	13.01	5.01	2.19	1.83	0.00
CUM. % WITH FILTER	61.36	77.96	90.96	95.97	98.17	100.00	100.00
FRACTION % WITHOUT FILTER	61.36	16.59	13.01	5.01	2.19	1.83	
CUM. % WITHOUT FILTER	61.36	77.96	90.96	95.97	98.17	100.00	
JET VEL. (CM/SEC)	0	1540	2047	3310	7208	12071	
D50 SIZE (MICRONS)	7.00	3.88	2.28	1.54	0.80	0.49	<0.49
DM/DLOGD (GRAINS/SCF)		1.54612	1.34042	0.70905	0.18209	0.20862	
GEO MEAN (MICRONS)		5.21	2.97	1.87	1.11	0.63	<0.63
PARTICLE COUNT		3.7D+07	5.6D+07	4.7D+07	2.0D+07	4.1D+07	

THE CYCLONE D50 VALUE IS ASSUMED TO BE 7 MICRONS.

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN Bag-I-2-2

MRI Project Number 4891-L(23)
Field Dates
Plant Pfizer
Sampling Location Baghouse Inlet
Sampling Date 12-5-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Walker
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-2-2 DATE 12-5-80

Flue Gas Temperature 414 °F

Static Pressure -30.6 " H_2O

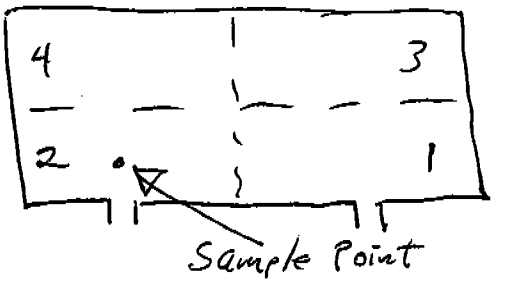
Barometric Pressure 29.48 " Hg

Sample Time 4 min

Probe Tip Diameter .078

Velocity at Sample Point 2685 FPS

Sample Rate .09 CFM



Schematic of Traverse Point Layout with Dimensions

ΔP_s = .37 at 0906

Gas Composition

CO_2 18.07

O_2 12.27

CO 0

N_2 69.67

H_2O 6 %

M_d = 31.38

Preheat Started 0920

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Meter Temp.	Comments	Meter Vol.
1007	1.78	1.80	81	Start	0
1008		1.80	80		.051
1009		1.80	80		.106
1010		1.80	79		.166
1011		1.80	78	Stop	.231

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Baghouse Inlet
Test Number Bag-I-2-2

Date 12-5-80
Initial RCS BDW

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	414
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb=29.48 Vm=.231 Tm=79.6	Vm_{std}	.223
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ %H2O=4.5	Mf	.955
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	31.38
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.06
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) 29.48 - 30.6 -	Ps	27.23
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ Cp=.84 ΔP=.37 1.0333	Vs	2707.8
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.078
$\frac{1{,}039\ (414 + 460)(.223)}{(2707.8)(4)(27.23)(.955)(.078^2)}$ .006	% I	119.8

MIDWEST RESEARCH INSTITUTE

Run No. Boy-I-2-2 | BRINK | Date
MRI Project No. | Particle Size Analysis | Recorded by

ANALYSIS

Final Weights	Tare Weights
By: DENT Date: 12-5-80	By: BOOMER Date: 11-4-80
Location: On Site LAB	Location: On Site LAB

FILTER SET # 40

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	40-C	.24903	.22644		* **	* **	
1	40-1	.35209	.34586				
2	40-2	.41905	.41413				
3	40-3	.34880	.34680				
4	40-4	.42084	.41987				
5	40-5	.34556	.34472				
Filter	40-F	.26440	.26498				
			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 Baghouse Inlet

Test Run Number Bag-I-2-2

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	12-5-80	1007-1011		
Probe Technician			Walker	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	12-5-80	1013	Walker	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-6-80	1059	I. PAVELONIS	
Write Up				

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MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

BAD RUN

RUN Bag-I-2-3

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Baghouse Inlet
Sampling Date 10-22-80

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

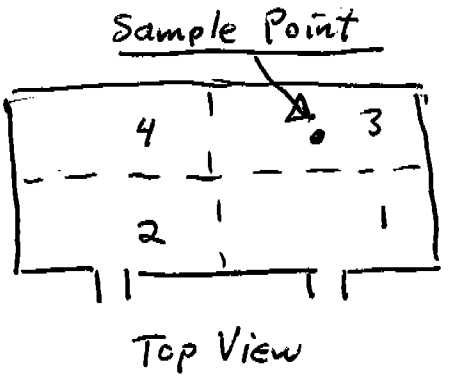
Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. Bag-I-2-3 DATE 10-22-80

Flue Gas Temperature	400	°F
Static Pressure	-2.25 "Hg ~~" H2O~~	
Barometric Pressure	29.48	" Hg
Sample Time	4	min
Probe Tip Diameter	.078"	
Velocity at Sample Point	3049	FPS
Sample Rate	.102	CFM



Schematic of Traverse Point Layout with Dimensions

Gas Composition

CO_2	18.8	N_2	68.8
O_2	12.4	H_2O	5 %
CO	0		

Pre-heat Started 11:45

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1212	2.86	2.86	63	Start	0
1214		2.86	63		.108
1216		2.86	64	Stop	.237

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Baghouse Inlet
Test Number Bag-I-2-3

Date 10-22-80
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_{std}	~~214~~ 236
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.951
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.50
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.84
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	27.23
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	3021
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.078
$\frac{1{,}039\ (400 + 460)(.236)}{(3021)(4)(27.23)(.951)(.078^2)}$	% I	110.6

SAMPLE HANDLING LOG

Project Number 4891-L (93)

Source Identification Baghouse Inlet

Test Run Number Bag-I-2-3

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-22-80	1212-1216		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-22-80	1220	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

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MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

BAD RUN
RUN Bag-I-2-4

MRI Project Number 4891-L (93)
Field Dates
Plant Pfizer
Sampling Location Baghouse Inlet
Sampling Date 10-22-80

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

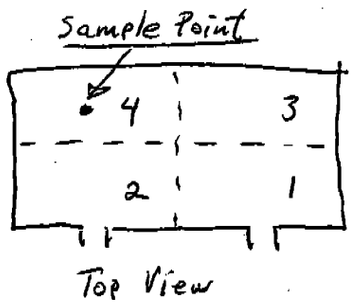
Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. Bag-I-2-4 DATE 10-22-80

Flue Gas Temperature	400	°F
Static Pressure	-2.25" Hg ~~H2O~~	
Barometric Pressure	29.49	" Hg
Sample Time	4	min
Probe Tip Diameter	.078"	
Velocity at Sample Point	2445 ~~2444~~	FPS
Sample Rate	.082	CFM



Schematic of Traverse Point Layout with Dimensions

Gas Composition

CO_2	18.8	N_2	68.8
O_2	12.4	H_2O	5 %
CO	0		

Preheat Started 1630

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1650	1.80	1.80	60	Start	0
1652		1.80	60		.098
1653		1.80	60		.151
1654		1.8	60	Stop	.195

SAMPLE HANDLING LOG

Project Number 4891-L (93)

Source Identification Baghouse Inlet

Test Run Number Bag-I-2-4

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-22-80	1650-1654		
Probe Technician			STultz	
Meter Technician			STultz	
Other				
Transport of Train to Cleanup Site	10-22-80	1705	STultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

INPUT DATA FOR FILE BAGI33

TEST DATE - 10-23-80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - BAG-I-3-3(1)

% WATER= 5.18
% CARBON DIOXIDE= 18.83
% CARBON MONOXIDE= 0.00
% OXYGEN= 13.17

BRINK IMPACTOR WITH CYCLONE

STACK TEMPERATURE= 400.0 DEGREES F.
BAR. PRESSURE= 29.70 INCHES HG
STATIC PRESSURE= -30.60 INCHES H20
AVE. DELTA P= 0.58 INCHES H20
PITOT COEFF.= .84
METER TEMP.= 56.0 DEGREES F.
PROBE DIA.= 0.078 INCHES

SAMPLING TIME= 4.0 MIN.
PRESSURE DROP= 3.57 INCHES HG
SAMPLER TEMP. = 400.0 DEGREES F.
PARTICLE DENS= 1
METER VOL.= 0.285 CUBIC FEET
DELTA H= 0.00 INCHES H20

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.= 0.289 CU. FT.
SAMPLE VOL.-WET STD.= 0.305 CU. FT.
STACK VELOCITY= 3307.1 FT./MIN.
NOZZLE VELOCITY= 4083.5 FT./MIN.
MASS COLLECTED= 77.725 MG.
LOADING= 3.93047 GRAIN/SCF
LOADING(DRY)= 4.14519 GRAIN/SCF

DRY MOLECULAR WT.= 31.54
WET MOLECULAR WT.= 30.84
% ISOKINETIC= 123.5
SAMPLING RATE-ACTUAL= 0.136 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)	259.56	406.71	418.88	418.47	403.92	382.09	257.84
TARE WT (MG)	203.36	401.85	403.96	416.33	402.75	381.65	257.96
NET WT (MG) CORRECTED	55.54	4.59	14.65	1.87	0.90	0.17	0.00
FRACTION % OF TOTAL	71.45	5.91	18.85	2.41	1.16	0.22	0.00
CUM. % WITH FILTER	71.45	77.36	96.21	98.62	99.78	100.00	100.00
FRACTION % WITHOUT FILTER	71.45	5.91	18.85	2.41	1.16	0.22	
CUM. % WITHOUT FILTER	71.45	77.36	96.21	98.62	99.78	100.00	
JET VEL. (CM/SEC)	0	1313	2584	4178	9099	15238	
D50 SIZE (MICRONS)	7.00	3.42	2.00	1.35	0.69	0.42	<0.42
DM/DLOGD (GRAINS/SCF)		0.74622	3.18227	0.55676	0.15646	0.03969	
GEO MEAN (MICRONS)		4.89	2.62	1.64	0.97	0.54	<0.54
PARTICLE COUNT		1.9D+07	1.5D+08	4.2D+07	2.0D+07	9.1D+06	

THE CYCLONE D50 VALUE IS ASSUMED TO BE 7 MICRONS.

BRINKS DATA SHEET

TEST NO. Bag-I-3-3 DATE 10-23-80

Flue Gas Temperature 400 °F

Static Pressure -2.25" Hg ~~" H2O~~

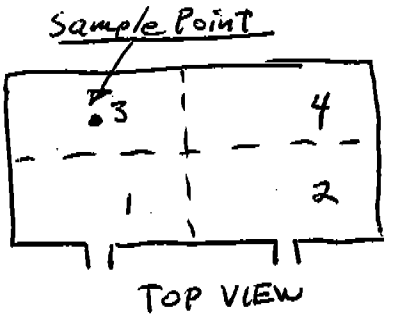
Barometric Pressure 29.70 " Hg

Sample Time 4 min

Probe Tip Diameter .078"

Velocity at Sample Point 3313 ~~3014~~ FPS

Sample Rate .110 ~~.101~~ CFM



Schematic of Traverse Point Layout with Dimensions

ΔP at Sample Point - Time 1503 = 0.60" H_2O (-.02 zero) .58 corrected

Gas Composition

CO_2 18.83 %

O_2 13.17 %

CO 0

N_2 68.0 %

H_2O 6 %

Pre-heat started 1507

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1526:30	3.57 ~~2.94~~	3	57	Start	0
1528		3.57	56		.118
1529		3.57	56		.172
1530:30		3.57	56	stop	.285

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-23-80
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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ (.285, 56, 29.70)	Vm_{std}	.289
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ ($\%H_2O = 5.19$)	Mf	.948
Molecular wt. dry stack gas, lb/lb-mole ($\%CO_2 \times 0.44$) + ($\%O_2 \times 0.32$) + ($\%N_2 + \%CO \times 0.28$)	Md	31.54
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.84 ~~30.73~~
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	27.45
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ (400, .68)	Vs	~~3316.7~~ ~~3315.3~~ 3307
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.078
$\frac{1{,}039\ (400 + 460)(.289)}{(4)(27.45)(.948)(.078^2)}$ (~~3313.3~~ ~~3312.9~~ 3307)	% I	~~124.1~~ 123.3

MIDWEST RESEARCH INSTITUTE

Run No. Bag - I - 3 3
MRI Project No. 4891-L93

BRINK
Particle Size Analysis

Date
Recorded by

ANALYSIS

Final Weights

By: J.P. Date: 10-25-80

Location: ON SITE LAB

Tare Weights

By: J.P. Date: 10-18-80

Location: ON SITE LAB

FILTER SET # 7

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	7-C	.25956	.20336	0.05620	* **	* **	
1	7-1	.40671	.40185	0.00486			
2	7-2	.41888	.40396	0.01492			
3	7-3	.41847	.41633	0.00214			
4	7-4	.40392	.40275	0.00117			
5	7-5	.38209	.38165	0.00044			
Filter	7-F	.25784	.25796	-0.00012			
			Total	0.07973 * **			

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 Baghouse Inlet

Test Run Number Bag-I-3-3

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-23-80	1526:30 – 1530:30		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-23-80	1550	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	10-27-80	11:00AM	Pavelomo	
Write Up				

(4)

MIDWEST RESEARCH INSTITUTE

RUN 0

MRI Project Number 4891-L(93)
Field Dates
Plant PFIZER
Sampling Location BAg-0-0-3
Sampling Date 10/20/80

FIELD CREW

Crew Chief Dick CORB

Testing Engineer 1 MARK HANSEN
2
3

Engr. Technician 1 D. Vogel
2
3

Lab Technician 1 Tom WALKER
2 Joel P.
3

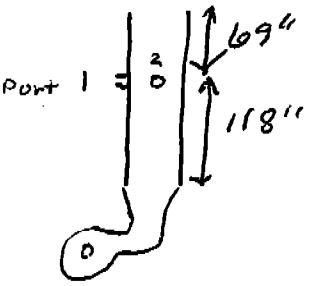
Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Pfizer
DATE 10-20-80
SAMPLING LOCATION Bag - O - 0-3
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE A) 33.5"
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE B) .25"
STACK I.D.. (DISTANCE A - DISTANCE B) 33.25"
NEAREST UPSTREAM DISTURBANCE 69"
NEAREST DOWNSTREAM DISTURBANCE 118"
CALCULATOR Vogel, Hansen



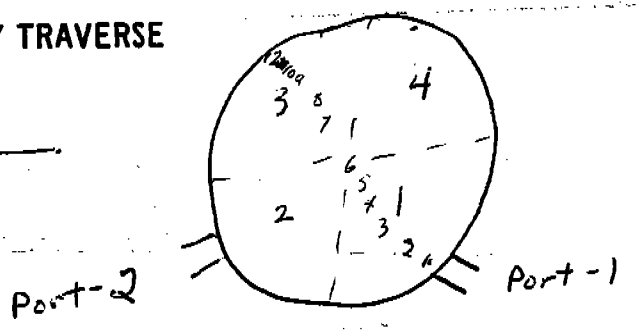
SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1-12	97.9	33.25"	32.25"	0.25"	
11	93.3		31.0		
10	88.2		29.25"		
9	82.3		27 3/8"		
8	75.0		25"		
7	64.4		21 3/8"		
6	35.6		11 7/8"		
5	25.0		8 1/4"		
4	17.7		5 7/8"		
3	11.8		3 7/8"		
2	6.7		2 1/4"		
1	2.1		1"		
2-12					
11					
10					
9					
8					
7					
6					
5					
4					
3					
2					
1					

EPA (Dur) 232
4 72

PRELIMINARY VELOCITY TRAVERSE

PLANT Pfizer
DATE 10-20-80
LOCATION Bag - O
STACK I.D. 33.25"
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O +0.44
OPERATORS Hansen, Vogel



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRIAL 1 Void - Due To Plant.

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1-12	0.~~49~~32	~~336~~ 330
11	.~~42~~32	339
10	.32	341
9	.31	341
8	.28	341
7	.~~56~~24	345
6	.15	342
5	.14	335
4	.14	335
3	.15	335
2	.13	335
1	.13	328
1-12	.~~45~~.52	285
11	.~~46~~.51	~~287~~ 290
10	.~~43~~.51	~~284~~ 285
9	.~~42~~	295
8	.~~42~~	295
7		
6		
5		
4		
3		
2		
1		
AVERAGE		

Static point 2-7 +.44

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
2-12	.~~19~~	338
11	.~~18~~	333
10	.~~18~~	336
9	.~~18~~	341
8		
7		
6		
5		
4		
3		
2		
1		
2-12	.53.~~56~~	287
11	.52	289
10	.52	291
9	.62	291
8	.63	295
7	.65	297
6	.34	297
5	.31	290
4	.30	290
3	.30	290
2	.30	290
1	.25	289
AVERAGE	.43	291.3

use this

EPA (Dur) 233
4-72

Run Number D

Date 10-20-80

MIDWEST RESEARCH INSTITUTE

PRELIMINARY

MOISTURE DETERMINATION

Recorded by Hansen

Assisted by Vogel

NOTE: Same as Run No. [illegible]

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = 29.10 in. Hg

☐ Barometer Location LAB

Reading Time 1430 by TW

☐ Elevation

134 ml 1
104 ml 2
1 ml 3

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final	1900	602.21			244
Initial	1740	535.90			200
Difference	90 min.	Vm = 66.31			Wc = 44

Tube No.	Weight (Grams)		
	Final	Initial	Difference
	691.5	673.9	17.6
Total Moisture Adsorbed:			Wa = 17.6

Meter Pressure, $P_B \approx Pm$ = 29.10 in. Hg

Average Meter Temperature, Tm = 73.8 °F

Total Weight of Moisture Collected, Wc + Wa = Wm = 61.6 gm

$$\text{Moisture Content} = \frac{100}{1 + \left[375 \frac{Pm\,Vm}{(Tm+460)\,Wm}\right]} = \cancel{23.01}\ 4.35 \text{ \% by Volume}$$

B. Wet/Dry Bulb Method

Dry Bulb Temperature = _____ °F

Wet Bulb Temperature = _____ °F

Moisture Content (from Ref. Table) = _____ % by Volume

C. Predetermined Value

% Moisture 4.5 Basis assumed

MRI - Form P4 (10/72)

NOMOGRAPH DATA

PLANT PFIZER

DATE 10-20-80

SAMPLING LOCATION Bag-0-0-3

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	4.5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.10
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.13
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.0
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	293
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.64
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.64
C FACTOR	1.05	
CALCULATED NOZZLE DIAMETER, in.	0.25	
ACTUAL NOZZLE DIAMETER, in.	0.25	
REFERENCE Δp, in. H_2O	.64	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-20-80
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

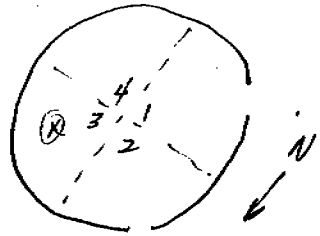
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	65
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	~~[illegible]~~ 5
Mole fraction dry gas	Mf	.955
Nozzle diameter, inches	Dn	.250
Barometric pressure, inches Hg	Pb	29.10
$\frac{5.168\ (65 + 460)\ (.84)\ (5)\ (.955)\ (.25^2)}{\sqrt{29.10}}$	K	~~2270~~ 126.1

FIELD DATA

PLANT Pfizer
DATE 10-20-88
SAMPLING LOCATION Bag 0-0-3
SAMPLE TYPE Particulate
RUN NUMBER D
OPERATOR Hansen
AMBIENT TEMPERATURE 53°F
BAROMETRIC PRESSURE 29.10
STATIC PRESSURE, (P_s) + 1.44
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 3', SS
NOZZLE I.D. .25
ASSUMED MOISTURE, % 4.5
SAMPLE BOX NUMBER 6
METER BOX NUMBER 4
METER $\Delta H_@$ 1.84
C FACTOR 1.05
PROBE HEATER SETTING 80
HEATER BOX SETTING 215
REFERENCE Δp .64

Leak CK: Initial at 15" Hg, CFM 0.0
Final at Hg, 13" CFM 0.0

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 126.1 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$ 3.684

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 535.90 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	1740											
3	5	1745	539.58	539.40	.64	1.8	1.9	293	60	54	9.5	190	52
	10	1750	543.27	543.02			1.9		66	56	9.5	202	54
	15	1755	546.95	546.64			1.9		68	56	9.5	215	56
1602	20	1800	550.64	550.33			1.95		69	57	10	220	58
	25	1805	554.32	554.04			1.95		70	58	10	223	58
	30	1810	558.00	557.75			2.0		71	59	10	227	59
	35	1815	561.69	561.49			2.05		72	59	10.5	232	61
	40	1820	565.37	565.27			2.05		73	60	10.5	232	61
	45	1825	569.06	569.05			2.05		73	60	10.5	228	60
*1827	50	1830	572.74	572.80			2.0		74	60	10.0	235	60
	55	1835	576.42	576.50			2.0		84	62	10.0	240	64
	60	1840	580.11	580.19			1.95		92	66	10.0	240	68
	65	1845	583.79	583.99			1.95		98	72	10.0	250	69
	70	1850	587.48	587.67			1.90		103	77	9.5	265	73
	75	1855	591.16	591.27			1.90		103	80	9.5	260	70
	80	1900	594.84	594.96			1.85		101	82	9.0	240	66
	85	1905	598.53	598.61			1.85		99	83	9.0	257	60
	90	1910	602.21	602.21			1.80		98	83	9.0	250	60
			V_m=	66.31		ΔH=	1.94		$T_{m\,avg}$ = 73.8				

COMMENTS 1827 - wind change, much heat to sampling position

E-105

EPA (Dur) 235

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-20-80
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}	290
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $V_m = 66.31$ $T_m = 73.8$ $\Delta H = 1.94$	Vm_{std}	64.08
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.955
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	30.649
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.08
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.13
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P_s = .64$	Vs	3,189
Total sample time, minutes	θ	90
Nozzle diameter, inches	Dn	.250
$\frac{1{,}039\ (290 + 460)(64.08)}{(3{,}189)(29.13)(.955)(.955)(.250^2)}$	% I	100.06

90 29.13

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification Bag-0-D-3

Test Run Number 0

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-20-80	1740-1910	Hansen	Ambient Temp. increased due to wind shift of exhaust gases.
Probe Technician			Hansen	
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	10-20-80	1920	Hansen	Silica gel impinger only. Liquid measured on stack.
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

FILE NAME - BAG013 1
RUN # - BAG-0-1-3-(1)
LOCATION - PFIZER
DATE - 12-3-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	630.760
FINAL METER VOLUME (CUBIC FEET)=	756.690
METER FACTOR= 1	
NET METER VOLUME (CUBIC FEET)=	125.930
GAS VOLUME (DRY STANDARD CUBIC FEET)=	123.896
BAROMETRIC PRESSURE (IN. HG)=	29.78
STATIC PRESSURE (INCHES H2O)=	0.44
PERCENT OXYGEN=	11.97
PERCENT CARBON DIOXIDE=	16.37
MOISTURE COLLECTED (ML)=	101.9
PERCENT WATER=	3.73
AVERAGE METER TEMPERATURE (F.)=	76.7
AVERAGE DELTA H (IN. H2O)=	2.08
AVERAGE DELTA P (IN. H2O)=	0.36
AVERAGE STACK TEMPERATURE (F.)=	337.9
DRY MOLECULAR WEIGHT=	31.098
WET MOLECULAR WEIGHT=	30.610
AVERAGE SQUARE ROOT OF DELTA P (IN. H2O)=	0.5884
% ISOKINETIC=	89.6
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	180.0
NOZZLE DIAMETER (INCHES)=	0.3060
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)=	2,370
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	14,293
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	9,424
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	9,333

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	1.0425
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.1296
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.0822
EMISSION RATE (LB/HR)=	10.36

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	1.0425
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.1296
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.0822
EMISSION RATE (LB/HR)=	10.36
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - BAG013
RUN # - BAG-0-1-3
LOCATION - PFIZER
DATE - 12-3-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	17.861
FINAL METER VOLUME (CUBIC METERS)=	21.426
METER FACTOR= 1	
NET METER VOLUME (CUBIC METERS)=	3.566
GAS VOLUME (DRY STANDARD CUBIC METERS)=	3.508
BAROMETRIC PRESSURE (MM HG)=	756.41
STATIC PRESSURE (MM H2O)=	11.2
PERCENT OXYGEN=	11.97
PERCENT CARBON DIOXIDE=	16.37
MOISTURE COLLECTED (ML)=	101.9
PERCENT WATER=	3.73
AVERAGE METER TEMPERATURE (C.)=	24.8
AVERAGE DELTA H (MM H2O)=	52.8
AVERAGE DELTA P (MM H2O)=	9.0
AVERAGE STACK TEMPERATURE (C.)=	170.0
DRY MOLECULAR WEIGHT=	31.098
WET MOLECULAR WEIGHT=	30.610
AVERAGE SQUARE ROOT OF DELTA P (MM H2O)=	2.9654
% ISOKINETIC=	89.6
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	180.0
NOZZLE DIAMETER (MM)=	7.77
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)=	722
FLOW RATE (ACTUAL, CUBIC M/MIN)=	405
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	267
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	264

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	1.0425
PARTICULATE LOADING, DRY STD. (G/CU. M)=	0.2972
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	0.1885
EMISSION RATE (KG/HR)=	4.71

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	1.0425
PARTICULATE LOADING, DRY STD. (G/CU. M)=	0.2972
PARTICULATE LOADING, ACTUAL (G/CU. M)=	0.1885
EMISSION RATE (KG/HR)=	4.71
PERCENT IMPINGER CATCH=	0.0

FILE NAME - BAG013
RUN # - BAG-O-1-3
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.)	OUT(F.)
1	0.30	1.80	300	62	60
2	0.57	3.40	320	64	60
3	0.28	1.70	340	65	60
4	0.42	2.50	355	67	61
5	0.24	1.50	345	70	62
6	0.40	2.20	340	74	61
7	0.50	3.00	350	78	62
8	0.25	1.60	335	82	64
9	0.30	1.80	305	80	64
10	0.56	3.40	340	80	65
11	0.25	1.50	340	82	67
12	0.24	1.40	340	83	67
13	0.43	2.30	350	85	67
14	0.25	1.50	350	84	67
15	0.48	2.90	340	87	70
16	0.23	1.40	350	88	72
17	0.50	3.00	335	86	72
18	0.25	1.00	330	85	73
19	0.46	2.70	330	84	73
20	0.25	1.50	340	86	73
21	0.45	2.70	340	88	74
22	0.45	2.70	340	92	75
23	0.22	1.30	335	94	76
24	0.29	1.60	335	91	79
25	0.55	3.20	350	90	80
26	0.27	1.70	345	91	79
27	0.25	1.50	340	90	78
28	0.33	1.90	345	91	78
29	0.23	1.30	335	92	78
30	0.50	2.95	335	94	78
31	0.24	1.50	335	94	79
32	0.47	2.80	335	96	80
33	0.25	1.50	340	96	82
34	0.45	2.60	340	96	82
35	0.25	1.50	340	96	82
36	0.45	2.50	340	96	82
37	0.37	2.25	340	92	82
38	0.23	1.40	340	89	81
39	0.27	1.50	330	80	75
40	0.45	2.70	340	81	75
41	0.25	1.20	335	81	74
42	0.47	2.80	335	80	72
43	0.50	2.95	340	80	72
44	0.23	1.30	340	81	70
45	0.40	2.40	330	80	70
46	0.23	1.30	330	80	70
47	0.29	1.80	330	75	65
48	0.27	1.65	340	76	66
49	0.49	2.80	340	78	66
50	0.25	1.50	340	79	65
51	0.55	3.20	340	79	65
52	0.26	1.60	340	79	65

53	0.26	1.55	340	79	66
54	0.30	1.70	340	75	66
55	0.50	2.80	340	75	65
56	0.28	1.70	340	75	65
57	0.49	2.50	340	75	66
58	0.50	2.90	340	77	66
59	0.25	1.80	340	78	66
60	0.40	2.00	340	78	66

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	0.3079	0.3073	0.0044	0.0000

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	89.6786	88.6331	120.0	1.0425
IMPINGERS	0.0000	0.0000	0.0	0.0000

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

MIDWEST RESEARCH INSTITUTE

RUN Prep -1- 3

MRI Project Number 4891-C-93
Field Dates 12-3-80
Plant [illegible]
Sampling Location [illegible]
Sampling Date 12-3-80

FIELD CREW

Crew Chief [illegible]

Testing Engineer 1 [illegible]
2
3

Engr. Technician 1
2
3

Lab Technician 1 [illegible] 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 Bag Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.54
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	60 ~~350~~
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.78
STATIC PRESSURE IN STACK, in. Hg (+0.44 $P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.81
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.001
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	350
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.33
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	0.30	
ACTUAL NOZZLE DIAMETER, in.	0.306	
REFERENCE Δp, in. H_2O	0.31	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant [illegible]
Sampling Location [illegible]
Test Number [illegible]

Date 12-3-[illegible]
Initial [illegible]

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

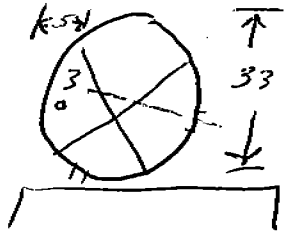
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	60
Pitot coefficient	Cp	0.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	0.95
Nozzle diameter, inches	Dn	0.306
Barometric pressure, inches Hg	Pb	29.78
$\frac{5.168\ (60 + 460)\ (.84)\ (3)\ (.95)\ (.306^2)}{\sqrt{29.78}}$	K	110.39

FIELD DATA

PLANT
DATE 12-3-90
SAMPLING LOCATION Bagham Outlet
SAMPLE TYPE Dist
RUN NUMBER Bg-0-1-3
OPERATOR
AMBIENT TEMPERATURE 25°F
BAROMETRIC PRESSURE 27.78
STATIC PRESSURE, (P_s) +0.44 "H_2O
FILTER NUMBER (s) 87



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 3 ft
NOZZLE I.D. 0.306
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 4
METER $\Delta H_@$ 1.84
C FACTOR 1.001
PROBE HEATER SETTING 95
HEATER BOX SETTING 400
REFERENCE Δp 0.31

Leak CK: Initial at 15" Hg, CFM 0.003
Final at Hg, CFM 0.000

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 110.4 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 630.760		VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
		Desired	Actual	0.54	DESIRED	ACTUAL		INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F			
1	3 0931	632.95	632.50	0.30	1.8	1.8	300	62	60	5	300	55
2	6 0934	635.78	635.78	0.57	3.4	3.4	320	61	60	5	300	50
3	9 0937	673.85	632.93	0.28	1.7	1.7	340	65	60	5	295	51
4	12 0940	640.35	640.38	0.42	2.6	2.5	355	67	61	5	295	51
5	15 0943	642.26	642.27	0.24	1.55	1.5	345	70	62	5	300	
6	18 0946	644.73	644.56	0.40	2.40	2.2	340	74	61	5	295	55
7	21 0949	647.47	647.27	0.50	3.0	3.0	350	78	62	5	295	54
8	0950 off	649.47	647.43	0.25	1.55	1.6	335	82	64	5	310	
9	0953 on	651.66	651.57	0.30	1.80	1.8	305	80	64	5		
10		654.56	654.45	0.56	3.4	3.4	340	80	65	5	300	
11	1003	656.51	656.63	0.25	1.5	1.5	340	82	67	5		
12	1006	658.42	658.48	0.24	1.4	1.4	340	83	67	5		
13	1009	660.87	660.89	0.43	2.3	2.3	350	85	67	5	310.	
14	1012	662.81	662.75	0.25	1.5	1.5	350	84	67	5		
15	1015	665.51	665.42	0.48	2.9	2.9	340	87	70	5	310	55
16	1015 off 1020	667.37	665.25	0.23	1.35	1.4	350	88	72	5	300	
17	1018 on	670.14	670.43	0.50	3.2	3	335	86	72	5	320	
18		672.10	672.16	0.25	1.5	1	330	85	73	5		
19	1030	674.76	674.76	0.46	2.7	2.7	330	84	73	5	280	
20	1033	676.80	676.76	0.25	1.5	1.5	340	86	73	5	300	
21	1036	679.32	679.37	0.45	2.7	2.7	340	88	74	5		53
22	1039	682.99	682.03	0.45	2.7	2.7	340	92	75	5		
23	1040 off	683.83	683.99	0.22	1.33	1.3	335	94	76	5		

COMMENTS. 1043 on

EPA (Dur) 235

E-115

TRAVERSE POINT NUMBER	CLOCK TIME (24 hr CLOCK) / SAMPLING TIME, min	GAS METER READING (V_m), ft^3 683.83 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
24		685.94	685.97	0.28	1.75	1.6	335	91	79	5	270	
25	1050	688.82	688.77	0.55	3.25	3.2	350	90	80	5		
26	1053	690.84	690.96	0.27	1.78	1.7	345	91	79	5	300	
27	1056	692.79	692.83	0.25	1.55	1.5	340	90	78	5		
28	1059	695.03	695.06	0.33	1.95	1.9	345	91	78	5	300	
29	1102	696.91	696.85	0.23	1.3	1.3	335	92	78	5		
30	1104	699.68	699.66	0.50	2.95	2.95	335	94	78	5	300	
31	1106 off	701.60	701.69	0.28	1.45	1.5	335	84	79	5	300	
32	1108 on	704.28	704.32	0.47	2.80	2.8	335	86	80	5	300	
33		706.23	706.31	0.25	1.5	1.5	340	86	82	5		
34		708.85	708.86	0.45	2.7	2.6	340	96	82	5	250	
35	1122	710.80	710.82	0.25	1.5	1.5	340	96	82	5		
36	1125	713.42	713.49	0.45	2.7	2.5	340	96	82	5		
37	1128	715.79	715.88	0.37	2.25	2.25	340	92	82	5		
38		717.66	717.45	0.23	1.4	1.4	340	88	81	5		
39	1131 off	719.77	719.82	0.27	1.65	1.5	330	80	75	5		
40	1133 on	722.39	722.45	0.45	2.7	2.7	340	81	75	5	310	
41		724.35	724.38	0.25	1.5	1.2	335	81	74	5		
42		727.03	727.04	0.47	2.8	2.9	335	80	72	5		
43	1148	729.90	729.90	0.50	2.95	2.95	340	81	72	5		
44	1151	731.68	731.69	0.23	1.3	1.3	340	81	70	5	300	
45	1154	734.16	734.13	0.40	2.4	2.4	330	80	70	5		
46	1156 off	736.04	736.06	0.23	1.3	1.3	330	80	70	5		
47	1158 on	738.16	738.20	0.29	1.9	1.4	330	75	65	5		
48	1205	740.20	740.37	0.27	1.65	1.65	340	76	66	5	300	52
49	1209	742.45	742.91	0.49	2.80	2.8	340	79	66	5		
50	1212	744.41	744.95	0.25	1.5	1.5	340	79	65	5	300	
51	1215	747.81	747.70	0.55	3.2	3.2	340	79	65	5	300	
52		749.90	749.83	0.26	1.55	1.6	340	79	65	5		
53	1220 off	751.79	752.02	0.26	1.55	1.55	340	79	66	5	300	
54	1223 on	753.93	754.08	0.30	1.8	1.7	340	75	65	5		
55		756.69	756.71	0.50	2.95	2.9	340	75	65	5	300	

Run Number Bag-0-1-3(1) Date 12-3-80 Sampling Location Baghouse Outlet

Comments:

EPA (Dun 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 (756.69)	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
56	1232	753.76	755.85	0.28	1.7	1.7	340	75	65	5	300	
57	1235	761.47	761.36	0.49	2.3	2.5	340	75	66	5		
58		764.25	764.11	0.50	2.9	2.9	340	77	66	5		
59	1241	766.20	766.31	0.25	1.5	1.8	340	78	66	5	300	
60	1244	768.67	768.722	0.40	2.4	2.	340	78	66	5	300	
		V_m = 137.96		Δp_s = 0.355		ΔH_s = 2.077	T_s = 338	T_m = 76.6				

Run Number ~~Dust~~ Bag-0 1-3

Date 12-3-80

Sampling Location ~~Dust Collector~~ Baghouse Outlet

Comments:

EPA (Dur) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant PEGen
Sampling Location Baghouse Outlet
Test Number Bag - 8 - 1 - 3

Date 12-3-80
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}	338
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 2.077, Pb = 28.78, Vm = 137.96, Tm = 76.6	Vm_{std}	131.22
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ 5%	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	31.90
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	31.21
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) +.44" H_2O	Ps	28.81
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ Cp = .84, ΔPs = 0.355	Vs	2418.2
Total sample time, minutes	θ	180
Nozzle diameter, inches	Dn	0.306
$\frac{1{,}039\ (338 + 460)(131.22)}{(2418)(180)(28.81)(.95)(.306^2)}$	% I	97.5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant [illegible]
Sample Location [illegible]
Sample Box No. C
Sample Type

Run No. bag-0-1-3
Sample Date 12-7-80
Recovery Date
Cleanup Person

Filter No. 57
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/	154	120	[illegible]		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/					
Sample No.(s)	54	20	2		

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

SILICA GEL

707.1
681.2
25.9

Silica Gel
Color

Description of Impinger Solution
Total Moisture, gm 101.9

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

RECOVERED SAMPLE

Probe Rinse: Sample No. 116
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
Personnel accepting custody
Seal(s) broken by
Date broken
Remarks:

MIDWEST RESEARCH INSTITUTE

Run No. Bag-0-1-3

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					
116		5	89.67860	88.63308	120		
	87	6	0.30793	0.30734			
		6					
		6					
		7					
		8					
		9					
121		10	95.51922	95.51596	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-L-93

Source Identification ~~Bay 10-1-2~~ Baghouse Outlet

Test Run Number Bg-0-1-3

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	12-3-80	0928 – 1244	Whitted	
Probe Technician				
Meter Technician				
Other				
Transport of Train to Cleanup Site	12-3-80	1245	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

(8)

MIDWEST RESEARCH INSTITUTE

RUN 2 1

MRI Project Number 4891-L(93)
Field Dates 10-
Plant Pfizer
Sampling Location Bag-0-1-3
Sampling Date 10-21-80

FIELD CREW

Crew Chief Dick Cobb

Testing Engineer 1 Mark Hansen
2
3

Engr. Technician 1
2
3

Lab Technician 1 Tom Walker
2 Joel P.
3

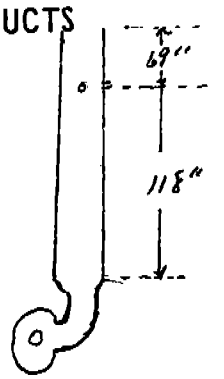
Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Pfizer
DATE 10-20-80
SAMPLING LOCATION Baghouse - Outlet
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) 33 1/4"
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) N/A
STACK I.D., (DISTANCE A - DISTANCE B) 33 1/4"
NEAREST UPSTREAM DISTURBANCE 69"
NEAREST DOWNSTREAM DISTURBANCE 118"
CALCULATOR Vogel, Hansen



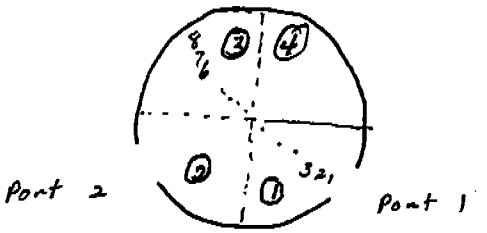
SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1-12	97.9	33 1/4"	32 1/2"		
11	93.3		31"		
10	88.2		29 1/4"		
9	82.3		27 3/8"		
8	75.0		25"		
7	64.4		21 3/8"		
6	35.6		11 7/8"		
5	25.0		8 1/4		
4	17.7		5 7/8"		
3	11.8		3 7/8"		
2	6.7		2 1/4"		
1	2.1		1"		

EPA (Dur) 232
4 72

PRELIMINARY VELOCITY TRAVERSE

PLANT Pfizer
DATE 10-20-80
LOCATION Baghouse - Outlet
STACK I.D. 33 1/4"
BAROMETRIC PRESSURE, in. Hg 29.10
STACK GAUGE PRESSURE, in. H_2O +0.44
OPERATORS Hansen, Vogel



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1-12	.67 ~~.53~~	294
11	.65	293
10	.69	293
9	.64	293
8	.64	293
7	.62	293
6	.36	290
5	.30	290
4	.26	288
3	.26	285
2	.30	283
1	.29	280
AVERAGE	0.47	289.58

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
2-12	.53	287
11	.52	289
10	.52	291
9	.62	291
8	.63	295
7	.65	297
6	.34	297
5	.31	290
4	.30	290
3	.30	290
2	.30	290
1	.25	289
AVERAGE	.43	291.3

ΔP_s = .45
T_s = 290.44

EPA (Dur) 233
4 72

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-21-80

SAMPLING LOCATION Bag-O-1-3

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	4.35
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.08
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.11
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	293
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.64
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.64
C FACTOR	1.02	
CALCULATED NOZZLE DIAMETER, in.	.25	
ACTUAL NOZZLE DIAMETER, in.	.25	
REFERENCE Δp, in. H_2O	.64	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer

Sampling Location Bag-0-1-3

Test Number 1

Date 10-21-80

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

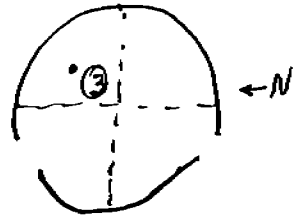
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	70
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.955
Nozzle diameter, inches	Dn	.25
Barometric pressure, inches Hg	Pb	29.08
$\frac{5.168\ (70 + 460)\ (.84)\ (5)\ (.955)\ (.25^2)}{\sqrt{29.08}}$	K	127.3

FIELD DATA

PLANT Pfizer
DATE 10-21-80
SAMPLING LOCATION Bag-0-1-3
SAMPLE TYPE Particulate
RUN NUMBER Bag-0-1-3
OPERATOR Hansen
AMBIENT TEMPERATURE 50°F
BAROMETRIC PRESSURE 29.08
STATIC PRESSURE, (P_s) + .44
FILTER NUMBER (s) 2



PROBE LENGTH AND TYPE 3' SS
NOZZLE I.D. .25'
ASSUMED MOISTURE, % 4.35
SAMPLE BOX NUMBER 6
METER BOX NUMBER 4
METER $\Delta H_@$ 1.84
C FACTOR 1.02
PROBE HEATER SETTING 80
HEATER BOX SETTING
REFERENCE Δp .64

Leak CK: Initial at 15" Hg, CFM .01
Final at 15" Hg, CFM 0.0

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 127.3 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$ 3.711/5 min.

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	1040		607.70	.64			293					
3	5	1045	611.41	611.13	.64	1.85	1.90	293	56	54	12.5	196	53
	10	1050	615.12	614.71			1.9		60	54	12.5	212	53
	15	1055	618.83	618.45			1.95		61	55	13	220	55
	20	1100	622.54	622.08			1.95		62	55	13	230	56
	25	1105	626.26	625.70			2.0		62	56	13.5	230	56
	30	1110	629.97	629.55			2.05		63	56	14	230	58
	35	1115	633.68	633.33			2.05		64	56	13.5	228	57
	40	1120	637.39	637.12			2.05		63	56	13.5	237	57
	45	1125	641.10	640.88			2.05		64	57	13.5	237	57
	50	1130	644.81	644.72			2.05		64	57	13.5	242	58
	55	1135	648.52	648.49			2.05		64	57	13.5	237	59
	60	1140	652.23	652.25			2.05		65	57	13.5	238	60
	65	1145	655.94	656.00			2.05		65	57	13.5	230	61
	70	1150	659.65	659.75			2.05		66	58	13.5	237	63
	75	1155	663.37	663.51			2.0		65	58	13.5	240	64
	80	1200	667.08	667.20			2.0		65	58	13.5	237	66
	85	1205	670.79	670.88			2.0		66	58	13.25	235	63
	90	1210	674.50	674.58			2.0		68	59	13.25	242	64
	95	1215	678.21	678.28			2.0		68	59	13.25	242	62
	100	1220	681.92	682.10			2.0		67	59	13.0	242	60
	105	1225	685.63	685.71			2.0		67	59	13.0	240	60
	110	1230	689.34	689.41			2.0		66	59	13.0	240	61
	115	1235	693.05	693.06			1.45		65	59	13.0	232	62

COMMENTS

EPA (Dur) 235

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
3	120	1240	696.76	696.70	.64	1.85	1.95	293	66	59	13.0	235	63
	125	1245	700.48	700.38			1.9		66	59	13.0	238	64
	130	1250	704.19	704.05			1.95		67	59	13.0	243	66
	135	1255	707.90	707.71			1.95		69	60	13.0	246	67
	140	1300	711.61	711.37			2.0		69	60	13.5	248	67
	145	1305	715.32	715.07			2.0		68	60	13.5	248	66
	150	1310	719.03	718.82			2.0		66	60	13.5	248	64
	155	1315	722.74	522.59			2.05		67	60	14.0	248	65
	160	1320	726.45	726.32			2.05		68	60	14.0	242	66
	165	1325	730.16	730.07			2.05		69	61	14.0	243	68
	170	1330	733.87	733.81			2.05		68	61	14.0	244	68
	175	1335	737.59	737.59			2.0		68	61	14.0	244	69
	180	1340	741.30	741.32			2.0		68	61	14.0	242	70
			V_m =	133.62		ΔH = 2.00			T_m =	61.8			

Run Number ~~2~~ 1 Date 10-21-80 Sampling Location Bag-0-~~1~~-3

Comments:

EPA (Dun) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Baghouse - Outlet
Test Number Bag - 0 - 1 - 3

Date 10-21-80
Initial G.C.

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	293
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Vm = 133.62, Pb = 29.09, Tm = 61.8, ΔH = 2	Vm_{std}	132.02
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 4.79	Mf	.952
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	30.649
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.04
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) P_s = +.44	Ps	29.11
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ Δp = .64	Vs	3198
Total sample time, minutes	θ	180
Nozzle diameter, inches	Dn	.25
$\frac{1{,}039\ (293 + 460)(132.02)}{(3198)(180)(29.11)(.952)(.25^2)}$	% I	103.6

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant PFIZER
Sample Location DAGHOUSE OUTLET
Sample Box No. 12
Sample Type Mass

Run No. Bay-0-1-3
Sample Date 10/21/80
Recovery Date 10/21/80
Cleanup Person DW

Filter No. #2
Sample No.
Sample Material Description LIME

MOISTURE AND/OR SAMPLE

Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	–		
Final Volume (wt) b/	187	114	3		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	87	14	3		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 140.4

SILICA GEL

785.3	
748.9	
36.4	

Silica Gel Color LIGHT BLUE

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

RECOVERED SAMPLE

Probe Rinse: Sample No. BEAKER #4
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. BEAKER #10
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 ANALYSIS

SAMPLE HANDLING LOG

Project Number 4891L-93

Source Identification Baghouse Outlet

Test Run Number Bag-0-1-3

Pollutant(s) in Sample LIME

Task	Date	Time	Personnel	Remarks
Sampling	10/21/80	AM	HANSEN, VOGEL	
Probe Technician				
Meter Technician				
Other				
Transport of Train to Cleanup Site				
Train Disassembly	10/21/80			
Train Cleanout	10/21/80		JW	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

(12)

MIDWEST RESEARCH INSTITUTE

RUN Bag-0-1-4

MRI Project Number 4891-L93
Field Dates
Plant A.-2 Gr
Sampling Location Baghouse-Outlet
Sampling Date 10-23-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

Lab Technician 1 T. Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-21-80

SAMPLING LOCATION Bag - 0-1-4

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	4.25
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.16 ~~30.88~~
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.19 ~~30.91~~
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	295
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.63
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	.25	
ACTUAL NOZZLE DIAMETER, in.	.25	
REFERENCE Δp, in. H_2O	.63	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant PCiZen
Sampling Location Bag - 0 - 1 - 4
Test Number One of Quad 4

Date 10-21-80
Initial G.S.

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

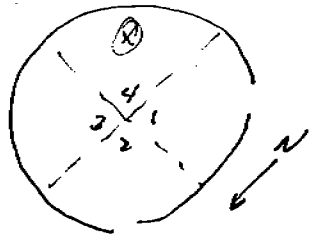
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	65
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.958
Nozzle diameter, inches	Dn	.25
Barometric pressure, inches Hg	Pb	29.16
$\frac{5.168\ (65 + 460)\ (.84)\ (5)\ (.958)\ (.25^2)}{\sqrt{29.16}}$	K	126.4

FIELD DATA

Bag-0-1-4

PLANT Pfizer
DATE 10-21-80
SAMPLING LOCATION Baghouse-Outlet
SAMPLE TYPE Mass
RUN NUMBER Bag-0-1-4
OPERATOR Hudson
AMBIENT TEMPERATURE 55
BAROMETRIC PRESSURE 29.16
STATIC PRESSURE, (P_s) -1.44
FILTER NUMBER (s) -7



PROBE LENGTH AND TYPE 3' SS
NOZZLE I.D. .25
ASSUMED MOISTURE, % 4.25
SAMPLE BOX NUMBER 6
METER BOX NUMBER 3
METER $\Delta H_@$ 1.84
C FACTOR 1
PROBE HEATER SETTING 400
HEATER BOX SETTING 8
REFERENCE Δp .63

0.1825/15sec.
0.73/min.
3.65/5min.

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

$VM = 126.4 \times \sqrt{\frac{Ps}{Ts + 460}}$

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	1620		51.90									
4	5	1625	55.55	55.53	.63	1.95	1.95	295	64	59	6.5	165	60
	10	1630	59.20	59.20			1.95		66	60	6.5	167	65
	15	1635	62.85	62.89			1.95		66	60	6.5	170	66
	20	1640	66.50	66.52			1.95		68	60	6.5	170	67
	25	1645	70.15	70.15			1.95		69	60	6.5	170	64
	30	1650	73.80	73.80			1.95		71	61	6.5	203	63
1655	ΔP=0 35	1655	77.45	77.46			1.95		69	62	6.5	193	61
1657	ΔP=.25 40	1700	81.10	81.14			1.95		70	62	6.5	191	62
1700	ΔP=.54 45	1705	84.75	84.79			1.95		69	62	6.5	191	63
	50	1710	88.40	88.42			1.95		70	62	6.5	197	63
	55	1715	92.05	92.06			1.95		70	62	6.5	~~192~~ 192	64
	60	1720	95.70	95.71			1.95		70	63	6.5	200	66
	65	1725	99.35	99.38			1.95		70	63	6.75	204	66
	70	1730	103.00	103.00			1.95		69	62	6.75	200	66
	75	1735	106.65	106.67			1.95		70	62	6.75	197	63
	80	1740	110.30	110.33			1.95		69	62	6.75	195	62
	85	1745	113.95	113.99			1.95		69	62	6.75	202	62
	90	1750	117.60	117.68			1.95		70	62	6.75	210	62
	95	1755	121.25	121.32			1.95		70	62	6.75	210	63
	100	1800	124.90	124.94			1.90		70	62	6.75	210	63
	105	1805	128.55	128.58			1.90		72	63	6.75	218	64
	110	1810	132.20	132.20			1.90		73	63	6.75	222	66
	115	1815	135.85	135.88			1.95		72	63	6.75	220	65

COMMENTS
1640 - Sample box heater turned to max temp. Doesn't seem to heat box enough (170°F)

EPA Form 235

E-135

135.85 (3.65/5min.) Leak check at 7.25" Hg = 0.0 CFM

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
4	120	1820	139.50	139.56	.63	1.95	1.95	295	72	63	6.75	218	62
	125	1825	143.15	143.22			1.95		72	63	6.75	218	60
	130	1830	146.80	146.88			1.95		71	63	6.75	215	59
	135	1835	150.45	150.52			1.90		71	63	6.75	220	59
	140	1840	154.10	154.17			1.90		71	62	6.75	220	60
	145	1845	157.75	157.78			1.90		71	62	6.75	221	60
	150	1850	161.40	161.40			1.90		71	62	6.75	224	61
	155	1855	165.05	164.99			1.90		72	62	6.75	230	62
	160	1900	168.70	168.60			1.90		72	62	6.75	240	63
	165	1905	172.35	172.24			1.95		72	62	7.0	232	64
	170	1910	176.00	175.84			1.95		72	62	7.0	232	65
	175	1915	179.65	179.58			2.0		71	62	7.25	226	66
	180	1920	183.30	183.175			2.0		71	62	7.25	225	66
			V_m =	119.43			ΔH = 1.94			T_m =	66.02		

θ = 180 V_m = 131.275 ΔH_{avg} = 1.94 $T_{s_{avg}}$ = 295

Run Number One Quad 4 Date 10-21-80 Sampling Location Bay-0-1-4

Comments: as wind dies down, ~~temp~~ sample box temp. rises.

FPA Form 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Bay - 0 - 1-4
Test Number One | Quad 4

Date 10-21-80
Initial MH

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	295
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	128.37
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.958
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	30.88
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.34
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.19
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	3157.3
Total sample time, minutes	θ	180
Nozzle diameter, inches	Dn	.25
$\frac{1{,}039\ (295 + 460)(128.37)}{(3157.3)(180)(29.19)(.958)(.25^2)}$	% I	101.4

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location Bag-0-1-4
Sample Box No.
Sample Type Mass

Run No. One Quad. 4
Sample Date 10-21-80
Recovery Date 10/22/80
Cleanup Person [illegible]

Filter No. #3
Sample No.
Sample Material Description LINE

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	—		
Final Volume (wt) b/	172ml	112ml	4ml		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	72ml	12ml	4ml		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 124.4g

SILICA GEL

	642.5g
	656.1g
	36.4g

Silica Gel Color LIGHT BLUE

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

RECOVERED SAMPLE

Probe Rinse: Sample No. BEAKER #8
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. BEAKER #10
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:

SAMPLE HANDLING LOG

Project Number 4891-293

Source Identification Bay-0-1-4

Test Run Number One Quad 4

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10/21/80		HANSEN, VOGEL	
Probe Technician	"			
Meter Technician	"		HANSEN	
Other	"			
Transport of Train to Cleanup Site	"		HANSEN, VOGEL	
Train Disassembly	10/22/80	AM		
Train Cleanout	10/22/80	AM		
Packing and Storage				
Shipment to Analysis Site				ON SITE
Lab Analysis			DW	ON SITE
Write Up				

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MIDWEST RESEARCH INSTITUTE

RUN Bag-0-2-3

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Bag-0-2-3
Sampling Date 10-22-80

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. P.
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-22-80

SAMPLING LOCATION Bag-0-2-3

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F 45 +10	$T_{m_{avg.}}$	55
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	4.25
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.48
STATIC PRESSURE IN STACK, in. Hg + .44 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.51
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	293
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.64
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.00	
CALCULATED NOZZLE DIAMETER, in.	.25	
ACTUAL NOZZLE DIAMETER, in.	.25	
REFERENCE Δp, in. H_2O	1.85	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer

Sampling Location Bag-0-2-3

Test Number 2

Date 10-22-80

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

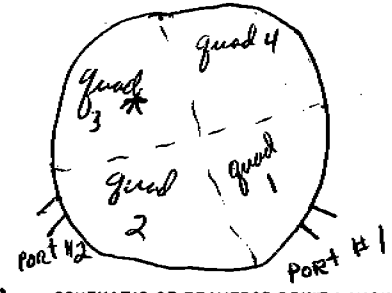
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	55
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.958
Nozzle diameter, inches	Dn	.25
Barometric pressure, inches Hg	Pb	29.48
$\frac{5.168\ (55 + 460)\ (.84)\ (5)\ (.958)\ (.25^2)}{\sqrt{29.48}}$	K	123.3

Sample point quad 3 from Port No. 1
24.75" into stack

FIELD DATA

PLANT Pfizer
DATE 10-22-80
SAMPLING LOCATION Bag-0-2-3
SAMPLE TYPE Mass
RUN NUMBER 2
OPERATOR Hansen
AMBIENT TEMPERATURE 45°F
BAROMETRIC PRESSURE 29.48
STATIC PRESSURE, (P_s) 7.44
FILTER NUMBER (s) 4



PROBE LENGTH AND TYPE 3', SS
NOZZLE I.D. .25
ASSUMED MOISTURE, % 4.25
SAMPLE BOX NUMBER 12
METER BOX NUMBER 4
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING 80°F
HEATER BOX SETTING 300°F
REFERENCE Δp .64

0.180/15 sec.
0.72/min.

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 6" Hg, CFM 0.0

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 123.3 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

3.59/5 min.

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	1120	802.70										
3 quad	5	1125	806.29	806.28	.64	1.85	1.85	293	65	68	5.5	181	50
	10	1130	809.88	809.87			1.85		74	67	5.5	202	54
	15	1135	813.47	813.45			1.85		79	67	5.5	208	57
	20	1140	817.06	817.03			1.85		80	66	5.75	220	58
1145	ΔP = 0	25	1145	820.65	820.62		1.85		78	65	5.75	227	60
1148	ΔP = .32	30	1150	824.24	824.24		1.85		77	64	6.0	230	61
	35	1155	827.83	827.83			1.85		78	63	6.0	236	64
	40	1200	831.42	831.41			1.85		83	64	6.0	242	67
	45	1205	835.01	835.01			1.85		86	66	6.0	244	64
1212	ΔP = 0	50	1210	838.60	838.61		1.85		90	69	6.0	253	69
1213	ΔP = .32	55	1215	842.19	842.26		1.85		93	71	6.0	253	69
1215	ΔP = .54	60	1220	845.78	845.88		1.85		94	74	6.0	253	63
	65	1225	849.37	849.50			1.85		95	75	6.0	256	60
	70	1230	852.96	853.00			1.80		97	77	6.0	258	69
	75	1235	856.55	856.69			1.80		97	79	6.0	256	63
	80	1240	860.14	860.32			1.80		98	79	5.75	259	61
	85	1245	863.73	863.86			1.80		96	80	5.75	255	61
	90	1250	867.32	867.42			1.75		99	81	5.75	257	68
	95	1255	870.91	870.95			1.75		101	83	5.75	262	66
	100	1300	874.50	874.51			1.75		98	84	5.75	267	68
	105	1305	878.09	878.11			1.75		98	84	5.75	264	63
	110	1310	881.68	881.67			1.75		99	84	5.75	264	61
	115	1315	885.27	885.26			1.75		101	85	5.75	265	66

E-143

COMMENTS - 1134 Turned probe heat & heater box setting to max.
- Wind changing directions making it either cold or very hot at sampling location (Bag-0).
- Impinger temp. probably affected by hot stack exhaust.

EPA (Dur) 235

3.59 cfm/5min, 0.72 cfm, 80/15 sec

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
3 quad	120	1320	888.86	888.83	.64	1.85	1.80	293	101	86	5.75	262	65
	125	1325	892.45	892.42			1.80		103	86	5.75	262	70
	130	1330	896.04	896.03			1.80		104	87	6.0	258	68
	135	1335	899.63	899.64			1.80		105	88	6.0	258	66
	140	1340	903.22	903.25			1.85		96	86	6.0	248	63
	145	1345	906.81	906.84			1.80		89	82	6.0	244	62
	150	1350	910.40	910.41			1.80		92	80	6.0	252	64
	155	1355	913.99	914.01			1.80		96	80	6.0	263	65
	160	1400	917.58	917.59			1.80		93	81	6.0	265	60
	165	1405	921.17	921.17			1.80		92	80	6.0	276	60
	170	1410	924.76	924.76			1.80		96	81	6.0	277	64
	175	1415	928.35	928.34			1.80		98	82	6.0	278	64
	180	1420	931.94	931.97			1.80		98	82	6.0	281	66
			V_m = 129.27			ΔH = 1.81			T_m = 69.6				

Run Number 2 Date 10-22-80 Sampling Location Bag-0-2-3

Comments:

EPA (Dun) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 11-22-80
Initial RE

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	293
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Vm = 129.27, Pb = 29.48, Tm + 460 = 529.6, ΔH = 1.81	Vm_{std}	127.51
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ %H2O = 4.05	Mf	.96
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	31.253
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.72 30.72
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) Ps = +.44	Ps	29.51
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ Ts+460 = 753, Δp = .64	Vs	3141
Total sample time, minutes	θ	180
Nozzle diameter, inches	Dn	.25
$\frac{1{,}039\ (293 + 460)(127.51)}{(3141)(180)(29.51)(.96)(.25^2)}$	% I	99.65

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location Baghouse - Outlet
Sample Box No. #3
Sample Type Particulate

Run No. Bag - 0 - 2 - 3
Sample Date 10-22-80
Recovery Date 10/22/80
Cleanup Person DW

Filter No. #4
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/	152	129	4.0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	52	29	4		
Sample No.(s)					

Combined impinger contents, Sample No. 1
Liquid Level Marked
Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 113.9

SILICA GEL

719.0	
690.5	
28.5	

Silica Gel Color LIGHT BLUE

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

RECOVERED SAMPLE

Probe Rinse: Sample No. BEAKER #15
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. BEAKER #16
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:

SAMPLE HANDLING LOG

Project Number 4891-193

Source Identification Baghouse Outlet

Test Run Number Bag-0-2-3

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-22-80	1120-1420		
Probe Technician				
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	10-22-80	1420-1440	Whited, Vogel, Hansen	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

20

MIDWEST RESEARCH INSTITUTE

RUN Bag-0-2-4

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Bag-0-2-4
Sampling Date 10-22-80

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 10-22-80

SAMPLING LOCATION Baghouse Outlet Bag-0-2-4

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	85
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	4.25
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.49
STATIC PRESSURE IN STACK, in. Hg +.44 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.52
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	295
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.63
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.05	
CALCULATED NOZZLE DIAMETER, in.	.25	
ACTUAL NOZZLE DIAMETER, in.	.25	
REFERENCE Δp, in. H_2O	.63	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Baghouse Outlet
Test Number Bag-0-2-4

Date 10-22-80
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

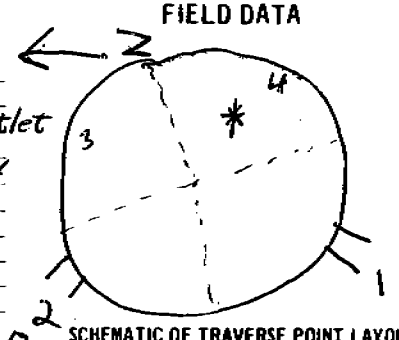
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	85
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.958
Nozzle diameter, inches	Dn	.25
Barometric pressure, inches Hg	Pb	29.49
$\frac{5.168\ (85 + 460)\ (.84)\ (5)\ (.958)\ (.25^2)}{\sqrt{29.49}}$	K	130.43

FIELD DATA

PLANT Pfizer
DATE 10-22-80
SAMPLING LOCATION Baghouse Outlet
SAMPLE TYPE Particulate
RUN NUMBER Bag-0-2-4
OPERATOR Hansen, Cobb
AMBIENT TEMPERATURE 65
BAROMETRIC PRESSURE 29.49
STATIC PRESSURE, (P_s) -4.44
FILTER NUMBER (s) 24



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 3' SS
NOZZLE I.D. .25
ASSUMED MOISTURE, % 4.25
SAMPLE BOX NUMBER 6/2
METER BOX NUMBER 3
METER $\Delta H_@$ 1.84
C FACTOR 1.05
PROBE HEATER SETTING No. 9
HEATER BOX SETTING ~~550~~ ~~400~~
REFERENCE Δp 0.63

0.189/15 sec.
0.754/min.
3.77/5 min

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

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 130.43 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 245.4 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	1620											
4 quad	5	1625	249.17	249.29	.63	1.85	1.85	295	82	81	5.75	226	65
	10	1630	252.94	252.91		~~1.85~~	1.85		87	81	5.75	244	60
	15	1635	256.71	256.49			1.85		91	81	5.75	247	65
	20	1640	260.48	260.10			1.85		91	82	5.75	248	62
	25	1645	264.25	264.78			1.90		91	82	6.0	252	65
	30	1650	268.02	267.49			1.95		93	82	6.0	252	63
	35	1655	271.79	271.29			1.95		88	81	6.0	253	56
	40	1700	275.56	274.99			2.0		86	79	6.0	253	54
	45	1705	279.33	278.72			2.0		86	78	6.0	242	53
	50	1710	283.10	282.42			2.0		86	77	6.0	247	57
	55	1715	286.87	286.15			2.05		89	77	6.25	249	59
	60	1720	290.64	289.93			2.05		94	80	6.25	249	56
	65	1725	294.41	293.70			2.2		97	82	6.5	247	65
	70	1730	298.18	297.60			2.2		98	83	6.5	250	65
	75	1735	301.95	301.52			2.2		98	85	6.5	240	58
	80	1740	305.72	305.43			2.1		98	86	6.5	245	58
	85	1745	309.49	309.34			2.1		97	85	6.5	240	58
	90	1750	313.26	313.03			2.0		89	89	6.5	245	55
	95	1755	317.03	316.72			1.95		86	80	6.0	243	56
	100	1800	320.80	320.44			2.05		85	78	6.0	241	55
	105	1805	324.57	324.28			2.1		83	75	6.0	240	55
	110	1810	328.34	328.14			2.1		81	73	6.0	244	55
	115	1815	332.11	332.02			2.1		80	71	6.5	244	55

COMMENTS

EPA Form 235

3.77 cf/5 min, 0.754 cfm, 0.189 cf/15 sec.

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
4quad	120	1820	335.88	335.87	.63	1.85	2.1	295	79	70	6.5	246	54
	125	1825	339.65	339.69			2.05		83	70	6.0	230	56
	130	1830	343.42	343.45			2.05		83	70	6.0	232	55
	135	1835	347.19	347.16			2.05		84	71	6.0	235	55
	140	1840	350.96	350.90			2.05		83	71	6.0	237	55
	145	1845	354.73	354.64			2.05		82	70	6.0	235	55
	150	1850	358.50	358.42			2.1		80	69	6.0	234	55
	155	1855	362.27	362.22			2.1		79	68	6.0	235	54
	160	1900	366.04	365.99			2.1		78	68	6.0	235	55
	165	1905	369.81	369.75			2.1		78	67	6.0	230	55
	170	1910	373.58	373.51			2.1		78	68	6.0	230	55
	175	1915	377.35	377.28			2.1		79	67	6.0	230	55
	180	1920	381.12	381.082			2.1		80	67	6.0	235	58

Run Number 2; 4th quad Date 10-22-80 Sampling Location Bag-0-2-4

Comments:

EPA :Dun 236
4 72

FILE NAME - BAG0331
RUN # - BAG-0-3-3-(1)
LOCATION - PFIZER
DATE - 10-23-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	993.475
FINAL METER VOLUME (CUBIC FEET)=	1092.140
METER FACTOR= 1	
NET METER VOLUME (CUBIC FEET)=	98.665
GAS VOLUME (DRY STANDARD CUBIC FEET)=	99.305
BAROMETRIC PRESSURE (IN. HG)=	29.67
STATIC PRESSURE (INCHES H2O)=	0.44
PERCENT OXYGEN=	16.00
PERCENT CARBON DIOXIDE=	16.33
MOISTURE COLLECTED (ML)=	101.5
PERCENT WATER=	4.59
AVERAGE METER TEMPERATURE (F.)=	61.3
AVERAGE DELTA H (IN. H2O)=	0.98
AVERAGE DELTA P (IN. H2O)=	0.36
AVERAGE STACK TEMPERATURE (F.)=	333.5
DRY MOLECULAR WEIGHT=	31.253
WET MOLECULAR WEIGHT=	30.644
AVERAGE SQUARE ROOT OF DELTA P (IN. H2O)=	0.5842
% ISOKINETIC=	103.5
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	190.0
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)=	2,350
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	14,170
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	9,360
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	9,271

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	0.0613
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.0095
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.0060
EMISSION RATE (LB/HR)=	0.76

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	0.0613
PARTICULATE LOADING, DRY STD. (GR./SCF)=	0.0095
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.0060
EMISSION RATE (LB/HR)=	0.76
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - BAG033
RUN # - BAG-0-3-3
LOCATION - PFIZER
DATE - 10-23-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	28.131
FINAL METER VOLUME (CUBIC METERS)=	30.925
METER FACTOR= 1	
NET METER VOLUME (CUBIC METERS)=	2.794
GAS VOLUME (DRY STANDARD CUBIC METERS)=	2.812
BAROMETRIC PRESSURE (MM HG)=	753.62
STATIC PRESSURE (MM H2O)=	11.2
PERCENT OXYGEN=	16.00
PERCENT CARBON DIOXIDE=	16.33
MOISTURE COLLECTED (ML)=	101.5
PERCENT WATER=	4.59
AVERAGE METER TEMPERATURE (C.)=	16.3
AVERAGE DELTA H (MM H2O)=	25.0
AVERAGE DELTA P (MM H2O)=	9.0
AVERAGE STACK TEMPERATURE (C.)=	167.5
DRY MOLECULAR WEIGHT=	31.253
WET MOLECULAR WEIGHT=	30.644
AVERAGE SQUARE ROOT OF DELTA P (MM H2O)=	2.9443
% ISOKINETIC=	103.5
PITOT COEFFICIENT=	0.8400
SAMPLING TIME (MINUTES)=	190.0
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)=	716
FLOW RATE (ACTUAL, CUBIC M/MIN)=	401
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	265
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	263

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	0.0613
PARTICULATE LOADING, DRY STD. (G/CU. M)=	0.0218
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	0.0137
EMISSION RATE (KG/HR)=	0.34

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	0.0613
PARTICULATE LOADING, DRY STD. (G/CU. M)=	0.0218
PARTICULATE LOADING, ACTUAL (G/CU. M)=	0.0137
EMISSION RATE (KG/HR)=	0.34
PERCENT IMPINGER CATCH=	0.0

FILE NAME - BAG033
RUN # - BAG-0-3-3
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	0.27	0.77	345	56	57
2	0.27	0.78	335	60	58
3	0.27	0.77	342	64	59
4	0.27	0.77	337	64	60
5	0.27	0.75	335	67	60
6	0.64	1.85	323	64	61
7	0.27	0.76	337	66	62
8	0.24	0.70	340	66	62
9	0.27	0.73	337	67	62
10	0.27	0.73	337	65	62
11	0.64	1.85	327	66	62
12	0.27	0.74	336	65	62
13	0.27	0.74	338	64	62
14	0.27	0.73	338	65	62
15	0.64	1.85	336	64	62
16	0.27	0.74	336	63	62
17	0.27	0.72	336	64	62
18	0.27	0.72	336	64	62
19	0.64	1.80	334	64	62
20	0.27	0.72	320	60	60
21	0.27	0.71	326	61	60
22	0.27	0.70	328	62	60
23	0.64	1.75	328	63	60
24	0.27	0.73	328	63	60
25	0.27	0.70	330	61	60
26	0.64	1.80	334	63	60
27	0.27	0.71	334	61	59
28	0.27	0.70	335	62	60
29	0.27	0.70	321	61	60
30	0.64	1.80	330	61	59
31	0.27	0.74	337	60	59
32	0.27	0.74	333	60	58
33	0.27	0.72	333	60	58
34	0.64	1.80	336	60	58
35	0.27	0.71	336	61	58
36	0.25	0.70	336	59	58
37	0.25	0.68	332	58	57
38	0.64	1.80	331	61	57

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	0.3024	0.2970	0.0004	0.0050

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	88.2403	88.1842	188.0	0.0564
IMPINGERS	0.0000	0.0000	0.0	0.0000

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

24

MIDWEST RESEARCH INSTITUTE

RUN Bag-0-33

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

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. Pavalonis
3 S. Johnson

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-23-80

SAMPLING LOCATION Bag-O-3-3(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	4.25
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	~~29.90~~ 29.67
STATIC PRESSURE IN STACK, in. Hg + .44 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.70
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	293
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.64
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	.25	
ACTUAL NOZZLE DIAMETER, in.	.25	
REFERENCE Δp, in. H_2O	~~1.85~~ .64	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer

Sampling Location Bag-Outlet

Test Number Bag 0-0-3-3

Date 10-23-80

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}	65
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.958
Nozzle diameter, inches	Dn	.25
Barometric pressure, inches Hg	Pb	29.67
$\frac{5.168\ (65 + 460)\ (.84)\ (5)\ (.958)\ (.25^2)}{\sqrt{29.67}}$	K	125.3

FIELD DATA

PLANT Pfizer
DATE 10-23-80
SAMPLING LOCATION Bag outlet
SAMPLE TYPE mess
RUN NUMBER Bag-0-3-3
OPERATOR Hansen
AMBIENT TEMPERATURE 50° F
BAROMETRIC PRESSURE 29.67
STATIC PRESSURE, (P_s) -1.44
FILTER NUMBER (s) 15

SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 3' SS
NOZZLE I.D. .25"
ASSUMED MOISTURE, % 4.26
SAMPLE BOX NUMBER 12
METER BOX NUMBER 4
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING 100
HEATER BOX SETTING 550
REFERENCE Δp .64

$VM = 125.3 \times \sqrt{\frac{Ps}{Ts + 460}}$

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

READ AND RECORD ALL DATA EVERY 5 MINUTES

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	1445	993.475										
Bag 3	5	b) 1450	995.77	995.81	.27	.77	.77	345	56	57	4.5	176	54
	10	1458	998.06	998.25	.27	.77	.78	335	60	58	4.5	184	54
	15	1503	1000.35	1000.67	.27	.77	.77	342	64	59	4.5	202	54
	20	1508	1002.64	1003.08	.27	.77	.77	337	64	60	4.25	202	53
	25	b) 1513	1004.94	1005.48	.27	.77	.75	335	67	60	4.25	204	55
	30	1521	1008.40	1008.64	.64	1.85	1.85	323	64	61	6.25	194	55
	35	1526	1010.73	1011.09	.27	.77	.76	337	66	62	4.25	207	55
	40	1531	1012.90	1013.42	.24	.70	.70	340	66	62	4.0	195	54
	45	1536	1015.20	1015.77	.27	.77	.73	337	67	62	4.25	200	54
	50	a) 1541	1017.51	1018.12	.27	.77	.73	337	65	62	4.25	202	54
	55	1548	1021.06	1021.21	.64	1.85	1.85	327	66	62	6.5	221	53
	60	1553	1023.38	1023.63	.27	.77	.74	336	65	62	4.5	209	55
	65	1558	1025.69	1025.99	.27	.77	.74	338	64	62	4.25	210	54
	70	a) 1603	1027.99	1028.35	.27	.77	.73	338	65	62	4.25	203	55
	75	1610	1031.54	1031.83	.64	1.85	1.85	336	64	62	6.5	218	55
	80	1615	1033.87	1034.28	.27	.77	.74	336	63	62	4.25	200	55
	85	1620	1036.18	1036.62	.27	.77	.72	336	64	62	4.25	217	55
	90	1625	1038.49	1038.96	.27	.77	.72	336	64	62	4.25	187	55
	95	b) 1630	1042.04	1042.40	.64	1.85	1.80	334	64	62	6.5	194	55
	100	1638	1044.35	1044.81	.27	.77	.72	320	60	60	4.25	190	55
	105	1643	1046.68	1047.13	.27	.77	.71	326	61	60	4.25	190	56
	110	1648	1048.99	1049.45	.27	.77	.70	328	62	60	4.25	198	57
	115	1653	1052.56	1052.84	.64	1.85	1.75	328	63	60	6.25	198	59

COMMENTS
a) 2 min. shutdown
b) 3 min shutdown

EPA (Dun 235

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
	115 b) 1653											
	120 1701	10 54.88	10 55.20	.27	.77	.73	328	63	60	4.25	203	59
	125 1706	10 57.20	10 57.51	.27	.77	.70	330	61	60	4.25	205	58
	130 1711	10 60.77	10 60.95	.64	1.85	1.80	334	63	60	4.50	196	61
	135 1716	10 63.08	10 63.30	.27	.77	.71	334	61	58	4.25	200	61
	140 a) 1721	10 65.39	10 65.61	.27	.77	.70	335	62	60	4.25	213	62
	145 1728	10 67.70	10 67.95	.27	.77	.70	321	61	60	4.25	213	61
	150 1733	10 71.29	10 71.26	.64	1.85	1.80	330	61	59	6.5	208	64
	155 1738	10 73.61	10 73.68	.27	.77	.74	337	60	59	4.5	210	64
	160 1743	10 75.92	10 76.05	.27	.77	.74	333	60	58	4.5	203	64
	165 b) 1748	10 78.23	10 73.38	.27	.77	.72	333	60	58	4.5	223	64
	170 1756	10 81.79	10 81.82	.64	1.85	1.80	336	60	58	6.5	213	66
	175 1801	10 84.10	10 84.16	.27	.77	.71	336	61	58	4.5	210	65
	180 1806	10 86.32	10 86.45	.25	.72	.70	336	59	58	4.5	210	64
	185 b) 1811	10 88.54	10 88.71	.25	.72	.68	332	58	57	4.25	200	63
	190 1819	10 92.10	10 92.14	.64	1.85	1.80	331	61	57	6.5	204	67
		V_m = 98.665		ΔP = .356	ΔH = .984		T_s = 333.5	T_M = 66.3				

Run Number Bag-0-3-3 Date 10-23-78 Sampling Location Bag Outlet

Comments: a) 2 min. shutdown
b) 3 min. shutdown

EPA (Dun 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-23-80
Initial BG

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	333.5
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .987$, $Pb = 29.67$, $Vm = 98.665$, $Tm+460 = 521.3$	Vm_{std}	~~99.117~~ ~~99~~ 99.3
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\%H_2O = 4.6$	Mf	.954
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.54
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.92
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) ±.44	Ps	29.70
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $Ts = 333.5$, $\Delta p = .1356$	Vs	2832.4 2389
Total sample time, minutes	θ	190
Nozzle diameter, inches	Dn	.25
$\frac{1{,}039\ (333.5 + 460)(99.3)}{(2389)(190)(29.7)(.954)(.25^2)}$	% I	~~36.0~~ 101.8

$P_s = 29.70$
$\%H_2O = 4.59$

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location Bag-0-3-3
Sample Box No. ~~Mass-Particulate~~
Sample Type Mass - Particulate

Run No. Bag-0-3-3
Sample Date 10-23-80
Recovery Date
Cleanup Person

Filter No. 15
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/	163	111	2		
Initial Volume (wt) b/	100	100			
Net Volume (wt) b/	63	11	2		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 101.5

SILICA GEL

680.2	
654.7	
25.5	

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. 45
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: ON SITE LAB ANALYSIS

MIDWEST RESEARCH INSTITUTE

Run No. Bg-0-73 PARTICULATE CLEAN-UP AND ANALYSIS

Date 10-27-80 FIELD ANALYSIS Performed by ~~10-27-80~~ JJ

	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					
45		5	88.24032	88.18415	188	J.J.	10-23-80
	15	6	0.30239	0.29704		J.J.	10-18-80
		6					
		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 Bag-Outlet

Test Run Number Bag-0-3-3

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-23-80	1445-1819	M. Hansen	
Probe Technician			M. Hansen	
Meter Technician			M. Hansen	
Other				
Transport of Train to Cleanup Site		1819-1840	Hansen, Vogel, Raja	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

(3)

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN P

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Bag-O-O-2
Sampling Date 10-20-80

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1 D. Vogel
2
3

Lab Technician 1 T. Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant PFIZER
Sampling Location Bag-o-0-9
Test No. 1

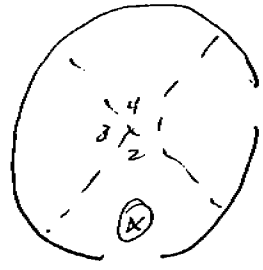
Date 10/20/80
Initial M.H. D.J.
corrections by MDH

Velocity head at sampling location, in. H_2O	ΔPs	~~.65~~	.31
Stack temperature at sample point, °F	Ts	~~295~~	290
Barometric pressure, in. Hg	Pb	29.10	
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	29.13	
Percent moisture in gas stream by volume	% H_2O	4.5	
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	Mf	.955	
Molecular wt. dry stack gas, lb/lb-mole (% CO_2 5.57 x 0.44) + (% O_2 5.33 x 0.32) + (% N_2 + % CO 19.74 x 0.28)	Md	30.649	
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.08	
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	~~3,174~~	2,219
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min (Fs = .49)	D_{n_c}	~~.168~~	.201
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	~~.529~~	.460
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	~~.351~~	.308

FIELD DATA - ANDERSEN

PLANT PF 125K
DATE 10/20/80
SAMPLING LOCATION Bag-0-0-2
SAMPLE TYPE Particulate
RUN NUMBER 0
OPERATOR Hansen - Voyel
AMBIENT TEMPERATURE 53
BAROMETRIC PRESSURE 29.10
STATIC PRESSURE, (P_s) +.44
Filter Set 2

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired)	~~.351~~ .308
Probe Tip Diameter	.195
CO_2	12.67
O_2	16.67
CO	0
N_2	70.5
% H_2O	4.5

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	1730	965.60									NA	NA
2-[redacted]	5	1735	967.94	967.24	.031	.32	.35	290	53	52	3		
	10	1740	968.68	968.81			.32		55	52	3		
	15	1745	970.22	—			.31		56	52	3		
	20	1750	971.76	971.84			.31		57	53	3		
	25	1755	973.30	—			.30		57	54	3		
	30	1800	974.84	974.93			.30		58	54	3		
	35	1805	976.38	976.45			.29		58	55	3		
	40	1810	977.92	977.96			.29		59	56	3		
	45	1815	979.46	979.47			.29		59	56	3		
	50	1820	981.00	980.98			.29		59	56	3		
	55	1825	982.54	982.51			.29		59	57	3		
	60	1830	984.08	984.04			.30		60	58	3		
	65	1835	985.62	985.56			.30		62	60	3		
	70	1840	987.16	987.15			.31		85	68	3		
	75	1845	988.70	988.73			.31		93	76	3		
	80	1850	990.24	990.34			.30		95	82	3		
	85	1855	991.78	991.90			.29		95	87	3		
	90	1900	993.32	993.39			.28		93	87	3		
			V_m = 27.792			ΔH =	~~.28~~ .30		67.3	1115-'18: 61.9			
									T_m =	64.62 / 64.67			

wind change intense heat

COMMENTS:

EPA (Dur) 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Bag-0-D-2
Test Number 0

Date 10-20-80
Initial D. Vogel

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $V_m = 27.792$ $\Delta H = .30$ $T_m = 64.67$	Vm_{std}	27.21
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.955
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	30.649
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.08
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.13
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2,219.0
Total sample time, minutes	θ	90
Nozzle diameter, inches	Dn	.195
$\frac{1{,}039\ (290 + 460)(27.21)}{(2.219)(90)(.955)(.955)(.195^2)}$	% I	100.37

90 29.13

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification Bag-0-9-2

Test Run Number 0

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-20-80	1730-1900	Vogel-Cobb	Ambient Temp. increased due to wind change on exhaust stacks.
Probe Technician			Vogel	
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site				
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

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MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Bag-0-1-1

MRI Project Number 4891-L(93)
Field Dates 10-21-80
Plant PFIZER
Sampling Location Bag
Sampling Date 10-21-8

FIELD CREW

Crew Chief Dick COBB

Testing Engineer 1 M. HANSEN
2
3

Engr. Technician 1 D. Vogel
2
3

Lab Technician 1 T. WALKER
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant PFIZER
Sampling Location Bag-O-1-1
Test No. 1

Date 10-21-80
Initial D.U.

Velocity head at sampling location, in. H_2O	ΔPs	.30
Stack temperature at sample point, °F	Ts	290
Barometric pressure, in. Hg	Pb	29.18
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.21
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	30.88
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.32
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	2168
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.204
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	.449
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)$ (Mf)	Fm	.301

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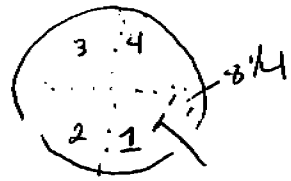
FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10-21-80
SAMPLING LOCATION Bag-0-1-1
SAMPLE TYPE Particul
RUN NUMBER 1
OPERATOR Ubgel / -?/
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 29.18
STATIC PRESSURE, (P_s) .144
Filter Set

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



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) .301
Probe Tip Diameter .195
CO_2
O_2
CO
N_2
% H_2O 4.35

Console #4

1615 START
Recd
1

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 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	1615 ~~747.266~~	747.266										
	5	1620	748.771	748.68	.30	.27	.25	290	60	60	4.5	NA	NA
	10	1625	750.27	750.07			.26		61	60	3.5		
	15	1630	751.78	751.40			.24		61	60	4		
	20	1635	753.28	752.93			.27		61	60	4		
	25	1640	754.79	—			.29		62	61	4		
	30	1645	756.29	755.77			.29		62	61	4		
	35	1650	757.80	757.60			.30		62	61	4		
	40	1655	759.30	759.15			.31		62	62	4		
	45	1700	760.81	760.77			.31		62	62	4		
	50	1705	762.31	762.37			.32		62	62	4		
	55	1710	763.82	763.98			.31		62	62	4		
	60	1715	765.32	765.57			.31		62	62	4		
	65	1720	766.83	767.15			.29		63	62	4		
	70	1725	768.33	768.64			.27		63	62	4		
	75	1730	769.84	770.02			.24		63	62	4		
	80	1735	771.34	771.33			.25		62	62	4		
	85	1740	772.85	772.73			.25		62	62	4		
	90	1745	774.35	774.18			.25		62	62	4		
	95	1750	775.86	775.70			.28		62	62	4		
	100	1755	777.36	777.26			.29		63	62	4		
1800	105	~~1760~~	778.87	778.89			.29		63	62	4		
1805	110	~~1770~~	780.37	780.31	MR	.27	.28		64	63	4		
1810	115	~~1775~~	781.875	781.62	MR		.28		64	63	4		

COMMENTS:

E-172

EPA (Our) 235
4 77

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
	120	1815	783.38	783.16	0.30	0.27	0.28	290	64	63	4	NA	NA
	125	1820	784.89	784.79	-	-	0.275		64	63	4		
	130	1825	786.39	786.21	-	-	0.275		64	63	4		
	135	1830	787.90	787.86	-	-	0.280		63	62	4		
	140	1835	789.40	789.21	-	-	0.28		63	62	4		
	145	1840	790.91	790.88	-	-	0.30		63	62	4		
	150	1845	792.41	792.43	-	-	0.29		62	62	4		
	155	1850	793.92	793.95	-	-	0.28		62	62	4		
	160	1855	795.42	795.46	-	-	0.27		62	62	4		
	165	1900	796.93	797.01	-	-	0.27		62	62	4		
	170	1905	798.43	798.42	-	-	0.25		62	62	4		
	175	1910	799.94	799.87	-	-	0.25		61	61	4		
	180	1915	801.44	801.34	-	-	0.26		60	60			
			801.440										
		END	Vm =	54.074			ΔH = .278		Tm = 62.0				

Run Number 1 Date 10-21-80 Sampling Location Bg-0-1-1

Comments:

EPA (Dun) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant PFIZER

Sampling Location Baghouse Outlet

Test Number Bag-0-1-1

Date 10-21-80

Initial NV

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 = 62.278, Pb = 29.18, Vm = 54.074, Tm+460 = 522	Vm_{std}	53.36
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.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	30.88
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.22
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.21
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2168
Total sample time, minutes	θ	180
Nozzle diameter, inches	Dn	.195
$\frac{1{,}039\ (290 + 460)(53.36)}{(2168)(180)(29.21)(.957)(.195^2)}$	% I	100.24

7

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN 2.1

MRI Project Number 4891-L(93)
Field Dates
Plant PETREK
Sampling Location Bag-O-P-2
Sampling Date 10-21-80

FIELD CREW

Crew Chief Dick Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1 D. Vogel
2
3

Lab Technician 1 T. Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant PFIZER
Sampling Location Bag-0-1-2
Test No. 2

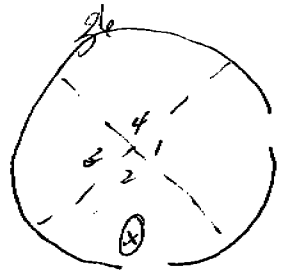
Date 10-21-80
Initial DH.

Velocity head at sampling location, in. H_2O	ΔPs	.31
Stack temperature at sample point, °F	Ts	290°
Barometric pressure, in. Hg	Pb	29.08
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	29.11
Percent moisture in gas stream by volume	% H_2O	4.35
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	Mf	.955
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	30.649
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	~~30.08~~ 30.07
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	~~22~~ ~~2319~~ ~~1236~~ 2220
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min FS = .490	D_{n_c}	.201
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	~~.459~~ .460
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	~~.304~~ .305

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10/21/80
SAMPLING LOCATION Bag-0-1-2
SAMPLE TYPE Particul
RUN NUMBER 2 1
OPERATOR Vogel
AMBIENT TEMPERATURE 50°
BAROMETRIC PRESSURE 29.08
STATIC PRESSURE, (P_s) + .44
Filter Set 3

Leak CK: Inital at 15" Hg, CFM N/A
Final at ____ Hg, CFM N/A



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired)	.305
Probe Tip Diameter	.195
CO_2	12.67
O_2	16.67
CO	0
N_2	70.5
% H_2O	4.35

8 1/4" inside
Grid. 2

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	0950 ~~994.~~	994.90										
	5	955	996.33	996.40	.38	.35	.35	290°	50	49	3	NA	NA
	10	1000	997.86	998.04			.34		52	49	3		
	15	1005	999.38	999.64			.32		53	50	3		
	20	1010	000.90	001.15			.29		54	50	3		
	25	1015	002.49	002.54			.26		54	52	3		
	30	1020	003.95	004.00			.25		54	52	3		
	35	1025	005.48	005.42			.29		54	52	4		
	40	1030	007.02	006.91			.29		54	52	4		
	45	1035	008.59	008.49			.30		55	53	4.5		
	50	1040	010.05	010.09			.31		56	54	4.5		
	55	1045	011.59	011.67			.30		56	54	5		
	60	1050	013.10	013.22			.36		56	54	5		
	65	1055	014.62	—			.36		56	54	5		
	70	1100	016.15	16.30			.29		55	54	5		
	75	1105	017.67	017.89			.29		56	54	5		
	80	1110	019.20	019.40			.28		56	54	5		
	85	1115	020.73	20.84			.25		56	54	5		
	90	1120	022.25	22.29			.25		56	54	5		
	95	1125	023.78	23.65			.25		55	53	5		
	100	1130	025.30	25.31			.22		56	54	5		
	105	1135	026.83	26.43			.25		56	55	5		
	110	1140	028.35	27.85			.26		56	56	5		
	115	1145	029.88	29.31			.27		56	56	6		
									1262.	1219			
									54.86	53.			

COMMENTS: Cont

EPA (Dur) 235
1 77

E-177

Cont

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
	120	1150	031.40	30.90	.31	.35?	.30	240	57	56	4	NA	NA
	125	1155	032.93	032.53			.35		57	54	6.5		
	130	1200	034.45	034.23			.37		57	54	6.5		
	135	1205	035.98	036.01			.37		58	56	7		
	140	1210	037.50	037.74			.34		58	56	6.5		
	145	1215	039.03	039.33			.30		60	58	6		
	150	1220	040.55	040.67			.28		60	58	6		
	155	1225	42.08	042.07			.27		59	58	5.5		
	160	1230	43.60	043.35			.30		58	58	6		
	165	1235	045.13	045.11			.30		59	58	6		
	170	1240	046.65	46.67			.30		59	58	6		
	175	1245	048.18	048.25			.30		59	58	6		
END RUN	180	1250	049.70	049.836			.29		59	58	6		
										~~57.84~~			
			V_m =	55.036		ΔH =	.286		T_m =	55.35			

Run Number Bag-0-1-2 Date 10-21-80 Sampling Location Baghouse Outlet

Comments:

EPA (Dun 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Rosen
Sampling Location Baghouse Outlet
Test Number Bag-0-1-2

Date 10-21-80
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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.08, Vm = 55.036, ΔH = .286, Tm+460 = 515.35	Vm_{std}	54.828
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 4.79	Mf	.952 ~~.955~~
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	30.649
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.04
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.11
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ Δp = .31, Cp = .84, Ts+460 = 750	Vs	2220
Total sample time, minutes	θ	~~90~~ 180
Nozzle diameter, inches	Dn	.195
$\frac{1{,}039\ (290 + 460)(54.828)}{(2220)(180)(29.11)(.952)(.195^2)}$ 54.820	% I	101.4

ANDERSEN PARTICLE SIZE ANALYSIS

Test No. Bag-0-1-2
Date 10-21-80
Time
Location Baghouse Outlet

Final Weights
By J.P. Date 10-22-80
Location ON-SITE LAB

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

PRES. 320.37 319.81

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	3-0	445.07	444.84				
1	3-1	404.76	404.45				
2	3-2	433.30	433.06				
3	3-3	424.90	424.72				
4	3-4	431.53	431.13				
5	3-5	425.97	425.41				
6	3-6	438.32	437.80				
7	3-7	503.89	503.59				
F	3-F	444.13	436.29				
			Total with filter				
			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-0-1-2

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-21-80	930 - 1250		
Probe Technician			D. Vogel	
Meter Technician			D. Vogel	
Other				
Transport of Train to Cleanup Site	10-21-80	1250-1315	D Vogel	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	10-23-80	3:00pm	JP.	
Write Up				

INPUT DATA FOR FILE BAG013(1)
TEST DATE - 12-3-80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - BAG-0-1-3-(2)

% WATER= 4.78
% CARBON DIOXIDE= 16.37
% CARBON MONOXIDE= 0.00
% OXYGEN= 11.97

ANDERSEN IMPACTOR WITH CYCLONE

STACK TEMPERATURE= 360.0 DEGREES F.
BAR. PRESSURE= 29.80 INCHES HG
STATIC PRESSURE= 0.44 INCHES H20
AVE. DELTA P= 0.34 INCHES H20
PITOT COEFF.= .84
METER TEMP.= 56.4 DEGREES F.
PROBE DIA.= 0.195 INCHES

SAMPLING TIME= 180.0 MIN.
PRESSURE DROP= 0.00 INCHES HG
SAMPLER TEMP. = 360.0 DEGREES F.
PARTICLE DENS= 1
METER VOL.= 61.230 CUBIC FEET
DELTA H= 0.37 INCHES H20

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.= 62.386 CU. FT.
SAMPLE VOL.-WET STD.= 65.518 CU. FT.
STACK VELOCITY= 2385.9 FT./MIN.
NOZZLE VELOCITY= 2734.8 FT./MIN.
MASS COLLECTED= 0.004 MG.
LOADING= 0.00000 GRAIN/SCF
LOADING(DRY)= 0.00000 GRAIN/SCF
RATE FOR 15 MICRON CYCLONE CUTOFF= 0.586 CU. FT/MIN

DRY MOLECULAR WT.= 31.10
WET MOLECULAR WT.= 30.47
% ISOKINETIC= 114.6
SAMPLING RATE-ACTUAL= 0.367 CU. FT/MIN
CYCLONE BLANK= 0.886 MG.
STAGE BLANK= 0.816 MG.
FILTER BLANK= 0.754 MG.

STAGE #	CYCLONE	0	1	2	3	4	5	6	7	FILTER
FINAL WT (MG)	485.03	447.22	452.08	482.98	462.28	431.99	427.47	433.96	452.81	433.80
TARE WT (MG)	484.14	446.76	451.61	482.45	461.69	464.72	460.24	467.08	486.17	494.28
NET WT (MG) CORRECTED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FRACTION % OF TOTAL	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CUM. % WITH FILTER	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
FRACTION % WITHOUT FILTER	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CUM. % WITHOUT FILTER	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
JET VEL. (CM/SEC)		0	44	81	136	225	399	966	1761	3522
D50 SIZE (MICRONS)		15.34	15.34	9.56	6.47	4.40	2.81	1.39	0.84	0.56	<0.56
DM/DLOGD (GRAINS/SCF)			0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	
GEO MEAN (MICRONS)			12.11	7.87	5.34	3.52	1.98	1.08	0.69	<0.69
PARTICLE COUNT			0.0D+00	0.0D+00	0.0D+00	0.0D+00	0.0D+00	0.0D+00	0.0D+00	

D50 FOR STAGE 0 EXCEEDS THE ESTIMATED CYCLONE D50 VALUE OF 15.31 MICRONS.

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

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Bag-0-1-2

MRI Project Number 4891 L 93
Field Dates 12-3-80
Plant Pfizer
Sampling Location Baghouse Outlet
Sampling Date 12-3-80

FIELD CREW

Crew Chief D. Cobb

Testing Engineer
1 D. Vogel
2 E. Olson
3

Engr. Technician
1
2
3

Lab Technician
1 Walker
2
3

Process Engineer
1
2

Other
1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Baghouse Outlet
Test No. Bag-0-1-3

Date 12-3-80
Initial D. Vogel / E. Olson

Velocity head at sampling location, in. H_2O	ΔPs	0.34
Stack temperature at sample point, °F	Ts	360
Barometric pressure, in. Hg	Pb	29.80
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.83
Percent moisture in gas stream by volume	% H_2O	5%
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	Mf	.95
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	31.08
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	26.57
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	2555.
Calculated nozzle diameter, in. $Fs = .56$ $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	0.200
Actual nozzle diameter, in.	D_{n_a}	0.195
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	0.56
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	0.341

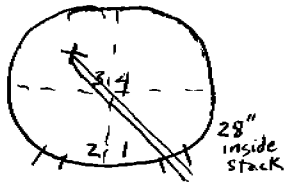
0.6

1.705 @ 5 min.
0.085 @ 15 sec,

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 12/3/80
SAMPLING LOCATION Baghouse Outlet
SAMPLE TYPE Particulate
RUN NUMBER Bag-O-81-3
OPERATOR D. Vogel / E. Olson
AMBIENT TEMPERATURE 30° F
BAROMETRIC PRESSURE 29.80
STATIC PRESSURE, (P_s) + 0.44
Filter Set ~~40~~ 39

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



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired)	0.341
Probe Tip Diameter	0.195
CO_2	16.3
O_2	12
CO	0
N_2	71.7
% H_2O	5.0 %

TRAVERSE POINT NUMBER Quadrant 3	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), m^3 Desired	GAS METER READING (V_m), m^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	1442	942.800										
	5	1447	944.51	944.41	.34	.31	.34	360	61	52	3	NA	NA
	10	1452	946.21	946.10		~~.34~~	.37		64	55	3		
1455↓	15	1501	947.92	947.76			.36		65	55	3		
1459↑	20	1506	949.62	949.41			.37		66	57	3		
	25	1511	951.33	951.26			.41		75	60	4		
1512↓	30	1518	~~1902~~ 953.03	952.91			.42		80	66	4		
1515↑	35	1524	954.74	954.65			.42		80	67	4		
	40	1529	956.44	956.46			.44		77	67	4		
	45	1534	958.15	958.25			.44		71	66	4		
1537↓	50	1541	959.85	960.04			.43		66	64	4		
1540↑	55	1546	961.56	961.76			.40		59	60	4		
	60	1551	963.26	963.41			.36		57	58	4		
	65	1556	964.97	965.02			.34		57	57	4		
1602↓	70	1601	966.67	966.62			.34		56	54	4		
1605↑	75	1608	968.38	968.22			.34		54	52	4		
	80	1614	970.08	969.85			.35		55	52	4		
	85	1619	971.79	971.57			.40		55	51	4		
	90	1624	973.49	973.35			.44		55	50	4		
1625↓	95	1631	975.20	975.25			.49		58	50	4		
1630↑	100	1636	976.90	977.15			.48		57	50	4		
	105	1641	978.61	978.91			.41		58	50	4		
	110	1646	980.31	980.50			.31		57	49	4		
	115	1651	982.02	981.88			.25		58	50	3		

74.62

E-185

COMMENTS:

EPA (Dur) 235
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
1653↓ 1655↑	120	1658	983.72	983.43		.31	.30	360	55	49	4	NA	NA
	125	1703	985.43	985.13			.40		56	50	4		
	130	1708	987.13	986.35			.40		58	49	4		
	135	1713	988.84	988.64			.46		59	49	4.5		
1717↓ 1719↑	140	1720	990.54	990.70		.48	~~.50~~	58	58	49	5		
	145	1725	992.25	992.39			.37		58	49	4		
	150	1730	993.95	994.02			.33		51	48	4		
	155	1735	995.66	995.69			.36		54	47	4		
1742↓ 1745↑	160	1740	997.36	997.34			.35		53	47	4		
	165	1748	999.07	999.04			.36		51	47	4		
	170	1753	1000.77	1000.72			.37		48	45	4		
	175	1758	1002.48	1002.37			.36		48	44	4		
	180	1803	1004.18	1004.033			.38		49	43	4		
									AVE	TM			
			61.23	VM		AVE ΔH	.37		56.4				

Run Number Bg-01-3 Date 12/3/80 Sampling Location Baghouse outlet

Comments:

EPA (Dori 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant PFIZER
Sampling Location Baghouse OUTLET
Test Number Bag-8-1-2

Date 12/3/80
Initial D. Vogel/E. Olson

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	360
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	62.491
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	31.08
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	26.57
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	29.83
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2555
Total sample time, minutes	θ	180
Nozzle diameter, inches	Dn	.195
$\frac{1{,}039\ (____ + 460)(____)}{(____)(____)(____)(____)(____^2)}$	% I	107.43

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 39

Test No. BAG-0-1-3
Date 12-3-80
Time
Location Baghouse Outlet

Final Weights
By DENT Date 12-4-80
Location JOB SITE LAB

Tare Weights
By JP Date 10-22-80
Location JOB SITE LAB

PRES. 485.03 484.14

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	39-0	447.22	446.76				
1	39-1	452.08	451.61				
2	39-2	482.98	482.45				
3	39-3	462.28	461.69				
4	39-4	431.99	464.72				
5	39-5	427.47	460.24				
6	39-6	433.96	467.08				
7	39-7	452.81	486.17				
F	39-F	433.80	494.28				
			Total with filter				
			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-0-1-3

Pollutant(s) in Sample Ambient-Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-3-80	1442-1803		
Probe Technician				
Meter Technician			Vogel/Olson	
Other				
Transport of Train to Cleanup Site	12-3-80	1805-1825	Vogel/Olson	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

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MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Bag-0-2-1

MRI Project Number 4891-L93
Field Dates
Plant Pfizer
Sampling Location Baghouse Outlet
Sampling Date 10-22-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Vogel
2
3

Engr. Technician 1 Hansen
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Bag-0-2-1
Test No. Two / Quad. 1

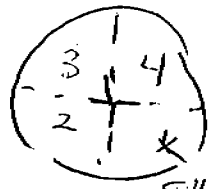
Date 10-22-80
Initial B.C.

Velocity head at sampling location, in. H_2O	ΔPs	.30
Stack temperature at sample point, °F	Ts	290
Barometric pressure, in. Hg	Pb	29.49
Static pressure in stack, in. Hg $P_s = +.44$ (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.52
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 $C_p = .84$ $5{,}128.8\ (Cp) \left(\sqrt{\Delta Ps}\right) \sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	2147
Calculated nozzle diameter, in. $Fs = .49$ $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.204
Actual nozzle diameter, in.	D_{n_a}	.195
Assumed meter temperature, °F	Tm	80
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.445
Calculated meter flow rate, ft^3/min $Fs \left(\frac{Tm+460}{Ts+460}\right) \left(\frac{Ps}{Pb}\right)$ (Mf)	Fm	.307

FIELD DATA - ANDERSEN

PLANT Cf-2a
DATE 10-22-80
SAMPLING LOCATION Baghouse-Outlet
SAMPLE TYPE Particulate
RUN NUMBER Bag-0-2-1
OPERATOR Vogel
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 29.49
STATIC PRESSURE, (P_s) +0.44
Filter Set 5 (?)

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



5 1/4" in stack

SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) .307
Probe Tip Diameter .195
CO_2 16.3
O_2 36 16.0
CO 30/2 0
N_2 67.7
% H_2O ≈ 4.3%

Console #4 pg 1 of 2

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	1605	938.200		.30								
	5	1610	939.74	939.74	.38	.30	.28	290	62	65	4	NA	NA
grad 1	10	1615	941.27	941.26		.28	.28		58	63	4		
	15	1620	942.81	942.75			.28		57	61	4		
	20	1625	944.34	944.34			.29		58	60	4		
	25	1630	945.88	945.87			.30		58	59	4		
	30	1635	947.41	947.40			.29		59	59	4		
	35	1640	948.95	948.95			.29		57	59	4		
	40	1645	950.48	950.48			.29		56	58	4		
	45	1650	952.02	952.01			.29		57	58	4		
	50	1655	953.55	953.55			.30		55	57	4		
	55	1700	955.09	955.09			.30		55	57	4		
3m	60	1705	956.62	956.60			.30		55	57	4		
	65	1710	958.16	958.17			.30		58	58	4		
	70	1715	959.69	959.69			.29		58	58	4		
	75	1720	961.23	961.21			.29		59	57	4		
	80	1725	962.76	962.75			.29		62	58	4		
	85	1730	964.30	964.21			.29		60	59	4		
	90	1735	965.83	965.83			.30		60	60	4		
	95	1740	967.37	967.32			.30		60	60	4		
	100	1745	968.90	969.93			.30		60	60	4		
	105	1750	970.44	970.40			.31		60	60	4		
	110	1755	971.97	971.95			.31		59	58	4		
	115	1800	973.51	973.52			.31		55	56	4		

COMMENTS: (505)

EPA (Dur) 235
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
2 hrs	120	1805	975.04	975.09	.30	.28	.31	290	54	55	4	NA	NA
	125	1810	976.58	976.52		1	.29		54	54	4		
	130	1815	978.11	978.03			.30		53	54	4		
	135	1820	979.65	979.55			.31		54	54	4		
	140	1825	981.18	981.12			.32		54	54	4		
	145	1830	982.72	982.72			.32		54	53	4		
	150	1835	984.25	984.24			.31		54	53	4		
	155	1840	985.79	985.79			.31		53	52	4		
	160	1845	987.32	987.26			.31		52	52	4		
	165	1850	988.86	988.87			.32		52	52	4		
	170	1855	990.39	990.34			.31		52	52	4		
	175	1900	991.93	991.93			.31		52	52	4		
E 110	180	1905	993.46	993.400			.30		52	52	4		
							ΔH AVE .29		AVE Temp	58.18			
			TOTAL Volume 55.2										

Run Number Bay-0-2-1 Date 10-22-80 Sampling Location Baghouse-Outlet

Comments:

EPA (Dur) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pf.-2cu
Sampling Location Baghouse - Outlet
Test Number Bag - 0 - 2 - 1

Date 10-22-80
Initial PV

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	55.4
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.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
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.68
Static pressure in stack, absolute, in. Hg (Pb) $\pm$ (0.074 x stack gage pressure, in H_2O)	Ps	29.52
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	2147
Total sample time, minutes	θ	180
Nozzle diameter, inches	Dn	.195
$\frac{1{,}039\ (290 + 460)(55.4)}{(2147)(180)(29.52)(.957)(.195^2)}$	% I	103.9

SAMPLE HANDLING LOG

Project Number 4891-L93

Source Identification Baghouse Outlet

Test Run Number Bag-O-2-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-22-80	1605-1905		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-22-80	1905-1920	Vogel	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

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MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Bag-0-2-2

MRI Project Number 4891-L93
Field Dates
Plant Pfizer
Sampling Location Baghouse - Outlet
Sampling Date 10/22/80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Vogel
2
3

Engr. Technician 1 Hansen
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant PFIZER
Sampling Location Bag - OUTLET
Test No. Bag-0-2-2

Date 10-22-80
Initial D. Vogel

Velocity head at sampling location, in. H_2O	ΔPs	.31
Stack temperature at sample point, °F	Ts	290
Barometric pressure, in. Hg	Pb	29.48
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O) .44 .44	Ps	29.51
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) 6.35 4.53 19.97	Md	30.88
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf) 29.55	Ms	30.32
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	2196
Calculated nozzle diameter, in. Fs = .49 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.202
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	.455
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.302

1.5

1.5 x

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10-22-80
SAMPLING LOCATION Bag outlet
SAMPLE TYPE Particulate
RUN NUMBER Bag-0-2-2
OPERATOR Hoge
AMBIENT TEMPERATURE 55°
BAROMETRIC PRESSURE 29.48
STATIC PRESSURE, (P_s) 4.44
Filter Set 4

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

8 1/4" in Stack

SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired)	.302
Probe Tip Diameter	.195
CO_2	14.5
O_2	14.17
CO	0
N_2	71.33
% 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
Quad #2	0	1115	188.675								pg 1 of 2		
	5	1120	190.19	190.02	.30	.27	.28	290	77	75	3	NA	NA
	10	1125	191.70	191.41			.27		77	75	3		
	15	1130	193.21	192.93			.30		76	74	3		
	20	1135	194.72	194.44			.30		77	74	3		
	25	1140	196.23	195.97			.30		75	72	3		
	30	1145	197.74	197.49			.30		69	70	3		
	35	1150	199.25	199.01			.30		65	70	3		
	40	1155	200.76	200.52			.30		64	67	3		
	45	1200	202.27	202.04			.30		68	66	3		
	50	1205	203.78	203.55			.30		75	69	3		
	55	1210	205.29	205.05			.30		78	70	3		
	60	1215	206.80	206.58			.30		84	75	3		
	65	1220	208.31	208.13			.30		84	78	3		
	70	1225	209.82	209.61			.30		83	78	3		
	75	1230	211.33	211.18			.30		88	80	3		
	80	1235	212.84	212.64			.30		89	83	3		
	85	1240	214.35	214.21			.30		88	84	3		
	90	1245	215.86	215.80			.32		96	83	3		
	95	1250	217.37	217.37			.31		83	84	3		
	100	1255	218.88	218.88			.29		100	86	3		
	105	1300	220.39	220.40			.29		102	92	3		
	110	1305	221.90	221.91			.29		99	95	3		
	115	1310	223.405	223.40			.29		99	95	3		
			cont	cont									

COMMENTS:

EPA (Dur) 235
4 72

1195

pg 2 of 2

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
	120	1315	224.92	224.94	.31	.27	.29	290	99	94	3	NA	NA
	125	1320	226.43	226.43			.28		98	94	3		
	130	1325	227.94	227.96			.27		98	95	3		
	135	1330	229.45	229.39			.27		101	96	3		
	140	1335	230.96	230.94			.27		102	97	3		
	145	1340	232.47	232.43			.27		94	95	3		
	150	1345	233.98	233.95			.27		85	92	3		
	155	1350	235.49	235.47			.28		84	88	3		
	160	1355	237.00	236.98			.27		94	89	3		
	165	1400	238.51	238.51			.28		98	92	3		
	170	1405	240.02	240.04			.28		96	92	3		
	175	1410	241.53	241.55			.27		100	94	3		
	180	1415	243.035	243.042			.27		98	92	3		
			V_m = 54.367			avg	.2892		T_m = 85.24				

Run Number 2

Date 10-22-80

Sampling Location Burg Outlet

Comments: Panel 2

Console 3 #

EPA (Dun) 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Baghouse - Outlet
Test Number Bag - O - 2 - 2

Date 10-22-80
Initial GC

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .289$ $Pb = 29.48$ $Tm+460 = 545.24$ $Vm = 54.367$	Vm_{std}	51.89
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 4.05$	Mf	.96
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	31.253
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	30.72
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	29.51
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .31$ $Cp = .84$ $Ts+460 = 750$	Vs	2182
Total sample time, minutes	θ	180
Nozzle diameter, inches	Dn	.195
$\frac{1{,}039\,(290 + 460)(51.89)}{(2182)(180)(29.51)(.96)(.195^2)}$	% I	95.57

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-~~6~~-4

MRI Project Number 4891-L (93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date ~~[illegible]~~ 12-8-80

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

This Test Re-run because of faulty filter holder. RCS

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 12-8-80

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

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	29.05
STATIC PRESSURE IN STACK, in. Hg −.38" H_2O (P_m ±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	29.02
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	637
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.108
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	.93	
CALCULATED NOZZLE DIAMETER, in.	.438	
ACTUAL NOZZLE DIAMETER, in.	.501	
REFERENCE Δp, in. H_2O	.062	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 12-8-80
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

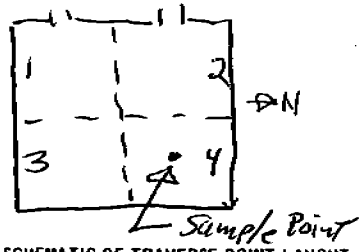
Ts = Stack temperature, °F

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	29.05
$\frac{5.168\ (65 + 460)\ (.84)\ (3)\ (.94)\ (.501^2)}{\sqrt{29.05}}$	K	299.30

FIELD DATA

PLANT: Pfizer
DATE: 12-8-80
SAMPLING LOCATION: ESP Inlet
SAMPLE TYPE: Mass
RUN NUMBER: ESP-I-4-4
OPERATOR: RCS
AMBIENT TEMPERATURE: 60
BAROMETRIC PRESSURE: 29.05
STATIC PRESSURE, (P_s): -.38" H_2O
FILTER NUMBER (s): 99

View From Gate Valve



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE: 4' SS
NOZZLE I.D.: .501
ASSUMED MOISTURE, %: 6
SAMPLE BOX NUMBER: 12
METER BOX NUMBER:
METER $\Delta H_@$: 1.84
C FACTOR: .93
PROBE HEATER SETTING: 80
HEATER BOX SETTING: 280
REFERENCE Δp: .062

Leak CK: Initial at 15" Hg, CFM .002
Final at Hg, CFM

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 299.3 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK) 1324	GAS METER READING (V_m), ft^3 338,280 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
ESP-I-4-4	3	1327	341.43	341.20	0.12	3.5	3.8	620	62	60	8		
	6	1330	344.31	344.40	0.10	2.8	3.3	620	66	60	7		
	9	1333	346.78	346.75	0.09	3.35	3.5	670	68	60	8		
	12	1336	349.37	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	70	60	7		
	15	1339									6		
				351.520	0.06	1.8	2.1	675	70	60			
					.088 avg			644.8 avg					

COMMENTS:

351.520

EPA Form 235

FILE NAME - ESPI441
RUN # - ESP-I-4-4-(1)
LOCATION - PFZIER
DATE - 10-30-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC FEET)=	843.969
FINAL METER VOLUME (CUBIC FEET)=	858.482
METER FACTOR= 1.001	
NET METER VOLUME (CUBIC FEET)=	14.528
GAS VOLUME (DRY STANDARD CUBIC FEET)=	15.309
BAROMETRIC PRESSURE (IN. HG)=	29.55
STATIC PRESSURE (INCHES H20)=	-0.38
PERCENT OXYGEN=	8.77
PERCENT CARBON DIOXIDE=	18.83
MOISTURE COLLECTED (ML)=	23.7
PERCENT WATER=	6.80
AVERAGE METER TEMPERATURE (F.)=	39.1
AVERAGE DELTA H (IN. H20)=	3.60
AVERAGE DELTA P (IN. H20)=	0.11
AVERAGE STACK TEMPERATURE (F.)=	621.0
DRY MOLECULAR WEIGHT=	31.364
WET MOLECULAR WEIGHT=	30.455
AVERAGE SQUARE ROOT OF DELTA P (IN. H20)=	0.3317
% ISOKINETIC=	105.9
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)=	1,567
FLOW RATE (ACTUAL, CUBIC FEET/MIN)=	20,564
FLOW RATE (STANDARD, WET, CUBIC FEET/MIN)=	9,910
FLOW RATE (STANDARD, DRY, CUBIC FEET/MIN)=	9,818

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	1.9466
PARTICULATE LOADING, DRY STD. (GR./SCF)=	1.9582
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.8792
EMISSION RATE (LB/HR)=	164.76

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	1.9466
PARTICULATE LOADING, DRY STD. (GR./SCF)=	1.9582
PARTICULATE LOADING, ACTUAL (GR./CU. FT.)=	0.8792
EMISSION RATE (LB/HR)=	164.76
PERCENT IMPINGER CATCH=	0.0

* * METRIC UNITS * *

FILE NAME - ESPI441
RUN # - ESP-I-4-4-(1)
LOCATION - PFZIER
DATE - 10-30-80
PROJECT # - 4891-L93

INITIAL METER VOLUME (CUBIC METERS)=	23.898
FINAL METER VOLUME (CUBIC METERS)=	24.309
METER FACTOR= 1.001	
NET METER VOLUME (CUBIC METERS)=	0.411
GAS VOLUME (DRY STANDARD CUBIC METERS)=	0.433
BAROMETRIC PRESSURE (MM HG)=	750.57
STATIC PRESSURE (MM H2O)=	-9.7
PERCENT OXYGEN=	8.77
PERCENT CARBON DIOXIDE=	18.83
MOISTURE COLLECTED (ML)=	23.7
PERCENT WATER=	6.80
AVERAGE METER TEMPERATURE (C.)=	3.9
AVERAGE DELTA H (MM H2O)=	91.4
AVERAGE DELTA P (MM H2O)=	2.8
AVERAGE STACK TEMPERATURE (C.)=	327.2
DRY MOLECULAR WEIGHT=	31.364
WET MOLECULAR WEIGHT=	30.455
AVERAGE SQUARE ROOT OF DELTA P (MM H2O)=	1.6715
% ISOKINETIC=	105.9
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)=	478
FLOW RATE (ACTUAL, CUBIC M/MIN)=	582
FLOW RATE (STANDARD, WET, CUBIC M/MIN)=	281
FLOW RATE (STANDARD, DRY, CUBIC M/MIN)=	278

PARTICULATE LOADING - PARTIAL CATCH

PARTICULATE WEIGHT (G)=	1.9466
PARTICULATE LOADING, DRY STD. (G/CU. M)=	4.4906
PARTICULATE LOADING, ACTUAL (G/CU. M.)=	2.0163
EMISSION RATE (KG/HR)=	74.80

PARTICULATE LOADING - TOTAL CATCH INCLUDING IMPINGERS

PARTICULATE WEIGHT (G)=	1.9466
PARTICULATE LOADING, DRY STD. (G/CU. M)=	4.4906
PARTICULATE LOADING, ACTUAL (G/CU. M)=	2.0163
EMISSION RATE (KG/HR)=	74.80
PERCENT IMPINGER CATCH=	0.0

FILE NAME - ESPI441
RUN # - ESP-I-4-4-(1)
LOCATION - PFZIER
DATE - 10-30-80
PROJECT # - 4891-L93

POINT #	DELTA P (IN. H20)	DELTA H (IN. H20)	STACK T (F.)	METER T. IN(F.)	OUT(F.)
1	0.11	3.50	625	32	32
2	0.11	3.50	630	39	32
3	0.11	3.60	625	45	35
4	0.11	3.70	625	50	35
5	0.11	3.70	600	55	36

FRACTION	FINAL WT. (G)	TARE WT. (G)	BLANK WT. (G)	NET WT. (G)
DRY CATCH	0.0000	0.0000	0.0000	0.0000
FILTER	0.9039	0.7800	0.0030	0.1209

FRACTION	FINAL WT. (G)	TARE WT. (G)	VOL. (ML)	NET WT. (G)
PROBE RINSE	86.9812	85.1464	330.0	1.8257
IMPINGERS	0.0000	0.0000	0.0	0.0000

PROBE RINSE BLANK (MG/ML)= .0275926
IMPINGER BLANK (MG/ML)= 0

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-4-4

MRI Project Number 4891-L-93
Field Dates 10-30-80
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-30-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whited
2
3

Engr. Technician 1 Stutz
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 10-30-80

SAMPLING LOCATION ESP Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	45
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.55
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.52
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.999
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	650
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.1
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.95	
CALCULATED NOZZLE DIAMETER, in.	0.445	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.062	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-30-80
Initial CW

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

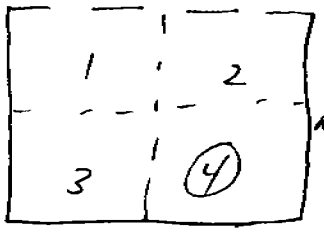
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	45
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.501
Barometric pressure, inches Hg	Pb	29.55
$\frac{5.168\ (45 + 460)\ (.84)\ (3)\ (.95)\ (.501^2)}{\sqrt{29.55}}$	K	288.5

FIELD DATA

PLANT Pfizer
DATE 10-30-80
SAMPLING LOCATION ESP - Inlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-I-4-4
OPERATOR Winfield
AMBIENT TEMPERATURE 25°F
BAROMETRIC PRESSURE 29.55
STATIC PRESSURE, (P_s) -0.38
FILTER NUMBER (s) 340



PROBE LENGTH AND TYPE 35"
NOZZLE I.D. 0.581
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.95
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 0.062

Leak CK: Initial at 15" Hg, CFM 0.000
Final at Hg, CFM 0.000

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 288.5 \times \sqrt{\frac{Ps}{Ts + 460}}$

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 / 0854	843.969										
	3 / 0857	846.87	846.73	0.11	3.4	3.5	625	32	32	11		
	6 / 0900	849.77	849.60	0.11	3.4	3.5	630	39	32	11	250	
	9 / 0903	852.67	852.47	0.11	3.4	3.6	625	45	35	11	230	
	12 / 0906	855.57	855.42	0.11	3.4	3.7	625	50	35	14	245	60
	15 / 0909	858.51	858.48	0.11	3.4	3.7	600	55	36	15	245	
		Final = 858.482										
		Vm = 14.513				ΔH = 3.6			Tm = 39.1			
				ΔP = .11			Ts = 621					
			14.513	0.11		3.44						

COMMENTS

EPA :Durr 235

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-30-80
Initial GO

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	621
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 3.6$, $Pb = 29.55$, $Vm = 14.513$, $Tm + 460 = 499.1$	Vm_{std}	15.293
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 6.85$	Mf	.932
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	31.391
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.48
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) $Ps = .38$	Ps	29.58
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P = .11$, $Cp = .84$	Vs	1565
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (621 + 460)(15.293)}{(1565)(15)(29.58)(.932)(.501^2)}$	% I	105.7

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP - I - 4 - 4
Sample Date 10 - 30 - 80
Recovery Date
Cleanup Person

Filter No. 40
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/	110	106	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	10	6	2		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 23.7

SILICA GEL

675.7	
670.0	
5.7	

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. 71
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. 90
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-E-4-4

Run No. _____

MIDWEST RESEARCH INSTITUTE

PARTICULATE CLEAN-UP AND ANALYSIS

Date 10 _____ 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					
71		5	86.98116	85.14635	330		
	40	6	0.90387	0.78000			
		6					
		6					
		7					
		8					
		9					
90		10	91.46781	91.40483	108		

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- 4-4

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	0854-0909		
Probe Technician				
Meter Technician			Whited	
Other				
Transport of Train to Cleanup Site	10-30-80	0910-0930	Rojo, Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

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MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-1-1

MRI Project Number 4891-L (93)
Field Dates
Plant Pfizer
Sampling Location ~~10-30-80~~ ESP Inlet
Sampling Date 10-30-80

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-1-1 DATE 10-30-80

Flue Gas Temperature 613 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.47 " Hg

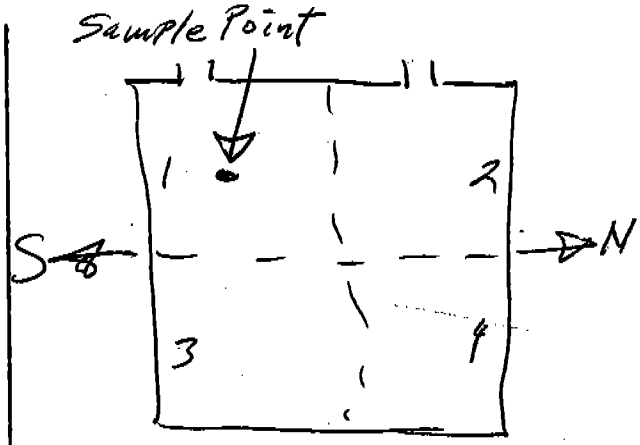
Sample Time 4 min

Probe Tip Diameter .165 "

Velocity at Sample Point 1410 FPS

Sample Rate .106 CFM

ΔP_s = .09



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .085 at 1436 Filter Set 24

Gas Composition

CO_2 _____ N_2 _____

O_2 _____ H_2O 6%

CO _____

M_d = 31.40 Preheat Started - 1348

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1442	2.65	2.65	66	Start	0
1443		2.65	66		.060
1444		2.65	66		.116
1445		2.65	67		.173
1446		2.65	67	STOP	.231

ISOKINETIC PERFORMANCE WORKSHEET

Plant: Pfizer
Sampling Location: ESP Inlet
Test Number: ESP-I-2-1

Date: 10-30-80
Initial: _____

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	613
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.47, Vm = .231, Tm = 66.6	Vm_{std}	.228
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 $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	29.44
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\frac{\sqrt{\Delta Ps_{avg}}}{.085}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	1371
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\,(613 + 460)(.228)}{(1371)(4)(29.44)(.94)(.115^2)}$	% I	126.6

SAMPLE HANDLING LOG

Project Number 4881-2(93)

Source Identification ESP Inlet

Test Run Number ESP-I-1-1

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1442-1446		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-30-80	1450	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

53

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-1-3

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

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

Brinks Loaded Wrong

MRI - Form PO (10/72)

BRINKS DATA SHEET

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

Filter Set #16

Flue Gas Temperature 633 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.27 " Hg

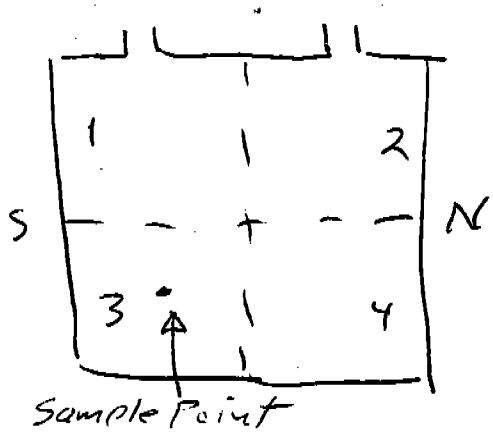
Sample Time 4 min

Probe Tip Diameter .115

Velocity at Sample Point 1065 FPS

Sample Rate .080 CFM

$\Delta P_{s\,avg}$ = .05" Hg



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP = .055" H_2O at 1607

Gas Composition

CO_2 _____ N_2 _____

O_2 _____ H_2O 6%

CO _____

Preheat Start – 1544

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1616	1.31	1.3	78	Start	0
1617		1.3	78		.040
1618		1.3	78		.073
1619		1.3	78		.119
1620		1.3	78	Stop	.152

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}	633
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb=29.27 Tm=78 Vm=.152	Vm_{std}	.146
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	29.24
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P_s = .055$	Vs	1117
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (633 + 460)(.146)}{(1117)(4)(29.24)(.94)(.115^2)}$	% I	102.1

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Inlet

Test Run Number ESP-I-1-3

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1616-1620		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-28-80	1640	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

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MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-1-3

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

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

Now Iso-kinetics

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

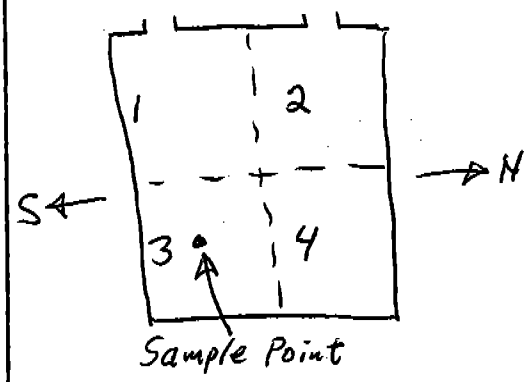
Sample Time 4 min

Probe Tip Diameter .116

Velocity at Sample Point 1365 FPS

Sample Rate .103 CFM

ΔPs at sample Point = .08



Schematic of Traverse Point Layout with Dimensions

Pitot ΔPs at 0902 = 0.05 " H_2O

Gas Composition

CO_2 _____ N_2 _____

O_2 _____ H_2O 6 %

CO _____

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.
0952	2.27	2.20	84	Start	0
0953		2.20	84		.093
0955		2.20	84		.148
0956		2.20	84	Stop	.194

ISOKINETIC PERFORMANCE WORKSHEET

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

Date: 10-28-80
Initial: BCS

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ (.198, 29.19, 84)	Vm_{std}	.187
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	30.46
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	29.31
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ (.05)	Vs	1079 1365
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\,(660 + 460)(.187)}{(1079)(4)(29.31)(.94)(.116^2)}$	% I	~~135.9~~ 136.0

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Task	Da
Sampling	10-28
Probe Technician	
Meter Technician	
Other	
Transport of Train to Cleanup Site	10-28
Train Disassembly	
Train Cleanout	
Packing and Storage	
Shipment to Analysis Site	
Lab Analysis	
Write Up	

INPUT DATA FOR FILE ESPI24

TEST DATE - 12-8-80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - ESP-I-2-4 (2)

% WATER= 6.00
% CARBON DIOXIDE= 20.77
% CARBON MONOXIDE= 0.00
% OXYGEN= 12.13

BRINK IMPACTOR WITH CYCLONE

STACK TEMPERATURE= 645.0 DEGREES F.
BAR. PRESSURE= 29.05 INCHES HG
STATIC PRESSURE= -0.38 INCHES H20
AVE. DELTA P= 0.09 INCHES H20
PITOT COEFF.= .84
METER TEMP.= 62.0 DEGREES F.
PROBE DIA.= 0.116 INCHES

SAMPLING TIME= 4.2 MIN.
PRESSURE DROP= 2.20 INCHES HG
SAMPLER TEMP. = 645.0 DEGREES F.
PARTICLE DENS= 1
METER VOL.= 0.218 CUBIC FEET
DELTA H= 0.00 INCHES H20

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.= 0.214 CU. FT.
SAMPLE VOL.-WET STD.= 0.228 CU. FT.
STACK VELOCITY= 1416.8 FT./MIN.
NOZZLE VELOCITY= 1605.7 FT./MIN.
MASS COLLECTED= 11.202 MG.
LOADING= 0.75930 GRAIN/SCF
LOADING(DRY)= 0.80777 GRAIN/SCF

DRY MOLECULAR WT.= 31.81
WET MOLECULAR WT.= 30.98
% ISOKINETIC= 113.3
SAMPLING RATE-ACTUAL= 0.118 CU. FT/MIN
CYCLONE BLANK= -0.767 MG.
STAGE BLANK= 0.163 MG.
FILTER BLANK= -0.810 MG.

STAGE #	CYCLONE	1	2	3	4	5	FILTER
FINAL WT (MG)	233.65	421.97	348.16	420.67	337.26	413.07	264.72
TARE WT (MG)	227.97	419.97	346.07	420.01	336.99	412.52	265.63
NET WT (MG) CORRECTED	6.45	1.84	1.93	0.50	0.11	0.39	0.00
FRACTION % OF TOTAL	57.55	16.40	17.20	4.44	0.96	3.45	0.00
CUM. % WITH FILTER	57.55	73.95	91.15	95.59	96.55	100.00	100.00
FRACTION % WITHOUT FILTER	57.55	16.40	17.20	4.44	0.96	3.45	
CUM. % WITHOUT FILTER	57.55	73.95	91.15	95.59	96.55	100.00	
JET VEL. (CM/SEC)	0	1142	2248	3634	7913	13252	
D50 SIZE (MICRONS)	7.00	4.02	2.35	1.58	0.80	0.48	<0.48
DM/DLOGD (GRAINS/SCF)		0.51779	0.55807	0.19654	0.02456	0.11870	
GEO MEAN (MICRONS)		5.31	3.07	1.93	1.13	0.62	<0.62
PARTICLE COUNT		1.2D+07	2.2D+07	1.3D+07	2.7D+06	2.4D+07	

THE CYCLONE D50 VALUE IS ASSUMED TO BE 7 MICRONS.

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-2-4

MRI Project Number 4898-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 12-8-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stutz
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

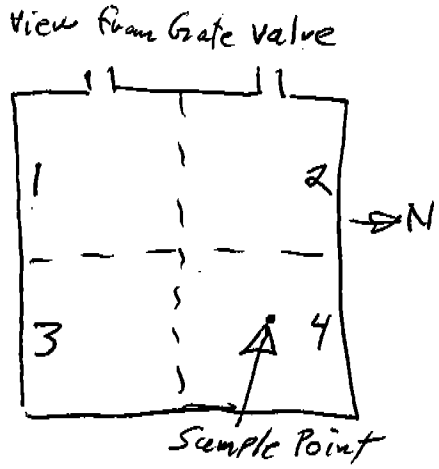
Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. ESP-I-2-4 DATE 12-8-80

Flue Gas Temperature	645	°F
Static Pressure	-.38	" H_2O
Barometric Pressure	29.05	" Hg
Sample Time	4.17	min
Probe Tip Diameter	.116	
Velocity at Sample Point	1417	FPS
Sample Rate	.107	CFM



Schematic of Traverse Point Layout with Dimensions

ΔP_s = .088 at 1333

Gas Composition

CO_2	20.77	N_2	67.10
O_2	12.13	H_2O	6 %
CO	0		

M_d = 31.81

Preheat Started 1430

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Meter Temp.	Comments	Meter Vol.
1445	2.2	2.2	62	Start	0
1446		2.2	62		.051
1447		2.2	62		.106
1448		2.2	62		.154
1449:10		2.2	62	Stop	.218

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Inlet
Test Number ESP-E-2-4

Date 12-8-80
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}	645
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb=29.05 Vm=.218 Tm=62	Vm_{std}	.214
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	31.44
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.63
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.02
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\frac{\sqrt{\Delta Ps_{avg}}}{.088}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	1425
Total sample time, minutes	θ	4.17
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\ (645 + 460)(.214)}{(1425)(4.17)(29.02)(.94)(.116^2)}$	% I	112.6

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Run No. _____ BRINK Date _____

MRI Project No. _____ Particle Size Analysis Recorded by _____

ANALYSIS

Final Weights	Tare Weights
By: JP Date: Dec 9, 1980	By: JP Date: Nov. 7, 1980
Location: Job Site Lab	Location: Job Site Lab

Filter Set # 43

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	43-C	.23365	.22797	.00568	* **	* **	
1	43-1	.42197	.41997	.00200			
2	43-2	.34816	.34607	.00209			
3	43-3	.42067	.42001	.00066			
4	43-4	.33726	.33699	.00027			
5	43-5	.41307	.41252	.00055			
Filter	43-F	.26472	.26563	.00091			
			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-~~3~~2-4

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	12-8-80	1445-1449:10		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	12-8-80	1455	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site	~~12-8-80~~		~~J. Pavelonis~~	~~Job Site Lab~~
Lab Analysis	12-8-80		J. Pavelonis	Job Site Lab
Write Up				

91

MIDWEST RESEARCH INSTITUTE

RUN ESP-0-1-4

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP-Outlet
Sampling Date 10-30-80

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 10-30-80

SAMPLING LOCATION ESP-Outlet -1-4

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	50
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.47
STATIC PRESSURE IN STACK, in. Hg +0.52 (P_m ±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	29.51
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	485
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.13
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.93	
CALCULATED NOZZLE DIAMETER, in.	.40	
ACTUAL NOZZLE DIAMETER, in.	.374	
REFERENCE Δp, in. H_2O	.168	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-O-1-4

Date 10-30-80
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

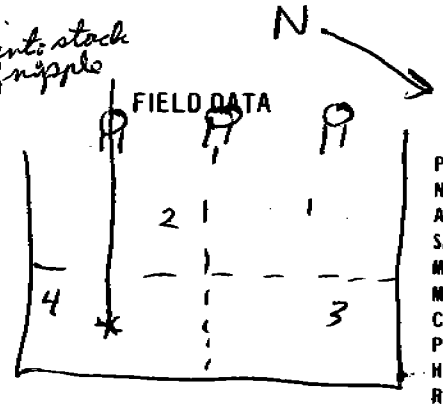
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	50
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.94
Nozzle diameter, inches	Dn	.374 #34
Barometric pressure, inches Hg	Pb	29.47
$\frac{5.168\ (50 + 460)\ (.84)\ (3)\ (.94)\ (.374^2)}{\sqrt{29.47}}$	K	160.87

33.25" into stack from top of nipple

FIELD DATA

PLANT Pfizer
DATE 10-30-80
SAMPLING LOCATION ESP-Outlet
SAMPLE TYPE MASS
RUN NUMBER ESP-O-1-4
OPERATOR M. Hansen
AMBIENT TEMPERATURE 45°F
BAROMETRIC PRESSURE 29.47
STATIC PRESSURE, (P_s) +0.52
FILTER NUMBER (s) 850



PROBE LENGTH AND TYPE 4ft, S.S.
NOZZLE I.D. .374
ASSUMED MOISTURE, % 6.0
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .93
PROBE HEATER SETTING 100°F
HEATER BOX SETTING 550°F
REFERENCE Δp .168

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

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 160.87 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 947.70 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
Quad 4	0 / 1410											
	3 / 1413	949.80	949.85	.16	1.8	1.90	483	50	47	9.5	165 a/	50
	6 / 1416	951.83	951.93	.15	1.7	1.70	480	53	47	8.5	—	—
	9 / 1419	953.86	953.93	.15	1.7	1.60	479	54	48	8.0	154 a/	52
	12 / 1422	955.93	955.90	.155	1.7	1.60	472	56	48	8.0	172 a/	—
	15 / 1425	957.97	957.92	.150	1.7	1.65	476	58	49	8.0	185	58
	18 / 1428	960.00	959.97	.15	1.7	1.70	483	59	50	8.5	184	—
	21 / 1431	962.04	962.01	.15	1.7	1.70	472	60	50	8.5	193	60
	24 / 1434	964.07	964.05	.15	1.7	1.70	480	60	51	8.5	157 a/	60
	27 / 1437	966.15	966.10	.155	1.7	1.70	470	60	51	10.0	200	61
	30 / 1440	968.19	968.19	.15	1.7	1.75	477	62	52	10.0	217	62
				ΔP=.152	ΔH=	1.7	T_s=477.2	T_m=	53.25			
		V_m=20.49							0.85			

COMMENTS a/ Short in Sample Box giving false Temp. readings.

EPA (Dun 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP-Outlet
Test Number ESP-O-1-4

Date 10-30-80
Initial GC

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	477.2
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1.7$ $Pb = 29.47$ $Vm = 20.49$ $Tm+460 = 513.3$	Vm_{std}	20.84
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 4.38$	Mf	.956
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	31.14
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	~~28.97~~ 30.56
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) $P_s = +.52$	Ps	29.51
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .152$ $C_p = .84$	Vs	1712
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.374
$\frac{1{,}039\ (477.2 + 460)(20.84)}{(1712)(30)(29.51)(.956)(.374^2)}$	% I	100.1

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-O-1-4
Sample Date 10-30-80
Recovery Date
Cleanup Person

Filter No. 50
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/	114	110	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	14	10	1		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 20.2

SILICA GEL

667.00
661.80
5.20
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.
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. 90
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:

SAMPLE HANDLING LOG

Project Number 4891-L93

Source Identification ESP-Outlet

Test Run Number ESP-O-1-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1410-1440		
Probe Technician				
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	10-30-80	1440-1500	Hansen, Raja	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

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MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-B-1-1

MRI Project Number 45
Field Dates 10/28/80
Plant Pfizer
Sampling Location ESP outlet
Sampling Date 10/28/80

FIELD CREW

Crew Chief E Cobb

Testing Engineer 1 Vogel
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)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location ESP outlet
Test No. ESP-0-1-1

Date 10/28/80
Initial D. Vogel

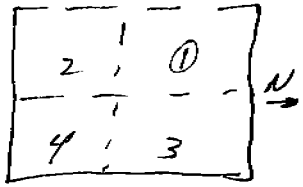
Velocity head at sampling location, in. H_2O	ΔPs	.14
Stack temperature at sample point, °F	Ts	490
Barometric pressure, in. Hg	Pb	29.20
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O) ,52	Ps	29.23
Percent moisture in gas stream by volume	% H_2O	6.0
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	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	31.37
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.57 ~~31.84~~
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1662 ~~1628~~
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min ,70	D_{n_c}	.280 ~~.281~~ ~~.325~~
Actual nozzle diameter, in.	D_{n_a}	.330
Assumed meter temperature, °F	Tm	50
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.986
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.498

14.6 min

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10/28/80
SAMPLING LOCATION ESP - outlet
SAMPLE TYPE Partical
RUN NUMBER ESP-0-J-1
OPERATOR Vogel
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 29.20
STATIC PRESSURE, (P_s) -1.52
Filter Set ~~[illegible]~~ 13

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired) .498
Probe Tip Diameter .330
CO_2
O_2
CO
N_2
% H_2O 6.0

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
Load	0	1006	189.399										
1	3	1009	190.893	190.73	.14	.73	.75	496	42	42	3	NA	NA
	6	1012	192.357	192.17			.77		44	43	3.5		
	9	1015	193.881	193.57			.78		47	44	3.5		
	12	1018	195.375	195.06			.90		51	45	4		
	15	1021	196.569	196.724			.80		51	45	4		
							.78						
			Vm = 7.327				(ave ΔH_s)		45.4				
									AVE Tm				

COMMENTS

EPA (Dur) 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant PFIZER
Sampling Location ESP outlet
Test Number ESP-0-1-1

Date 10-28-80
Initial D. Dogel

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	490
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	7.48
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	31.37
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.57
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.23
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$	Vs	1662
Total sample time, minutes	θ	~~45~~ 14.6
Nozzle diameter, inches	Dn	.330
$\frac{1{,}039\ (490 + 460)(7.48)}{(1662)(14.6)(29.23)(.94)(.330^2)}$	% I	101.68

ANDERSEN PARTICLE SIZE ANALYSIS

Filter Set # 13

ESPO-1-1 (1)

Test No. ESP-0-1-1
Date 10-28-80
Time
Location ESP-Outlet

Final Weights
By J.D. Date 10-29-80
Location On Site-Lab

Tare Weights
By J.D. Date 10-17-80
Location On Site Lab

Press. 690.35 510.90 179.45

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0		439.19	435.81	3.38			
1		446.83	439.57	7.26			
2		477.22	456.24	20.98			
3		483.84	458.35	25.49			
4		467.33	440.13	27.20			
5		466.49	447.37	19.12			
6		467.09	462.62	4.47			
7		462.59	459.63	2.96			
F		475.30	469.86	5.44			
			Total with filter				
			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 ESP-Outlet

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

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1910-1916		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-28-80	1920-1940	Vogel, Rojas	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	10-5-80	9:00AM	J. Pawlowski	
Write Up				

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MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-1-1

MRI Project Number 4891-L(93)
Field Dates
Plant PFIZER
Sampling Location outlet ESP
Sampling Date 10/28/80

FIELD CREW

Crew Chief S. Cobb

Testing Engineer 1 Daniel Vogel
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

Filter w/ water

MRI - Form PO (10/72)

950

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location OUTLET: ESP
Test No. ESP-O-1-1

Date 10/28/80
Initial D. Vogel

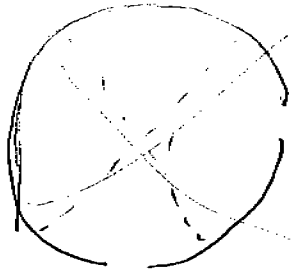
Velocity head at sampling location, in. H_2O	ΔPs	.11
Stack temperature at sample point, °F	Ts	496
Barometric pressure, in. Hg	Pb	29.28
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	29.31
Percent moisture in gas stream by volume	% H_2O	6.0%
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	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	31.37
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.57
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1471
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.295
Actual nozzle diameter, in.	D_{n_a}	.330
Assumed meter temperature, °F	Tm	48 48
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.873
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.839

.878 @ 2 min
.109 @ 15 sec.

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10/28/80
SAMPLING LOCATION ESP-outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-9-1-1
OPERATOR Vogel
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 29.28
STATIC PRESSURE, (P_s) 7.52
Filter Set 15

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired) .439
Probe Tip Diameter .330
CO_2
O_2
CO
N_2
% H_2O 6.0

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
	209.853											
QUAD	0 / 1555											
1	2 1557 / 1609	210.731	210.710	.11	.58	.60	490	46	47	3	NA	NA
	4 1554 / 1606	211.609	211.600		.59	.61	490	47	47	3	NA	NA
	6 1601 / 1604	212.487	212.455			.60	490	49	48	3	NA	NA
					ΔH							
	Time			AE	.603		490	47.3		3		
	5 min 53 sec											
	(2%)	(5.48?)										
		Vm =										
		2.602										

Start first quad

COMMENTS:

EPA Dur 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant PFIZER
Sampling Location ESP outlet
Test Number ESP-0-1-1

Date 08/26/80
Initial D. Lloyd

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	490
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .603 Pb = 29.28	Vm_{std}	2.65
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	31.37
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.57
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.31
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	1471
Total sample time, minutes	θ	6 min
Nozzle diameter, inches	Dn	.330
$\frac{1{,}039\ (490 + 460)(2.65)}{(1471)(6)(\cancel{29.57}\ 29.31)(.94)(.330^2)}$	% I	98.77

SAMPLE HANDLING LOG

Project Number 4891-L93

Source Identification ESP outlet

Test Run Number ESP-0-L-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10/28/80	1555 1601	Vogel	
Probe Technician				
Meter Technician	10/28/80		Vogel	
Other				
Transport of Train to Cleanup Site	10/28/80	1605 1610	Raju	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

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MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-1-2

MRI Project Number 4891-L(93)
Field Dates 10/27/80
Plant Pfizer
Sampling Location E.S.P. OUTLET
Sampling Date 10/27/80

FIELD CREW

Crew Chief E. Cobb

Testing Engineer 1 Daniel Vogel
2
3

Engr. Technician 1 M. Hansen
2
3

Lab Technician 1 T Walker
2 T. Johnson
3 T Pavalons

Process Engineer 1 Pat Karlapudi
2

Other 1 E.D.
2

Bad weather in Texas so Good

MRI - Form PO (10/72)

1

ANDERSEN SAMPLING CALCULATIONS

Plant PFIZER.
Sampling Location ESP. O-1-2
Test No. ESP. outlet

Date 10-25-80
Initial

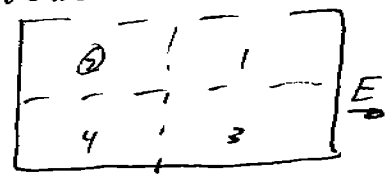
Velocity head at sampling location, in. H_2O	ΔPs	.11
Stack temperature at sample point, °F	Ts	500
Barometric pressure, in. Hg	Pb	29.32
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	29.35
Percent moisture in gas stream by volume	% H_2O	7.0
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	Mf	.93
Molecular wt. dry stack gas, lb/lb-mole (% CO_2 x 0.44) + (% O_2 x 0.32) + (% N_2 + % CO x 0.28) 13.66 17.5	Md	31.37
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	34.75
Stack velocity, fpm 349 $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	~~1271~~ 1340
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min .71 = Fs.	D_{n_c}	.311 ~~.320~~
Actual nozzle diameter, in.	D_{n_a}	.333
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	~~.708~~ .749
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$ 1.001	Fm	.387

1.167 @ 3 min
.0967 @ 15 sec

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10-29-70
SAMPLING LOCATION ~~Bag~~ ESP. outlet
SAMPLE TYPE Particulate
RUN NUMBER E.S.P.-0-1-2
OPERATOR Vogel
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 29.32
STATIC PRESSURE, (P_s) +.52
Filter Set 12

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



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) .387
Probe Tip Diameter .333
CO_2
O_2
CO
N_2
% H_2O 79

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	1659	172,400										
1701 QUAD	3	~~1656~~	173,541	173,65	.11	.46	.48	500	54	54	0	NA	NA
1704 2	6	~~1653~~	174,722	174,75			.48		56	54	0		
	9	1707	175,583	175,90			.45		58	55	0		
	12	1710	177.044	177.06			.44		60	56	0		
	15	1713	178,205	178,20			.41		61	57	0		
							.434		56.5 AVE Tm		0		
			Vm=	5,801									

COMMENTS:

EPA-Durham 235
4-72

E-254

ISOKINETIC PERFORMANCE WORKSHEET

Plant PFIZER
Sampling Location ESP outlet
Test Number ESP-0-1-2

Date 10-28-80
Initial D. Dorf

Isokinetic equation:

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

516.5

Average stack temperature, °F	Ts_{avg}	500
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$	Vm_{std}	5.808
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	36.75
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	29.35
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$	Vs	1271
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.333
$\frac{1{,}039\ (500 + 460)(5.808)}{(1271)(15)(29.35)(.93)(.333^2)}$	% I	100.39

SAMPLE HANDLING LOG

Project Number 4891-L93

Source Identification ESP outlet

Test Run Number ESP-0-1-2

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10/27/80	1655-1713		
Probe Technician				
Meter Technician			Dario Vogel	
Other				
Transport of Train to Cleanup Site	10/27/80	1720-1740	Raju - Vogel	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

(W)

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-9-4-4-(1)

MRI Project Number 4891-L93
Field Dates
Plant Rizen
Sampling Location ESP-Outlet
Sampling Date 11/4/80

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

Anderson loaded wrong

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location ESP - Outlet
Test No. ESP-0-4-4

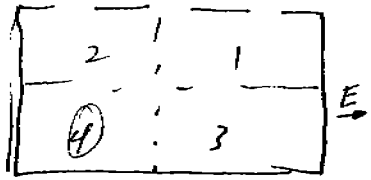
Date 11-4-80
Initial CC

Velocity head at sampling location, in. H_2O	ΔPs	.16
Stack temperature at sample point, °F	Ts	494
Barometric pressure, in. Hg	Pb	29.02
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O) P_g: +.52	Ps	29.06
Percent moisture in gas stream by volume	% H_2O	6
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	31.14
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.36
Stack velocity, fpm Q_p = .84 $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1854
Calculated nozzle diameter, in. Fs = .71 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.264
Actual nozzle diameter, in.	D_{n_a}	.270
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	.737
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)$ (Mf)	Fm	.378

FIELD DATA - ANDERSEN

PLANT Pi:2 ea
DATE 11-4-80
SAMPLING LOCATION ESP-outlet
SAMPLE TYPE Part. Cu lete
RUN NUMBER ESP-0-4-4
OPERATOR Cobb
AMBIENT TEMPERATURE 52
BAROMETRIC PRESSURE 29.02
STATIC PRESSURE, (P_s) -.52
Filter Set 31

Leak CK: Inital at 15" Hg, CFM N/A
Final at ____ Hg, CFM N/A



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired) .378 (.095)
Probe Tip Diameter .270
CO_2
O_2
CO
N_2
% H_2O 6

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 / 9:22	283.55										
Quad 4	2 / 924	284.31	284.22	.16	.41	.41	494	52	52	N/A	N/A	N/A
	4 / 926	285.06	285.07			.42		53	52			
	6 / 928	285.818	285.7			.41		53	52			
		Vm = 2.15			ΔH = .413			Tm = 52.3				
				ΔP = .16			Ts = 494					

COMMENTS:

EPA (Dur) 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP- Outlet
Test Number ESP-O-4-4

Date 11-4-80
Initial RC

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	494	
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .413, Pb = 29.02, Vm = 2.15, Tm+460 = 512.3	Vm_{std}	2.151	
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ H_2O = 6% (assumed)	Mf	0.94	.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	31.14	31.14
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.35	~~28.36~~ 30.35
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) +0.52	Ps	29.06	29.06
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = .16, C_p = .84	Vs	1792	~~1684~~
Total sample time, minutes	θ	6	6
Nozzle diameter, inches	Dn	0.27	.27
$\frac{1{,}039\ (494 + 460)(2.151)}{(1792)(6)(29.06)(.94)(.27^2)}$	% I	99.6	96.2

SAMPLE HANDLING LOG

Project Number 4891-293

Source Identification ESP-Outlet

Test Run Number ESP-0-4-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	11-4-80	922-928		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	11-4-80	930-945	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

INPUT DATA FOR FILE ESP044

TEST DATE - 11/05/80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - ESP-0-4-4-(1)

% WATER= 3.68
% CARBON DIOXIDE= 17.00
% CARBON MONOXIDE= 0.00
% OXYGEN= 11.83

ANDERSEN IMPACTOR WITH CYCLONE

STACK TEMPERATURE= 495.0 DEGREES F.
BAR. PRESSURE= 29.20 INCHES HG
STATIC PRESSURE= -0.52 INCHES H20
AVE. DELTA P= 0.13 INCHES H20
PITOT COEFF.= .84
METER TEMP.= 53.5 DEGREES F.
PROBE DIA.= 0.270 INCHES

SAMPLING TIME= 6.0 MIN.
PRESSURE DROP= 0.00 INCHES HG
SAMPLER TEMP. = 495.0 DEGREES F.
PARTICLE DENS= 1
METER VOL.= 2.130 CUBIC FEET
DELTA H= 0.37 INCHES H20

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.= 2.139 CU. FT.
SAMPLE VOL.-WET STD.= 2.220 CU. FT.
STACK VELOCITY= 1604.1 FT./MIN.
NOZZLE VELOCITY= 1727.8 FT./MIN.
MASS COLLECTED= 4.450 MG.
LOADING= 0.03093 GRAIN/SCF
LOADING(DRY)= 0.03211 GRAIN/SCF
RATE FOR 15 MICRON CYCLONE CUTOFF= 0.741 CU. FT/MIN

DRY MOLECULAR WT.= 31.19
WET MOLECULAR WT.= 30.71
% ISOKINETIC= 107.7
SAMPLING RATE-ACTUAL= 0.687 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)	491.89	413.14	439.60	445.14	444.71	448.68	455.75	449.46	454.75	557.05
TARE WT (MG)	487.50	413.25	440.18	445.55	445.14	449.12	456.26	449.98	455.23	556.97
NET WT (MG) CORRECTED	4.35	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
FRACTION % OF TOTAL	97.87	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.23
CUM. % WITH FILTER	97.87	98.77	98.77	98.77	98.77	98.77	98.77	98.77	98.77	100.00
FRACTION % WITHOUT FILTER	99.09	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CUM. % WITHOUT FILTER	99.09	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
JET VEL. (CM/SEC)		0	53	99	165	272	484	1170	2133	4266
D50 SIZE (MICRONS)	15.73	14.73	9.17	6.20	4.20	2.67	1.30	0.78	0.51	<0.51
DM/DLOGD (GRAINS/SCF)		0.00977	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	
GEO MEAN (MICRONS)		15.22	11.62	7.54	5.10	3.35	1.87	1.01	0.63	<0.63
PARTICLE COUNT		7.9D+04	0.0D+00	0.0D+00	0.0D+00	0.0D+00	0.0D+00	0.0D+00	0.0D+00	

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

119

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-4-4(1) Repeat

MRI Project Number 4891-L93
Field Dates
Plant Pfizer
Sampling Location ESP Outlet
Sampling Date 11-5-80

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)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location ESP- Outlet
Test No. ESP-0-4-4(2) Repeat

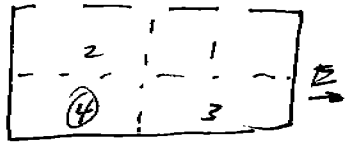
Date 11-5-80
Initial CC

Velocity head at sampling location, in. H_2O	ΔPs	.13
Stack temperature at sample point, °F	Ts	495
Barometric pressure, in. Hg	Pb	29.2
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O) $P_g = -.52$	Ps	29.16
Percent moisture in gas stream by volume	% H_2O	6
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	31.2
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.53
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1664
Calculated nozzle diameter, in. $F_s = .71$ $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.280
Actual nozzle diameter, in.	D_{n_a}	.27
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	.661
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)$ (Mf)	Fm	.338

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 11-5-80
SAMPLING LOCATION ESP-Outlet
SAMPLE TYPE Anderson-Portable
RUN NUMBER ESP-0-4-4(2)
OPERATOR Cobb
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 29.2
STATIC PRESSURE, (P_s) -.52
Filter Set 28

Leak CK: Inital at 15" Hg, CFM N/A
Final at ____ Hg, CFM N/A



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) .338 (.085)
Probe Tip Diameter .27
CO_2 17
O_2 11.83
CO 0
N_2 71.17
% H_2O Assumed 6%

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 / 1535	289.700										
Quad 4	2 / 1537	290.384	290.40	.13	.37	.37	495	53	53	N/A	N/A	N/A
	4 / 1539	291.05	291.15			.37		54	53			
	6 / 1541	291.73	291.83			.37		55	53			
				ΔP = .13			T_s = 495					
		V_m =	2.13		ΔH =	.37		T_m =	53.5			

COMMENTS:

EPA (Dur) 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 11-5-80
Initial GC

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	495
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .37, Pb = 29.2, Vm = 2.13, Tm+460 = 513.5	Vm_{std}	2.139
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ Assume = 6%	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	31.2
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.41
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) Ps = -.52	Ps	29.16
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP .13, Cp = .84	Vs	1619
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.27
$\frac{1{,}039\ (495 + 460)(2.139)}{(1619)(6)(29.16)(.94)(.27^2)}$	% I	109.3

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 28

Test No. ESP 0-4-4 (2) Repeat
Date 11-5-80
Time
Location Baghouse Outlet

Final Weights
By AP Date 11-7-80
Location On Site Lab

Tare Weights
By AP Date 10-21-80
Location On Site Lab

PRES. 491.89 487.50 4.39

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	28-0	413.14	413.25	-0.11			
1	28-1	439.60	440.18	-0.58			
2	28-2	445.14	445.55	-0.41			
3	28-3	444.71	445.14	-0.43			
4	28-4	448.68	449.12	-0.44			
5	28-5	455.75	456.26	-0.51			
6	28-6	449.46	449.98	-0.52			
7	28-7	454.75	455.23	-0.48			
F	28-F	557.05	556.97	0.08			
			Total with filter				
			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 4591-193

Source Identification ESP Outlet

Test Run Number ESP-0-4-4 repeat (2)

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	11-5-80	1535-1541		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	11-5-80	1545-1600	Cobb	
Train Disassembly				Lorelei Wang
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J. Pawlonis	On Site Lab
Write Up				

INPUT DATA FOR FILE DC141

TEST DATE - 12-3-80		% WATER=	1.00
PROJECT # - 4891-L93		% CARBON DIOXIDE=	0.00
TEST SITE - PFIZER		% CARBON MONOXIDE=	0.00
RUN ID - DC-1-4-(1)		% OXYGEN=	21.00

ANDERSEN IMPACTOR WITH CYCLONE

STACK TEMPERATURE=	30.0 DEGREES F.	SAMPLING TIME=	12.0 MIN.
BAR. PRESSURE=	29.75 INCHES HG	PRESSURE DROP=	0.00 INCHES HG
STATIC PRESSURE=	-7.65 INCHES H20	SAMPLER TEMP. =	30.0 DEGREES F.
AVE. DELTA P=	1.30 INCHES H20	PARTICLE DENS=	1
PITOT COEFF.=	.84	METER VOL.=	2.252 CUBIC FEET
METER TEMP.=	32.4 DEGREES F.	DELTA H=	0.10 INCHES H20
PROBE DIA.=	0.113 INCHES		

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.=	2.401 CU. FT.	DRY MOLECULAR WT.=	28.84
SAMPLE VOL.-WET STD.=	2.425 CU. FT.	WET MOLECULAR WT.=	28.73
STACK VELOCITY=	3754.8 FT./MIN.	% ISOKINETIC=	73.5
NOZZLE VELOCITY=	2761.6 FT./MIN.	SAMPLING RATE-ACTUAL=	0.192 CU. FT/MIN
MASS COLLECTED=	159.240 MG.	CYCLONE BLANK=	0.886 MG.
LOADING=	1.01335 GRAIN/SCF	STAGE BLANK=	0.816 MG.
LOADING(DRY)=	1.02359 GRAIN/SCF	FILTER BLANK=	0.754 MG.

RATE FOR 15 MICRON CYCLONE CUTOFF= 0.208 CU. FT/MIN

STAGE #	CYCLONE	0	1	2	3	4	5	6	7	FILTER
FINAL WT (MG)	626.39	457.78	441.08	476.12	436.77	470.42	437.79	466.67	448.16	575.89
TARE WT (MG)	477.72	456.83	440.30	475.11	435.20	467.19	432.20	463.15	446.86	575.94
NET WT (MG) CORRECTED	147.78	0.13	0.00	0.19	0.75	2.41	4.77	2.70	0.48	0.00
FRACTION % OF TOTAL	92.81	0.08	0.00	0.12	0.47	1.52	3.00	1.70	0.30	0.00
CUM. % WITH FILTER	92.81	92.89	92.89	93.01	93.48	95.00	98.00	99.70	100.00	100.00
FRACTION % WITHOUT FILTER	92.81	0.08	0.00	0.12	0.47	1.52	3.00	1.70	0.30	
CUM. % WITHOUT FILTER	92.81	92.89	92.89	93.01	93.48	95.00	98.00	99.70	100.00	
JET VEL. (CM/SEC)		0	15	28	46	76	135	328	597	1194
D50 SIZE (MICRONS)	22.16	22.16	13.86	9.42	6.44	4.15	2.11	1.32	0.91	<0.91
DM/DLOGD (GRAINS/SCF)			0.00000	0.00735	0.02902	0.08078	0.10292	0.08429	0.01920	
GEO MEAN (MICRONS)			17.52	11.42	7.78	5.17	2.96	1.66	1.09	<1.09
PARTICLE COUNT			0.0D+00	8.0D+04	4.6D+05	1.9D+06	4.3D+06	6.3D+06	2.2D+06	

D50 FOR STAGE 0 EXCEEDS THE ESTIMATED CYCLONE D50 VALUE OF 15.76 MICRONS.

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

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust-1-4(1)

MRI Project Number 4891-L93
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-2-80

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)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Dust Collector
Test No. Dust-1-4-(1)

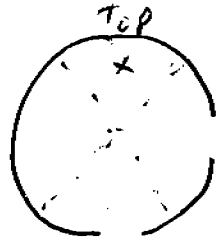
Date 12-3-80
Initial AC.

Velocity head at sampling location, in. H_2O	ΔPs	1.3
Stack temperature at sample point, °F	Ts	30
Barometric pressure, in. Hg	Pb	29.75
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O) -7.65	Ps	29.18
Percent moisture in gas stream by volume	% H_2O	1
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	Mf	.99
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	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.73
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	3755
Calculated nozzle diameter, in. Fs = .19 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.096
Actual nozzle diameter, in.	D_{n_a}	.113
Assumed meter temperature, °F	Tm	35
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.19
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.186

FIELD DATA - ANDERSEN

PLANT [illegible]
DATE [illegible]
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Andersen-Particulate
RUN NUMBER Dust 1-4-(1)
OPERATOR Cash
AMBIENT TEMPERATURE 46
BAROMETRIC PRESSURE 29.75
STATIC PRESSURE, (P_s) -7.65
Filter Set 40

Leak CK: Inital at 15" Hg, CFM N/A
Final at ____ Hg, CFM N/A



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired) .186 (.5580 cm/3 min)
Probe Tip Diameter .113
CO_2 0
O_2 21
CO 0
N_2 79
% H_2O 1

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	1640											
	3	1643	310.41	310.48	1.3	1.1	.1	30	30	30	N/A	N/A	N/A
	6	1646	310.02	310.06			.1		32	30			
	9	1649	311.59	311.90	311.59		.1		34	32			
	12	1652	312.13	312.152			.1		37	34			
			V_m = 2.352			ΔH =	.1		T_m =	32.38			
					ΔP = 1.3			T_s = 30					

COMMENTS.

EPA (Dur) 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 12-3-80
Initial GE

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	30
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .1$ $Pb = 29.75$ $Vm = 2.252$ $Tm+460 = 492.4$	Vm_{std}	2.4
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.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 $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	29.18
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = 1.3$ $C_p \sim .84$	Vs	3755
Total sample time, minutes	θ	12
Nozzle diameter, inches	Dn	.113
$\frac{1{,}039\,(30 + 460)(2.4)}{(3755)(12)(29.18)(.99)(.113^2)}$	% I	73.5

ANDERSEN PARTICLE SIZE ANALYSIS

FILTER SET # 40

Test No. Dust-1-4-(1)
Date 12-3-80
Time
Location Dust Collector

Final Weights
By DENT Date 12-4-80
Location On Site LAB

Tare Weights
By JP Date 10-22-80
Location On Site LAB

PRES 626.39 477.72

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	40-0	457.78	456.83				
1	40-1	441.08	440.30				
2	40-2	476.12	475.11				
3	40-3	436.77	435.20				
4	40-4	470.42	467.19				
5	40-5	437.79	432.20				
6	40-6	466.67	463.15				
7	40-7	448.16	446.86				
F	40-F	575.89	575.94				
			Total with filter				
			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 Dust Collector

Test Run Number Dust-1-4-01

Pollutant(s) in Sample Inhalable Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-3-80	1640-1652		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	12-3-80	1652-1700	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-6-80	1313	J. PAULONIS	
Write Up				

INPUT DATA FOR FILE DC142

TEST DATE - 12-4-80
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - DC-1-4-(2)

% WATER= 1.00
% CARBON DIOXIDE= 0.00
% CARBON MONOXIDE= 0.00
% OXYGEN= 21.00

ANDERSEN IMPACTOR WITH CYCLONE

STACK TEMPERATURE=	35.0 DEGREES F.	SAMPLING TIME=	12.3 MIN.
BAR. PRESSURE=	29.50 INCHES HG	PRESSURE DROP=	0.00 INCHES HG
STATIC PRESSURE=	-7.65 INCHES H20	SAMPLER TEMP. =	35.0 DEGREES F.
AVE. DELTA P=	1.25 INCHES H20	PARTICLE DENS=	1
PITOT COEFF.=	.84	METER VOL.=	2.450 CUBIC FEET
METER TEMP.=	41.1 DEGREES F.	DELTA H=	0.10 INCHES H20
PROBE DIA.=	0.113 INCHES		

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.=	2.545 CU. FT.	DRY MOLECULAR WT.=	28.84
SAMPLE VOL.-WET STD.=	2.570 CU. FT.	WET MOLECULAR WT.=	28.73
STACK VELOCITY=	3716.6 FT./MIN.	% ISOKINETIC=	78.1
NOZZLE VELOCITY=	2902.7 FT./MIN.	SAMPLING RATE-ACTUAL=	0.202 CU. FT/MIN
MASS COLLECTED=	43.504 MG.	CYCLONE BLANK=	0.886 MG.
LOADING=	0.26119 GRAIN/SCF	STAGE BLANK=	0.816 MG.
LOADING(DRY)=	0.26383 GRAIN/SCF	FILTER BLANK=	0.754 MG.

RATE FOR 15 MICRON CYCLONE CUTOFF= 0.214 CU. FT/MIN

STAGE #	CYCLONE	0	1	2	3	4	5	6	7	FILTER
FINAL WT (MG)	516.51	474.80	478.72	474.59	479.99	450.18	475.87	485.55	474.26	459.98
TARE WT (MG)	472.12	474.94	478.95	474.82	480.29	450.23	476.16	485.95	474.47	460.09
NET WT (MG) CORRECTED	43.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FRACTION % OF TOTAL	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CUM. % WITH FILTER	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
FRACTION % WITHOUT FILTER	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CUM. % WITHOUT FILTER	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
JET VEL. (CM/SEC)		0	16	29	48	80	142	344	628	1255
D50 SIZE (MICRONS)		21.68	21.68	13.56	9.21	6.29	4.06	2.06	1.28	0.89	<0.89
DM/DLOGD (GRAINS/SCF)			0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	
GEO MEAN (MICRONS)			17.15	11.18	7.61	5.06	2.89	1.63	1.07	<1.07
PARTICLE COUNT			0.0D+00	0.0D+00	0.0D+00	0.0D+00	0.0D+00	0.0D+00	0.0D+00	

D50 FOR STAGE 0 EXCEEDS THE ESTIMATED CYCLONE D50 VALUE OF 15.54 MICRONS.

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

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust-1-4-(2)

MRI Project Number 4891-L93
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-4-80

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)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Dust Collector
Test No. Dust-1-4-12

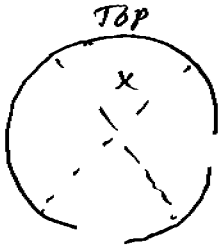
Date 12-4-80
Initial CC

Velocity head at sampling location, in. H_2O	ΔPs	1.25
Stack temperature at sample point, °F	Ts	35
Barometric pressure, in. Hg	Pb	29.5
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	28.93
Percent moisture in gas stream by volume	% H_2O	1
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	Mf	.99
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	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.73
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	3717
Calculated nozzle diameter, in. Fs = .19 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.097
Actual nozzle diameter, in.	D_{n_a}	.113
Assumed meter temperature, °F	Tm	45
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.19
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.188

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 12-4-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Anderson Particulate
RUN NUMBER Dust-1-4-(2)
OPERATOR Cobb
AMBIENT TEMPERATURE 35
BAROMETRIC PRESSURE 29.5
STATIC PRESSURE, (P_s) -2.65
Filter Set 44

Leak CK: Inital at 15" Hg, CFM N/A
Final at ____ Hg, CFM N/A



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions .47

Calculated ACFM (desired) .188 (.564)
Probe Tip Diameter .113
CO_2 0
O_2 21
CO 0
N_2 79
% H_2O 1

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 314.49 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 1515											
	3 1518	315.05	315.11	1.25	.1	.11	35	40	40	N/A	N/A	N/A
	6 1521	315.62	315.71			.1		41	40			
	9 1524	316.18	316.29			.085		42	41			
	12 1527	316.75	316.94			.09		44	41			
	Add 20 sec											
	θ = 12.33 min			ΔP = 1.25			T_s = 35					
		Vm =	2.45		ΔH =	.099		Tm =	41.13			

COMMENTS:

EPA (Dur) 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number Dust - 1-4-(2)

Date 12
Initial RC

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	35
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .099, Pb = 29.5, Vm = 2.45, Tm + 460 = 501.13	Vm_{std}	2.545
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.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	28.93
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = 1.25, Cp = .84	Vs	3717
Total sample time, minutes	θ	12.33
Nozzle diameter, inches	Dn	.113
$\frac{1{,}039\ (35 + 460)(2.545)}{(3717)(12.33)(28.93)(.99)(.113^2)}$	% I	78.1

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 44

Test No. Dust-1-4-(2)
Date 12-4-80
Time
Location Dust Collector

Final Weights
By DENT Date 12-5-80
Location On Site LAB

Tare Weights
By JP Date 10-23-80
Location On Site LAB

PRES. 516.51 472.12

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	44-0	474.80	474.94				
1	44-1	478.72	478.95				
2	44-2	474.59	474.82				
3	44-3	479.99	480.29				
4	44-4	450.18	450.23				
5	44-5	475.87	476.16				
6	44-6	485.55	485.95				
7	44-7	474.26	474.47				
F	44-F	459.98	460.09				
		Total with filter					
		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.

MIDWEST RESEARCH INSTITUTE

RUN Dust 3-2 -(1)

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 1-6-81

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. Johnson
3 A. Small

Process Engineer 1
2

Other 1
2

Bob was lead lab in Texas

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 1-6-81

SAMPLING LOCATION Dust Collector
Dust -3-2

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	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.03
STATIC PRESSURE IN STACK, in. Hg -7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.46
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	55
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.95
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	.205	
ACTUAL NOZZLE DIAMETER, in.	.183	(Nozzle # 7)
REFERENCE Δp, in. H_2O	1.50	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number Dust-3-2

Date 1-6-81
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

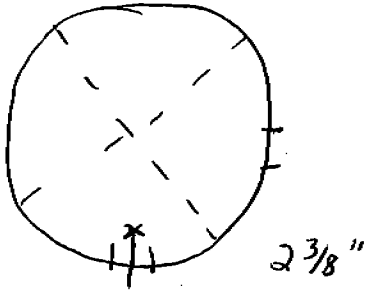
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	60
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	29.03
$\frac{5.168\ (60 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.03}}$	K	69.45

FIELD DATA

PLANT Pfizer
DATE 1-6-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER Dust-3-2
OPERATOR M. Hansen
AMBIENT TEMPERATURE 30°F
BAROMETRIC PRESSURE 29.03
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 105



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 2', SS.
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER 8
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp 1.50
VM = 69.45 x $\sqrt{\Delta Ps / (Ts + 460)}$

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

READ AND RECORD ALL DATA EVERY 5 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)		GAS METER READING (V_m), ft^3 175.90		VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
			Desired	Actual		DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
Dust 3-2	0	1445											
	5	1450	179.27	179.22	1.20	1.50	1.50	50	30	27	3.0	NA	NA
	10	1455	182.66	182.59	1.20	1.50	1.55	43	38	28	3.0		
	15	1500	186.07	186.05	1.20	1.50	1.60	37	44	30	3.0		
	20	1505	189.54	189.58	1.25	1.60	1.65	40	49	32	3.0		
	25	1510	193.04	193.06	1.25	1.60	1.60	33	52	34	3.0		
	30	1515	196.53	196.57	1.25	1.60	1.60	36	55	36	3.0		
	35	1520	200.01	200.08	1.25	1.60	1.60	37	58	38	3.0		
	40	1525	203.50	203.57	1.25	1.60	1.60	34	59	40	3.0		
	45	1530	206.99	207.06	1.25	1.60	1.55	36	60	42	3.0		
	50	1535	210.56	210.57	1.30	1.65	1.60	32	61	44	2.5		
	55	1540	214.20		1.35	1.70		32	62	45	2.5		

COMMENTS Kiln Nr. 7 is down.
It's snowing.

EPA-Dur-235

INPUT DATA FOR FILE DC341
TEST DATE - 1-7-81
PROJECT # - 4891-L93
TEST SITE - PFIZER
RUN ID - DC-3-4-(1)

% WATER= 1.00
% CARBON DIOXIDE= 0.00
% CARBON MONOXIDE= 0.00
% OXYGEN= 21.00

ANDERSEN IMPACTOR WITH CYCLONE

STACK TEMPERATURE=	35.0 DEGREES F.	SAMPLING TIME=	18.0 MIN.
BAR. PRESSURE=	29.20 INCHES HG	PRESSURE DROP=	0.00 INCHES HG
STATIC PRESSURE=	-7.65 INCHES H20	SAMPLER TEMP. =	35.0 DEGREES F.
AVE. DELTA P=	1.04 INCHES H20	PARTICLE DENS=	1
PITOT COEFF.=	.84	METER VOL.=	3.387 CUBIC FEET
METER TEMP.=	30.3 DEGREES F.	DELTA H=	0.11 INCHES H20
PROBE DIA.=	0.115 INCHES		

CALCULATED RESULTS

SAMPLE VOL.-DRY STD.=	3.559 CU. FT.	DRY MOLECULAR WT.=	28.84
SAMPLE VOL.-WET STD.=	3.595 CU. FT.	WET MOLECULAR WT.=	28.73
STACK VELOCITY=	3407.7 FT./MIN.	% ISOKINETIC=	79.6
NOZZLE VELOCITY=	2713.3 FT./MIN.	SAMPLING RATE-ACTUAL=	0.196 CU. FT/MIN
MASS COLLECTED=	253.890 MG.	CYCLONE BLANK=	0.170 MG.
LOADING=	1.08983 GRAIN/SCF	STAGE BLANK=	0.149 MG.
LOADING(DRY)=	1.10084 GRAIN/SCF	FILTER BLANK=	0.133 MG.

RATE FOR 15 MICRON CYCLONE CUTOFF= 0.214 CU. FT/MIN

STAGE #	CYCLONE	0	1	2	3	4	5	6	7	FILTER
FINAL WT (MG)	710.31	445.05	425.72	445.15	427.33	444.06	428.05	445.16	426.83	548.22
TARE WT (MG)	504.74	441.60	423.42	442.34	404.06	438.79	421.91	440.78	424.77	548.40
NET WT (MG) CORRECTED	205.40	3.30	2.15	2.66	23.12	5.12	5.99	4.23	1.91	0.00
FRACTION % OF TOTAL	80.90	1.30	0.85	1.05	9.11	2.02	2.36	1.67	0.75	0.00
CUM. % WITH FILTER	80.90	82.20	83.05	84.10	93.20	95.22	97.58	99.25	100.00	100.00
FRACTION % WITHOUT FILTER	80.90	1.30	0.85	1.05	9.11	2.02	2.36	1.67	0.75	
CUM. % WITHOUT FILTER	80.90	82.20	83.05	84.10	93.20	95.22	97.58	99.25	100.00	
JET VEL. (CM/SEC)		0	15	28	47	78	138	333	608	1215
D50 SIZE (MICRONS)	22.04	22.04	13.78	9.36	6.40	4.13	2.09	1.31	0.90	<0.90
DM/DLOGD (GRAINS/SCF)			0.04529	0.06805	0.60016	0.11555	0.08705	0.08885	0.05104	
GEO MEAN (MICRONS)			17.43	11.36	7.74	5.14	2.94	1.65	1.09	<1.09
PARTICLE COUNT			3.2D+05	7.4D+05	9.6D+06	2.8D+06	3.7D+06	6.7D+06	5.8D+06	

D50 FOR STAGE 0 EXCEEDS THE ESTIMATED CYCLONE D50 VALUE OF 15.86 MICRONS.

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

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN DC-3-4(1)

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 1-7-81

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. Johnson
3 A. Small

Process Engineer 1
2

Other 1
2

non-iso

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Dust Collector
Test No. DC-3-4-1

Date 1-7-81
Initial MDH

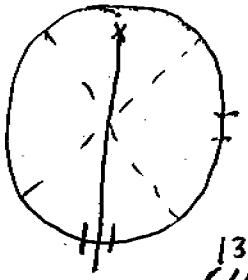
Velocity head at sampling location, in. H_2O	ΔPs	1.04
Stack temperature at sample point, °F	Ts	35
Barometric pressure, in. Hg	Pb	29.20
Static pressure in stack, in. Hg -7.65 (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	28.63
Percent moisture in gas stream by volume	% H_2O	1.0
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	Mf	.99
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	28.84
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.73
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	3,408
Calculated nozzle diameter, in. Fs = .190 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.101
Actual nozzle diameter, in.	D_{n_a}	.115
Assumed meter temperature, °F	Tm	27
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.190
Calculated meter flow rate, ft^3/min Fs = .190 $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.181

Top

FIELD DATA - ANDERSEN

.543/3min.

PLANT Pfizer
DATE 1-17-81
SAMPLING LOCATION Duct Collector
SAMPLE TYPE Particle Size
RUN NUMBER DC-3-4-1
OPERATOR M. Hansen
AMBIENT TEMPERATURE 15 °F
BAROMETRIC PRESSURE 29.20
STATIC PRESSURE, (P_s) -7.65
Filter Set 61



13 1/8" (11 1/8 in)

SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) .181 (.045/15sec.)
Probe Tip Diameter .115
CO_2 0
O_2 21
CO 0
N_2 79
% H_2O 1.0 assumed.

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

Console No. 2

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	1110	257.70										
Dust-3-4	3	1113	258.24	258.23	1.04	.10	.10	35	30	27	2.0	NA	NA
	6	1116	258.79	258.80			.11		31	27	1.5		
	9	1119	259.33	259.39			.11		32	28	1.5		
	12	1122	259.87	259.95			.11		33	28	1.5		
	15	1125	260.42	260.52			.11		35	29	1.5		
	18	1128	260.96	261.037			.11		35	29	1.5		
			V_m = 3.387			ΔH =	~~.108~~ .11		T_m =	30.3			

COMMENTS:

EPA (Dur) 235

E-290

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number DC-3-4-1

Date 1-7-81
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}	35
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = ~~.108~~ .11, Tm = 30.3, pb = 29.20, Vm = 3.387	Vm_{std}	3,559
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.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	28.63
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = 1.04	Vs	3,408
Total sample time, minutes	θ	18
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (35 + 460)(3{,}559)}{(3{,}408)(18)(28.63)(.99)(.115^2)}$	% I	79.6

ANDERSEN PARTICLE SIZE ANALYSIS

Test No. DC-3-4-(1)
Date 1-7-81
Time
Location) Dust Collector

Final Weights
By SMALL Date 1-10-81
Location

Tare Weights
By DENT Date 12-4-80
Location

PRES 710.31 504.74

Stage No.	Filter No. (6)	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0		445.05	441.60				
1		425.22	423.42				
2		445.15	442.34				
3		427.33	404.06				
4		444.06	438.79				
5		428.05	421.91				
6		445.16	440.78				
7		426.83	424.77				
F		548.22	548.40				
		Total with filter					
		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 Dust Collector

Test Run Number DC-3-4-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-7-81	1110-1128	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	1-7-81	1110-1128	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-7-81	1132	M. Hansen	
Train Disassembly	1-7-81	1135.	J Johnson	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				