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 III-B
Appendix C

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

C-3 Electrostatic Precipitator Inlet

C-3-1 Mass

85

MIDWEST RESEARCH INSTITUTE

RUN EPP-I-1-1

MRI Project Number 4691-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 Stultz
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfize

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	$T_{m_{avg.}}$	50
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 ±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	$T_{s_{avg.}}$	600
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.09
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.96	
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
Sampling Location ESP Inlet
Test Number ESP-I-1-1

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

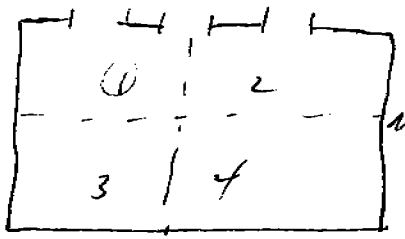
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	50
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
$\frac{5.168\ (50 + 460)\ (.84)\ (.95)\ (3)\ (.501^2)}{\sqrt{29.55}}$	K	291.35

FIELD DATA

PLANT Pfizer
DATE 10-30-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-I-1-1
OPERATOR Whitod
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.55
STATIC PRESSURE, (P_s) 0.38
FILTER NUMBER (s) 41

Facing ESP



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 17½"
NOZZLE I.D. .501
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.96
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 0.062

Leak CK: Initial at 15" Hg, CFM 0.002
Final at Hg, CFM 0.000

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 271.3 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 858.685 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 / 1120											
	3 / 1123	860.47	860.58	0.04	1.25	1.5	620	42	42	5	235	
	6 / 1126	862.14	862.29	0.035	1.05	1.2	600	46	44	5		
	9 / 1129	863.81	863.93	0.035	1.05	1.0	625	48	45	4½		
	12 / 1132	865.46	865.50	0.035	1.05	0.87	630	50	45		240	
	15 / 1135	867.13	867.01	0.035	1.05	0.95	590	51	45	4½		
		Final = 867.015				*						
		V_m =	8.33		ΔH =	1.124		T_m =	45.8			
				ΔP = .036			T_s = 613					
		V_m =	8.33	ΔP_s = 0.036	ΔH =	1.17	T_s = 613	T_m =	45.8			

COMMENTS
* add 0.03" H_2O

EPA-Dwg. 235

C-3-1-4

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-30-80
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}	613
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1.124$ $Pb = 29.55$ $Vm = 8.33$ $Tm+460 = 505.8$	Vm_{std}	8.609
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 7.41$	Mf	.926
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	31.30 ~~31.90~~
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.32
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) $Ps = +.538$	Ps	29.58
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .036$ $C_p = .84$ $\sqrt{\Delta P} = 0.1897$	Vs	899.92
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (613 + 460)(8.609)}{(899.9)(15)(29.58)(.926)(.501^2)}$	% I	103.4

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

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

Filter No. 41
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/	110	100	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	10	0	2		
Sample No.(s)	1				

Combined impinger contents, Sample No.
Liquid Level Marked
Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 14.6

SILICA GEL

678.3
675.7
2.6
Silica Gel
Color

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

RECOVERED SAMPLE

Probe Rinse: Beaker ~~Sample~~ No. 55
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: Beaker ~~Sample~~ No. 90
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:

CSP-I-1-1

MIDWEST RESEARCH INSTITUTE

Run No. _____

PARTICULATE CLEAN-UP AND ANALYSIS

Date _____

FIELD ANALYSIS

Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ Received No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
55		5	102.4501	93.99352	195 ml	JP DW	
	~~41~~	6		~~93.99352~~			
	41	6	0.99373	0.78133			
		6					
		7					
		8					
		9					
90		10	91.40781	91.40483	108 ml		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L-93

Source Identification ESP Inlet

Test Run Number ESP-I-1-1

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1120-1135	Whited-Stilte	
Probe Technician				
Meter Technician			Whited	
Other				
Transport of Train to Cleanup Site	10-30-80	1145	Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE LAB
Write Up				

(89)

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-1-2

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: Coss

Testing Engineer: 1 Whited
2
3

Engr. Technician: 1 Stulte
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	$T_{m_{avg.}}$	50
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	$T_{s_{avg.}}$	600
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.09
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	.96	
CALCULATED NOZZLE DIAMETER, in.	0.450	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.059	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-30-80
Initial CL

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

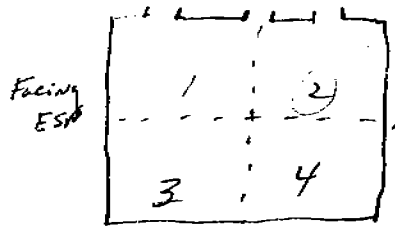
ΔPs = Velocity head of S pitot, inches H_2O

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	.95
Nozzle diameter, inches	Dn	.501
Barometric pressure, inches Hg	Pb	29.55
$\frac{5.168\ (50 + 460)\ (.95)\ (.84)\ (3)\ (.501^2)}{\sqrt{29.55}}$	K	291.35

FIELD DATA

PLANT Pfizer
DATE 10-30-80
SAMPLING LOCATION ESP- Inlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-I-1-2
OPERATOR Whitted
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.55
STATIC PRESSURE, (P_s) .38
FILTER NUMBER (s) 42



PROBE LENGTH AND TYPE 12 1/8
NOZZLE I.D. .501
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.96
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 0.059

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

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 29 \times \sqrt{\frac{Ps}{Ts + 460}}$

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	1412	867.264										
	3	1415	869.87	869.88	0.085	2.7	3.0	630	46	46	7	270	
	6	1418	872.48	872.52	0.085	2.7	3.0	600	54	50	7½	270	55
	9	1421	875.11	875.07	0.085	2.7	2.7	580	58	50	7½		
	12	1424	877.73	877.67	0.085	2.7	2.7	590	60	50	7½	275	
	15	1427	880.27	880.29	0.080	2.5	2.8	590	63	53	8	280	
			Final = 880.293										
			V_m = 13.029	Δp = 0.084		ΔH = 2.8	T_s = 598		T_m =	53			

COMMENTS

EPA-Durr 235

ISOKINETIC PERFORMANCE WORKSHEET

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

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}	590
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 2.80$, $Pb = 29.55$, $Tm = 53$, $Vm = 13.029$	Vm_{std}	13.33
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	31.04
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	30.26
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	29.52
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta Ps = 0.084$, $\sqrt{\Delta P} = 0.2898$	Vs	1353.6
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\,(590 + 460)(13.33)}{(1353.6)(29.52)(.94)(15)(.501^2)}$	% I	102.8

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-I-1-2
Sample Date 10-30-80
Recovery Date
Cleanup Person

Filter No. 42
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

	1	2	3	4	5
Impinger Sequence	1	2	3	4	5
Impinger Type a/					
Impinger Solution					
Final Volume (wt) b/	108	106			
Initial Volume (wt) b/	100	100			
Net Volume (wt) b/	8	6			
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 17.1

SILICA GEL

681.4	
678.3	
3.1	

Silica Gel Color

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 74
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:

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-1-2

PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
74		5	100.1757	88.59629	222 ml		
	42	6	0.96545	0.77725			
		6					
		6					
		7					
		8					
		9					
90		10	91.40781	91.40483	108 ml		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4591-2-93

Source Identification ESP Inlet

Test Run Number ESP-I-1-2

Pollutant(s) in Sample _____

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1412-1427		
Probe Technician				
Meter Technician			Whited	
Other				
Transport of Train to Cleanup Site	10-30-80	1430	Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

50

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-1-3(2)

MRI Project Number 4891-L93
Field Dates 5-10
Plant Pozen
Sampling Location ESP- Inlet
Sampling Date 10-28-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Whited
2
3

Lab Technician 1 Raja
2 Walker
3

Process Engineer 1
2

Other 1
2

NOMOGRAPH DATA

PLANT Pfizer Ind

DATE 10-28-80

SAMPLING LOCATION ESP - Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	51
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.18
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.80
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.99
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	~~650~~ 580
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.08 at point SP-3
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.86	
CALCULATED NOZZLE DIAMETER, in.	0.480	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	~~.070~~ 0.065	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-28-80
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

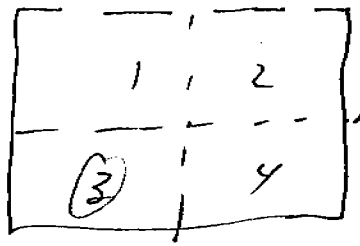
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	51
Pitot coefficient	Cp	0.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	0.95
Nozzle diameter, inches	Dn	0.501
Barometric pressure, inches Hg	Pb	29.18
$\frac{5.168\ (51 + 460)\ (.84)\ (3)\ (.95)\ (.501^2)}{\sqrt{29.18}}$	K	293.8

FIELD DATA

PLANT Pfizer Ind
DATE 10-28-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Particulate
RUN NUMBER ESP I-1-3
OPERATOR Whited, Stutz
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 29.18
STATIC PRESSURE, (P_s) 0.38" H_2O
FILTER NUMBER (s) 33



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 4'
NOZZLE I.D. 0.501
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.64
C FACTOR 0.86
PROBE HEATER SETTING 85
HEATER BOX SETTING 400
REFERENCE Δp 0.09

Leak CK: Initial at 15" Hg, CFM 0.010
Final at Hg, CFM 0.000

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 293.16 \times \sqrt{\frac{Ps}{Ts + 460}}$

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 / 1354		749.256									
	3 / 1357	751.22	751.35	0.05	1.15	1.7	650	54	54	7	250	
	6 / 1400	753.01	753.18	0.04	0.90	1.3	620	58	55	6	255	
	9 / 1403	754.99	754.85	0.05	1.20	1.2	635	60	55	5		
	12 / 1406	756.97	756.5	0.057	1.15	1.15	640	64	56	6	270	55
	15 / 1409	758.75	758.56	0.04	0.9	1.15	625	68	58	6½	270	
		Final = 758.558										
		9										
	Final, Average	Vm 9.302		Δp=0.0474		ΔH=1.3	T_s=634	T_m=58.2				

COMMENTS

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-28-80
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}	634
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1.3$ $T_m = 58.2$ $V_m = 9.302$ $P_b = 29.18$	Vm_{std}	9.27
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 6.03$	Mf	0.94
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	31.46
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	30.65
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$ $P_s = .38$	Ps	29.25
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\sqrt{\Delta P} = .2177$ $C_p = .84$	Vs	1036.8
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\,(634 + 460)(9.27)}{(1036.8)(15)(29.25)(.94)(.501^2)}$	% I	98.21

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

ESPI-1-3(2)

Plant Pfizer
Sample Location ESP-Inlet
Sample Box No. 6
Sample Type MLSS

Run No. ESP-I-1-3
Sample Date 10-25-80
Recovery Date
Cleanup Person

Filter No. 33
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/	112	98	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	+12	-2	0		
Sample No.(s)					

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

SILICA GEL

705.8	
703.2	
2.6	

Silica Gel Color ✓

Description of Impinger Solution
Total Moisture, gm 12.6

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 103
Liquid Level Marked
Sealed

Impinger Rinse: Sample No.
Liquid Level Marked
Sealed

Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed

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

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

ESP I-1-3(2) MIDWEST RESEARCH INSTITUTE

Run No. ESP I-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~~ BLANK No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
103		5	92.25573	80.33612	215 ml		
	33	6	0.93231	0.78727			
		6					
		6					
		7					
		8					
		9					
83		10	89.91564	89.91034	100 ml		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-293

Source Identification ESP- Inlet

Test Run Number ESP-I-1-3 ESP-I-1-3(2)

Pollutant(s) in Sample MASS

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1354-1409		
Probe Technician				
Meter Technician			Whited	
Other				
Transport of Train to Cleanup Site	10-28-80	1409-1430	Whited, Raja	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

54

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-~~2881~~-4 (2)

MRI Project Number 4891-L93
Field Dates 10-15
Plant Pfizer
Sampling Location ESP-Inlet
Sampling Date 10-28-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whited
2
3

Engr. Technician 1
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 10-28-80

SAMPLING LOCATION ESP - Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	57
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.27
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.24
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.99
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	650
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.085
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.98	
CALCULATED NOZZLE DIAMETER, in.	0.468	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.058	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-28-80
Initial EG

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

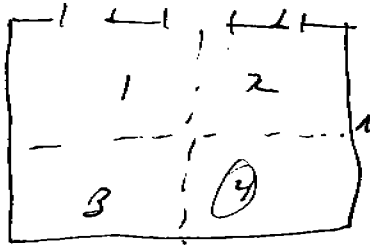
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	57
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	0.95
Nozzle diameter, inches	Dn	.501
Barometric pressure, inches Hg	Pb	29.27
$\frac{5.168\ (57 + 460)\ (.84)\ (3)\ (.95)\ (.501^2)}{\sqrt{29.27}}$	K	296.75

FIELD DATA

PLANT Pfizer
DATE 10-28-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Total Particulate
RUN NUMBER ESP-I-1-4 (2)
OPERATOR Uhited, stulte
AMBIENT TEMPERATURE 55
BAROMETRIC PRESSURE 29.27
STATIC PRESSURE, (P_s) 0.38" H_2O
FILTER NUMBER (s) 34



PROBE LENGTH AND TYPE 39, 31"
NOZZLE I.D. .501
ASSUMED MOISTURE, % 2%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR .99
PROBE HEATER SETTING 70
HEATER BOX SETTING 400
REFERENCE Δp 0.057 0.060

Leak CK: Initial at 15" Hg, CFM 0.0005
Final at Hg, CFM

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 26.8 \times \sqrt{\frac{Ps}{Ts + 460}}$

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 / 1543	758.740										
Quad 4	3	761.23	760.05	0.08	1.45	1.80	610	53	55	7	260	
	6	763.77	762.28	0.08	1.45	2.2	630	55	55	7½	275	
	9	766.47	764.75	0.09	1.6	2.5	630	60	55	9		
	12	769.05	767.41	0.085	1.6	2.8	660	64	56	12	255	
	15 1558	771.54	770.05	0.080	1.5	2.8	675	68	58	14		
	Final = 770.05											
		Vm = 11.31		0.083		2.42	653		58			

COMMENTS.

EPA-Dwg-235

C-3-1-28

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-28-80
Initial E.W.

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	653
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 2.42$, $Pb = 29.27$, $Vm = 11.31$, $Tm = 58$	Vm_{std}	~~11.36~~ 11.34
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 8.12$	Mf	.919
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	~~31.46~~ 31.46
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.37
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	~~29.29~~ 29.3
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P = 0.083$, $\sqrt{\Delta P} = 0.288$	Vs	~~1379.6~~ ~~1391~~ 1388
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (653 + 460)(11.34)}{(\cancel{1379.6}\ 1388)(15)(\cancel{29.29}\ 29.3)(\cancel{.95}\ .919)(.501^2)}$	% I	~~94.0~~ 93.2

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

ESP-I-1-4(2)

Plant Pr.-Ex.
Sample Location ESP - Inlet
Sample Box No. 6
Sample Type Mass

Run No. ESP - I - 1 - 4(2)
Sample Date 10 - 28 - 80
Recovery Date
Cleanup Person

Filter No. 34
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/	110	105	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	10	5	2		
Sample No.(s)					

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

SILICA GEL

710.0	
705.8	
4.2	

Silica Gel Color

Description of Impinger Solution
Total Moisture, gm 21.2

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 104
Liquid Level Marked
Sealed

Impinger Rinse: Sample No.
Liquid Level Marked
Sealed

Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed

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

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

ESP-I-1-4(2) MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-1-4 PARTICULATE CLEAN-UP AND ANALYSIS

Date 10-30-80 FIELD ANALYSIS Performed by 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~~ Benzene No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
104		5	114.3487	93.27875	200		
	34	6	0.98529	0.77524			
		6					
		6					
		7					
		8					
		9					
83		10	89.91564	89.91034	100		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L93

Source Identification ESP- Inlet

Test Run Number ESP-I-1-4 ESP-I-1-4(2)

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1543-1556		
Probe Technician				
Meter Technician			whited	
Other				
Transport of Train to Cleanup Site	10-28-80	1556-1615	whited, Shelty	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

(94)

MIDWEST RESEARCH INSTITUTE

RUN ESP-T-2-1

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 Stultz
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	$T_{m_{avg.}}$	50
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6 %
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.40 ~~29.40~~
STATIC PRESSURE IN STACK, in. Hg (P_m ±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	29.37
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.999
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	600
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.04
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.94	
CALCULATED NOZZLE DIAMETER, in.	0.555	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.06	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Inlet
Test Number ESP-I-2-7

Date 10-30-80
Initial EW

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

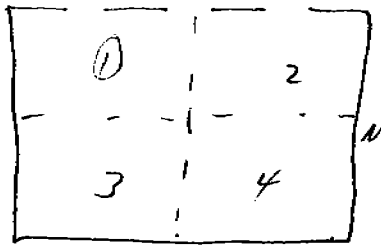
ΔPs = Velocity head of S pitot, inches H_2O

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	.501
Barometric pressure, inches Hg	Pb	29.40
$\frac{5.168\ (50 + 460)\ (.84)\ (.94)\ (3)\ (.501^2)}{\sqrt{29.40}}$	K	289.02

FIELD DATA

PLANT Pfizer
DATE 10-30-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Particulate
RUN NUMBER ESP I-2-1
OPERATOR Whited
AMBIENT TEMPERATURE 48
BAROMETRIC PRESSURE 29.55
STATIC PRESSURE, (P_s) 0.38" H_2O
FILTER NUMBER (s) 51



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 17 1/4
NOZZLE I.D. 0.501
ASSUMED MOISTURE, % 6%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
N→ METER $\Delta H_@$ 1.84
C FACTOR 0.96
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 0.059

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

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 289 \times \sqrt{\frac{Ps}{Ts + 460}}$

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 / 1631	880.895										
	3 / 1640	883.55	883.35	0.090	2.80	3.0	610	48	48	8 1/2	235	
	6 / 1643	886.19	886.11	0.09	2.8	3.1	615	52	48	9	235	
	9 / 1647	888.86	888.82	0.10	3.1	3.2	635	57	50	9		
	12 / 1650	891.58	891.64	0.09	2.8	3.1	635	60	50	11	235	
	15 / 1653	894.30	894.34	0.095	2.9	2.9	610	61	50	11	240	50
		Final = 894.337										
		V_m =	13.442	Δp_s = 0.093	ΔH =	3.06	T_s = 621	T_m =	52.4			

COMMENTS.

EPA-Dur) 235

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-30-80
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}	621
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 3.06$, $Pb = 29.55$, $V_m = 13.442$, $T_m = 52.4$	Vm_{std}	13.78
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 5.83$	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	30.30 ~~31.04~~
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	29.56 ~~30.26~~
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	29.52
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\sqrt{\Delta Ps} = .305$, $C_p = .84$	Vs	1462.5 ~~1445~~
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\,(621 + 460)(13.78)}{(1462.5)(15)(29.52)(.94)(.501^2)}$	% I	101.3 ~~102.5~~

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pieer
Sample Location ESP Inlet
Sample Box No. 6
Sample Type Particulate

Run No. ESP-I-2-1
Sample Date 10-30-80
Recovery Date
Cleanup Person

Filter No. 51
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/	110	104	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	10	4	0		
Sample No.(s)					

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

SILICA GEL

685.4	
681.4	
4.0	

Silica Gel
Color

Description of Impinger Solution
Total Moisture, gm 18g

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ BEAKER No. 78
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
Personnel accepting custody
Seal(s) broken by
Date broken
Remarks:

ESP-I-2-1

Run No. _____

MIDWEST RESEARCH INSTITUTE

PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ Beaker No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
78		5	98.98184	86.81112	210		
	51	6	0.85963	0.77755			
		6					
		6					
		7					
		8					
		9					
90		10	91.40781	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-2-1

Pollutant(s) in Sample _____

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1637-1653	Whited Stutz	
Probe Technician				
Meter Technician	10-30-80		Whited	
Other				
Transport of Train to Cleanup Site	10-30-80	1655	Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE LAB
Write Up				

98

MIDWEST RESEARCH INSTITUTE

RUN ESP I-2-2

MRI Project Number 4891-L-93
Field Dates 10-31-80
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-31-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whitesel
2
3

Engr. Technician 1 Stoltz
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 10-31-80

SAMPLING LOCATION ESP Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	40
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.29
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.26
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.9990
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	600
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.1
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.92	
CALCULATED NOZZLE DIAMETER, in.	0.445	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.061	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-31-80
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

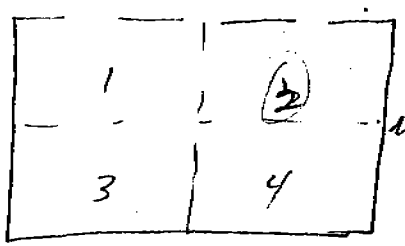
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	40
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	29.29
$\frac{5.168\ (40 + 460)\ (.84)\ (.94)\ (3)\ (.501^2)}{\sqrt{29.29}}$	K	283.88

FIELD DATA

PLANT Pfizer
DATE 10-31-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-I-2-2
OPERATOR Whited
AMBIENT TEMPERATURE 46
BAROMETRIC PRESSURE 29.29
STATIC PRESSURE, (P_s) ~~0.0~~ 0.38
FILTER NUMBER (s) 5



PROBE LENGTH AND TYPE 17 ft
NOZZLE I.D. 0.501
ASSUMED MOISTURE, % 6%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.82
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 0.061

Leak CK: Initial at 15" Hg, CFM 0.001
Final at Hg, CFM 0.000

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 288 \times \frac{Ps}{\sqrt{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK) 0700	GAS METER READING (V_m), ft^3 Desired 894.543	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	0											
	3	3	897.02	897.32	0.085	2.5	3.0	600	39	39	9.0	230	<40
	6	6	899.67	899.77	0.09	2.7	2.6	575	42	38	9.0		
	9	9	902.30	902.13	0.09	2.7	2.4	590	45	39	7	230	
	12	2	904.93	904.60	0.09	2.7	2.5	590	47	40	8	230	
	15	5	907.56	907.31	0.09	2.7	2.6	590	49	40	9		
			Final=	907.305									
			Vm =	12.762	Δp = 0.089		ΔH = 2.62	Ts = 589	Tm = 41.6				

COMMENTS

EPA-Dwg-235

C-3-1-44

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-31-80
Initial [illegible]

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	589
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 2.62$ $Tm = 41.6$ $Vm = 12.762$ $Pb = 29.29$	Vm_{std}	13.23
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ Assumed 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	30.30
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	29.56
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.26
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\sqrt{\Delta P} = .298$	Vs	1414
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (589 + 460)(13.23)}{(1414)(29.26)(.94)(15)(.501^2)}$	% I	98.5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: ESP-I-2-2
Sample Date: 10-31-80
Recovery Date:
Cleanup Person:

Filter No.: 52
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/	114	94	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/					
Sample No.(s)	14	6	2		

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

SILICA GEL

668.3	
655.5	
2.8	

Silica Gel Color:

Description of Impinger Solution:
Total Moisture, gm: 12.8

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 85
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. 91
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. ESP-I-2-2 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~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
85		5	98.45163	86.02109	125		
	52	6	2.02218	0.77424			
		6					
		6					
		7					
		8					
		9					
91		10	84.80300	84.79945	154		

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 4881-L-93

Source Identification ESP Inlet

Test Run Number ESP-I-2-2

Pollutant(s) in Sample _____

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	0900-0915	Whited STUTZ	
Probe Technician				
Meter Technician	10-31-80		Whited	
Other				
Transport of Train to Cleanup Site	10-31-80	0920	Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				~~LAB~~ ON SITE LAB
Write Up				

61

MIDWEST RESEARCH INSTITUTE

RUN ~~ESP-I-1-4~~ ~~2-3 2-4~~ 2-3

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

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whited
2
3

Engr. Technician 1 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 Ind

DATE 10-28-80

SAMPLING LOCATION ESP Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	58
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.31
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.28
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.999
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	650
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	~~0.04~~ 0.055
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.98	
CALCULATED NOZZLE DIAMETER, in.	0.44	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.058	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Inlet
Test Number ESP-I-2-3

Date 10-28-80
Initial KW

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

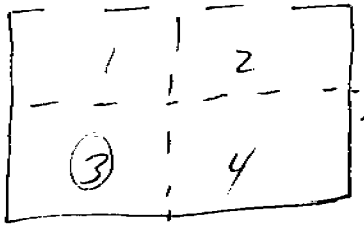
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	58
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	29.31
$\frac{5.168\ (58 + 460)\ (.84)\ (3)\ (.95)\ (.501^2)}{\sqrt{29.31}}$	K	297.1

FIELD DATA

PLANT Pfizer
DATE 10-28-80
SAMPLING LOCATION ESP - Inlet
SAMPLE TYPE Total Particulate
RUN NUMBER ESP - I - 2 - 3
OPERATOR Whited
AMBIENT TEMPERATURE ~~50~~ 45°
BAROMETRIC PRESSURE 29.31
STATIC PRESSURE, (P_s) .38" H_2O
FILTER NUMBER (s) 35



PROBE LENGTH AND TYPE 39.37"
NOZZLE I.D. .501
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.98
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 0.058

Leak CK: Initial at 15" Hg, CFM .005
Final at Hg, CFM 0.005

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 297 \times \sqrt{\frac{Ps}{Ts + 460}}$

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	1737	770.382										
	3	1740	772.74	772.79	0.07	2.2	2.15	650	48	48	9	260	
	6	1743	775.18	775.19	0.075	2.35	2.35	650	52	48	8		
	9	1746	777.70	777.57	0.080	2.45	2.40	650	58	48	9	240	
	12	1749	780.22	780.07	0.080	2.45	2.60	670	62	48	11	250	
	15	1752	782.72	782.66	0.080	2.50	2.70	660	65	50	12	250	
			Final = 782.661										
				Vm	12.279	Δp 0.077	ΔH = 2.51	Ts = 656	Tm = 52.7				

COMMENTS

EPA-Dwg. 235

C-3-1-52

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP - Inlet
Test Number ESP-I-2-3

Date 10-28-80
Initial CV

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	656
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 2.51, Pb = 29.31, Tm = 52.7, Vm = 12.28	Vm_{std}	12.48
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	31.46
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	29.28
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ ΔP_s = 0.077, $\sqrt{\Delta P_s}$ = 0.277	Vs	1328
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	0.501
$\frac{1{,}039\ (656 + 460)(12.48)}{(1328)(15)(29.28)(.95)(.501^2)}$	% I	104

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-I-2-3
Sample Date 10-28-80
Recovery Date 10-28-80
Cleanup Person E. Whited

Filter No. 35
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	~~95~~ 100	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	10	0	0		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 13.4

SILICA GEL

713.4	
710.0	
3.4	

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~~ Blank No. 98
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~~ Blank No. 83
Liquid Level Marked
Sealed
Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

ESP-I-2-3

Run No. _____

MIDWEST RESEARCH INSTITUTE

PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ Blank No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
98		5	101.6172	83.35912	200		
	35	6	1.30875	0.79032			
		6					
		6					
		7					
		8					
		9					
83		10	89.91564	89.91034	100		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L-93

Source Identification ESP- Inlet

Test Run Number ESP- I-2-3

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1739-1752		
Probe Technician	~~10-28-80~~	~~1750~~	R. Stultz	
Meter Technician	~~10-28-80~~	~~1750~~	E Whited	
Other			Raja	
Transport of Train to Cleanup Site	10-28-80	1752-1815	Raja, Whited, Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-2-4

MRI Project Number 4891-L93
Field Dates
Plant Pfizer
Sampling Location ESP-Inlet
Sampling Date 10-29-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whited
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-29-80

SAMPLING LOCATION ESP - Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	50.0 ~~65.0~~
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.50
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.47
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.999
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	650
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.085
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.98	
CALCULATED NOZZLE DIAMETER, in.	0.455	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.062	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-29-80
Initial EW

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

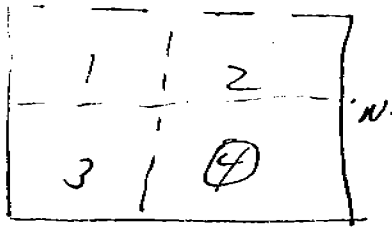
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	50
Pitot coefficient	Cp	0.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	0.95
Nozzle diameter, inches	Dn	0.501
Barometric pressure, inches Hg	Pb	29.50
$\frac{5.168\ (50 + 460)\ (.84)\ (3)\ (.95)\ (.501^2)}{\sqrt{29.50}}$	K	291.6

FIELD DATA

PLANT Pfizer
DATE 10-29-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Total Particulate
RUN NUMBER ESP-I-2-4
OPERATOR Whitel
AMBIENT TEMPERATURE 20.0
BAROMETRIC PRESSURE 29.50
STATIC PRESSURE, (P_s) 0.38 "H_2O
FILTER NUMBER (s) 36



PROBE LENGTH AND TYPE 39"
NOZZLE I.D. 0.501
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.98
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp ~~0.62~~ 0.57

Leak CK: Initial at 15" Hg, CFM 0.006
Final at Hg, CFM 0.000

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 29.6 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 752.956 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 0801											
	3	755.75	755.23	0.1	3.0	3.0	630	28	28	8	230	
	6	758.68	758.65	0.11	3.3	3.5	625	35	31	9	240	
	9 10	791.50	791.38	0.11	3.3	3.8	640	4[illegible]	32	10		
	12	794.50	794.14	0.11	3.3	3.5	655	38	32	12	240	55
	15 0911	797.42	797.11	0.11	3.3	3.7	635	31	32	14	245	
		Final =	797.113									
	Final Average	Vm = 14.167		Δp = .108	ΔH = 3.5		T_s = 637	T_m = 36				

$\sqrt{\Delta p}$ = .329

COMMENTS

EPA Form 235

C-3-1-60

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP - Outlet
Test Number ESP- I- 2-4

Date 10-29-80
Initial EW

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	637
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 3.5, Pb = 29.50, Vm = 14.157	Vm_{std}	14.98
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	31.46
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.79
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.47
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\sqrt{\Delta P} = .329$, $Cp = .84$	Vs	1558
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (637 + 460)(14.98)}{(1558)(15)(29.47)(.95)(.501^2)}$	% I	104

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: ESP-I-2-4
Sample Date: 10-29-80
Recovery Date:
Cleanup Person:

Filter No.: 36
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/	109	109	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	9	9			
Sample No.(s)					

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

SILICA GEL

662.2
655.5
06.7
Silica Gel Color:

Description of Impinger Solution:
Total Moisture, gm: 24.7

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ BEAKER No. 56 & 66
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. 70
Liquid Level Marked:
Sealed:

Filter Blank: Sample No.:
Sealed:

Sample Disposition:
Carrier: Date Shipped:
Remarks:

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

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-2-4 PARTICULATE CLEAN-UP AND ANALYSIS

Date 10-30-80 FIELD ANALYSIS Performed by [illegible]

	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~~ Bank #2 No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4	89.16283	66 - 76.23927			
66 & 56		5	93.56129	56 = 91.30581	265	[illegible]	10-23
	36	6	0.97493	0.78013		[illegible]	10-21
		6					
		6					
		7					
		8					
		9					
70		10	78.44831	78.44736	110		

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 4891-193

Source Identification ESP-Inlet

Test Run Number ESP-I-2-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	0901-0916		
Probe Technician				
Meter Technician			Whited	
Other				
Transport of Train to Cleanup Site	10-29-80	0920-09-35	Rajan, Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

102

MIDWEST RESEARCH INSTITUTE

RUN ESP-I- ~~[illegible]~~ 3-1

MRI Project Number 4891-L-93
Field Dates 10-31-80
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-31-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whited
2
3

Engr. Technician 1 Stultz
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 10-31-80

SAMPLING LOCATION ESP Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	41
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.29
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.26
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.999
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	600
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.085
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.92	
CALCULATED NOZZLE DIAMETER, in.	0.460	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.062	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-31-80
Initial CC

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

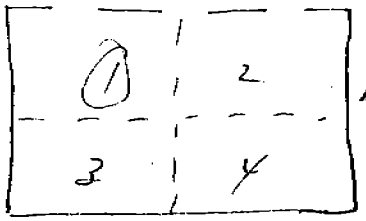
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	41
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.99
Nozzle diameter, inches	Dn	.501
Barometric pressure, inches Hg	Pb	29.29
$\frac{5.168\ (41 + 460)\ (.99)\ (.84)\ (3)\ (.501^2)}{\sqrt{29.29}}$	K	284

FIELD DATA

PLANT Pfizer
DATE 10-31-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-I-1
OPERATOR Whited
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.29
STATIC PRESSURE, (P_s) -.38" H_2O
FILTER NUMBER (s) 53



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 17 1/8
NOZZLE I.D. .501
ASSUMED MOISTURE, % 6%
SAMPLE BOX NUMBER 6
N → METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR .52
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 0.062

Leak CK: Initial at 15" Hg, CFM 0.001
Final at Hg, CFM 0.000

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 284 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	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	1037	907.557										
	3	1040	910.19	910.22	~~0.080~~ 0.09	2.7	2.8	600	42	42	9	230	
	6	1043	912.94	912.88	0.10	3.0	3.0	610	48	44	9	230	55
	9	1046	915.58	915.53	0.095	2.9	3.0	630	45	51	9 1/2	230	
	12	1049	918.11	918.13	0.085	2.6	2.8	610	54	48	10	230	
	15	1052	920.66	~~920.66~~	0.085	2.6	2.7	590	55	48	10	235	
			Final = ~~920.683~~ 921.255										
			Vm =	13.698		ΔH = 2.86			Tm =				
					Δp = .091			Ts = 608					
			Vm = 13.698		Δp = 0.091	ΔH = 2.86		Ts = 608	Tm =	47.7			

Gallon
Taken after test

COMMENTS

EPA Form 235

C-3-1-68

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-31-90
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}	608
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 2.86, Vm = 13.698, Tm = 47.7, Pb = 29.29	Vm_{std}	14.04
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 5.79	Mf	.942
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	31.3 ~~30.70~~
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	~~29.56~~ ~~29.26~~ 30.52
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) 1.5 = +.38	Ps	~~29.26~~ 29.32
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\sqrt{\Delta P}$ = 0.302, Cp = .84	Vs	~~1606.6~~ ~~1446~~ 1421
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (608 + 460)(14.04)}{(\cancel{1446}\ 1421)(15)(\cancel{29.26}\ 29.32)(.942)(.501^2)}$	% I	~~104~~ 105.4

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: ESP-I-3-1
Sample Date: 10-31-80
Recovery Date:
Cleanup Person:

Filter No.: ~~8~~ 53
Sample No.:
Sample Material Description:

MOISTURE AND/OR SAMPLE

	1	2	3	4	5
Impinger Sequence	1	2	3	4	5
Impinger Type a/					
Impinger Solution					
Final Volume (wt) b/	110	102	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/					
Sample No.(s)	10	2	1		

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

SILICA GEL

668.7	
663.5	
5.2	

Silica Gel Color:

Description of Impinger Solution:
Total Moisture, gm: 18.2

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ BEAKER No. 12
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. 91
Liquid Level Marked:
Sealed:

Filter Blank: Sample No.:
Sealed:

Sample Disposition:
Carrier: Date Shipped:
Remarks:

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

ESP-I-3-1

Run No. _____

MIDWEST RESEARCH INSTITUTE

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~~ BENKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
12		5	98.31092	85.98733	202 ml		
	53	6	0.93787	0.77389		JPEW	
		6					
		6					
		7					
		8					
		9					
91		10	84.80300	84.79945	154 ml		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L-93

Source Identification ESP Inlet

Test Run Number ESP-I-3-1

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-31-80	1037-1052	Whited, Stults	
Probe Technician				
Meter Technician	10-31-80		Whited	
Other				
Transport of Train to Cleanup Site	10-31-80	1055	Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				ON SITE LAB
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-3-2

MRI Project Number 4891-L (93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 11-3-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Raja
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 11-3-80

SAMPLING LOCATION ESP Inlet, ESP-I-3-2

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	6
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	29.07
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	590
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.09
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	.97	
CALCULATED NOZZLE DIAMETER, in.	.447	
ACTUAL NOZZLE DIAMETER, in.	.501	
REFERENCE Δp, in. H_2O	.057	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant: Pfizer
Sampling Location: ESP Exhst
Test Number: ESP-I-3-2

Date: 11-3-80
Initial: BCS

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

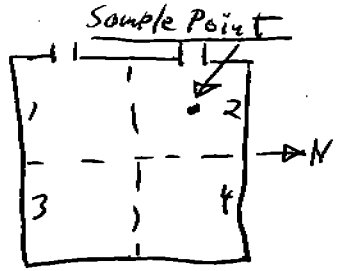
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	70
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.94
Nozzle diameter, inches	Dn	.501
Barometric pressure, inches Hg	Pb	29.10
$\frac{5.168\ (70 + 460)\ (.84)\ (3)\ (.94)\ (.501^2)}{\sqrt{29.10}}$	K	301.89

FIELD DATA

PLANT Pfizer
DATE 11-3-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-I-3-2
OPERATOR RCS
AMBIENT TEMPERATURE 65
BAROMETRIC PRESSURE 29.10
STATIC PRESSURE, (P_s) -.38
FILTER NUMBER (s) 55



PROBE LENGTH AND TYPE 3' SS
NOZZLE I.D. .501
ASSUMED MOISTURE, % 6
SAMPLE BOX NUMBER 8
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR .97
PROBE HEATER SETTING 75
HEATER BOX SETTING 350
REFERENCE Δp .057

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

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 301.89 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	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		922.843									
ESP-I-3-2	3	1618	925.68	925.71	.095	3.0	3.1	615	69	68	10	276	
	6	1621	928.51	928.49	.095	3.0	3.0	618	72	68	9	280	
	9	1624	931.37	931.29	.095	3.0	3.05	598	75	68	10	279	
	12	1627	934.19	934.15	.095	3.0	3.2	627	77	69	12	275	
	15	1630	937.03	936.996	.095	3.0	3.1	613	78	70	12	276	
								614					

COMMENTS Vm = 14.153 .095 3.09 71.2

EPA-Dwg 235

C-3-1-76

ISOKINETIC PERFORMANCE WORKSHEET

Plant: Pfizer
Sampling Location: ESP Inlet
Test Number: ESP-I-3-2

Date: 11-3-80
Initial: RCS

Isokinetic equation:

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

Average stack temperature, °F $\Delta H_{avg} = 3.09$	Ts_{avg}	614
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $Pb = 29.10$ $V_m = 14.153$ $T_m = 71.2$	Vm_{std}	13.784
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.07
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\rho_{s\,avg} = .095$	Vs	1459
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (614 + 460)(13.784)}{(1459)(15)(29.07)(.94)(.501^2)}$	% I	102.5

Note: actual moisture for this test = 6.49%

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: ESP-I-3-2
Sample Date: 11-3-80
Recovery Date: 11-3-80
Cleanup Person: Raja

Filter No.: 55
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/	108	105	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	8	5	2		
Sample No.(s)					

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

SILICA GEL

674.00	
668.70	
5.30	

Silica Gel Color

Description of Impinger Solution
Total Moisture, gm: 20.3

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 20
Liquid Level Marked
Sealed

Impinger Rinse: Sample No.
Liquid Level Marked
Sealed

Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed

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

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-3-2 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~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
20		5	96.89329	80.72443	200 ml		
	55	6	0.98771	0.77339			
		6					
		6					
		7					
		8					
		9					
114		10	83.65408	83.65438	115 ml		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-2(83)

Source Identification ESP Inlet

Test Run Number ESP-I-3-2

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	11-3-80	1615-1630		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other			Raja	
Transport of Train to Cleanup Site	11-3-80	1700	Raja ~~Stultz~~	
Train Disassembly	11-3-80	1700	Raja	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-3-3

MRI Project Number 4891-L-93
Field Dates 10-29-80
Plant AQ-zen
Sampling Location ESP. Inlet
Sampling Date 10-29-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whited
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-29-80

SAMPLING LOCATION ESP Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	50
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	.95
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.50
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.47
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.999
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	656
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.077
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.96	
CALCULATED NOZZLE DIAMETER, in.	0.473	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.062	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP - Inlet
Test Number ESP-I-33

Date 10-29-80
Initial F.L.O.

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

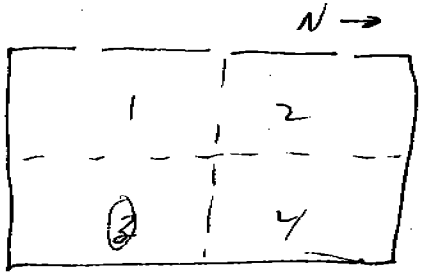
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	50
Pitot coefficient	Cp	0.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	0.501
Barometric pressure, inches Hg	Pb	29.50
$\frac{5.168\ (50 + 460)\ (.84)\ (3)\ (.95)\ (.501^2)}{\sqrt{29.50}}$	K	291.59

Tom Spit →

FIELD DATA

PLANT Pfizer
DATE 10-29-88
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Total Particulate
RUN NUMBER ESP-I-3-2
OPERATOR Whited
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 29.50
STATIC PRESSURE, (P_s) 0.38" H_2O
FILTER NUMBER (s) 37



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 39"
NOZZLE I.D. 0.501
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.96
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 0.062

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

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 291.6 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired (797.447)	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 / 1431											
	3	800.24	800.14	0.10	2.85	3.00	655	50	46	9	270	
	6	802.87	802.79	0.09	2.50	3.00	650	55	50	8	255	
	9 / 1439	805.35	805.45	0.085	2.40	3.00	645	60	50	9.5	275	
	12 / 1442	807.92	808.01	0.085	2.40	2.7	635	68	52	9.5	275	
	15 / 1445	810.40	810.33	0.080	2.3	2.2	645	70	55	8.0		
	Final = 810.325											
	Final, Average	V_m =	12.878	Δp = .088	ΔH =	2.78	T_s = 646	T_m =	55.0			

COMMENTS

C-3-1-84

EPA Form 235

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-29-80
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}	646
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 2.78$, $Pb = 29.50$, $Tm = 55.0$, $Vm = 12.878$	Vm_{std}	13.1 ~~13.09~~
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O =	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	31.53
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.85
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.47
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\sqrt{\Delta P} = 0.2966$, $Cp = 0.84$	Vs	1409.4
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	0.501
$\frac{1{,}039\ (646 + 460)(13.1)}{(1409.4)(15)(29.47)(.95)(.501^2)}$	% I	101.33

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer
Sample Location: E.S.P. Inlet
Sample Box No.: 6
Sample Type: P Mass

Run No.: ESP I-3-3
Sample Date: 10/29/80
Recovery Date: 10/29/80
Cleanup Person: DW

Filter No.: 37
Sample No.: ~~I-3-3~~
Sample Material Description:

MOISTURE AND/OR SAMPLE

Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M	M	
Impinger Solution	H_2O	H_2O	-		
Final Volume (wt) b/	102	110	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	2	10	1		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm: 17.9 gm

SILICA GEL

	667.1
	662.2 g
	4.9

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. 65
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~~ Blank No. 70
Liquid Level Marked
Sealed

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

MIDWEST RESEARCH INSTITUTE

Run No. ESP I-3-3

PARTICULATE CLEAN-UP AND ANALYSIS

Date 10-30-80

FIELD ANALYSIS

Performed by 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~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
65		5	109.3406	90.90063	228	JJ	10-29
	37	6	0.89319	0.78729		JJ	10-21
		6					
		6					
		7					
		8					
		9					
70		10	78.44831	78.44736	110		

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-3-3

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	(1431-1445)		
Probe Technician	~~10-28-80~~	~~1440~~	~~Stoltz~~ Stoltz	
Meter Technician	~~10-28-80~~	~~1440~~	Whited	
Other				
Transport of Train to Cleanup Site	10-28-80	1431-1450	Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-3-4

MRI Project Number 4891-L-93
Field Dates 10-29-80
Plant Pfizer
Sampling Location ESP-Inlet
Sampling Date 10-29-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whitel
2
3

Engr. Technician 1 Stultz
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-29-90

SAMPLING LOCATION ESP- I-3-4

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	60
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.50
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.47
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	0.98	
CALCULATED NOZZLE DIAMETER, in.	0.438	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.059	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-29-90
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

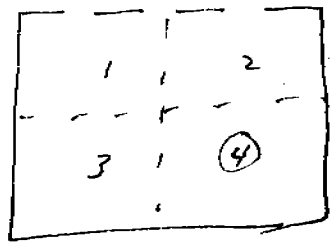
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	60
Pitot coefficient	Cp	0.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	0.501
Barometric pressure, inches Hg	Pb	29.50
$\frac{5.168\ (60 + 460)\ (.84)\ (3)\ (.95)\ (.501^2)}{\sqrt{29.50}}$	K	297.3

FIELD DATA

PLANT Pfizer
DATE 10-25-80
SAMPLING LOCATION ESP- Inlet
SAMPLE TYPE Total Particulate
RUN NUMBER ESP- I-3-4
OPERATOR Whited
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.50
STATIC PRESSURE, (P_s) 0.38" H_2O
FILTER NUMBER (s) 38



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 38"
NOZZLE I.D. 0.501
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR 0.999
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 0.058

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

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 297.3 \times \sqrt{\frac{Ps}{Ts + 460}}$

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	1610	810.668										
	3	1613	813.43	813.34	0.10	3.2	3.2	700	55	55	8	220	
	6	1616	816.35	816.23	0.11	3.3	3.4	680	58	55	9	250	
	9	1619	819.31	819.12	0.11	3.3	3.4	650	63	55	10	245	
	12	1622	822.24	822.06	0.11	3.3	3.5	675	66	55	11½	245	
	15	1625	825.17	825.09	0.11	3.3	3.7	675	70	55	13	245	6
			Final 825.092										
			V_m = 14.442		ΔP = .108	ΔH =	3.44	T_s = 676	T_m =	58.7			

COMMENTS

EPA Form 235

C-3-1-92

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP - Inlet
Test Number ESP - I - 3 - 4

Date 10-29-80
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}	676
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 3.44, Pb = 29.5, Vm = 14.442, Tm+460 = 518.7	Vm_{std}	14.613
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = ~~6.33~~ 5.92	Mf	.941 ~~.937~~
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	31.57
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	~~29.67~~ ~~30.58~~ 30.73
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) Ps = .38	Ps	29.53
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ ΔP = .108, Cp = .84	Vs	~~1589~~ 1584
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (676 + 460)(14.613)}{(1584)(15)(29.53)(.941)(.501^2)}$	% I	104.1 ~~104.2~~ ~~103.8~~

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-I-3-4
Sample Date 10-29-80
Recovery Date ~~[illegible]~~
Cleanup Person

Filter No. 38
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/	108	104	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	8	4	2		
Sample No.(s)					

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

SILICA GEL

	672.5
~~[illegible]~~	667.1
	5.4

Silica Gel
Color

Description of Impinger Solution
Total Moisture, gm 19.4

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ BEAKER No. 84
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. 70
Liquid Level Marked
Sealed

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

MIDWEST RESEARCH INSTITUTE

Run No. ESP I-3-4

PARTICULATE CLEAN-UP AND ANALYSIS

Date ~~10-29-80~~ 10-30-80 FIELD ANALYSIS Performed by [illegible]

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~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
84		5	103.9494	88.48486	185	[illegible]	10-29
	38	6	1.05711	0.78672		[illegible]	10-21
		6					
		6					
		7					
		8					
		9					
70		10	78.44831	78.44736	110 ml		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4881-L-93

Source Identification ESP-Inlet

Test Run Number ESP-I-3-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	1610-1625		
Probe Technician				
Meter Technician			Whited	
Other				
Transport of Train to Cleanup Site	10-29-80	1625-1645		
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

118

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-4-1(2)

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 11-5-80

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)

NOMOGRAPH DATA

PLANT Pfizer

DATE 11-5-80

SAMPLING LOCATION ESP-Inlet, ESP-I-4-1(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	6
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.20
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.92
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	613
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.085
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	~
C FACTOR	.96	
CALCULATED NOZZLE DIAMETER, in.	.460	
ACTUAL NOZZLE DIAMETER, in.	.501	
REFERENCE Δp, in. H_2O	.059	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 11-5-80
Initial BCS

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

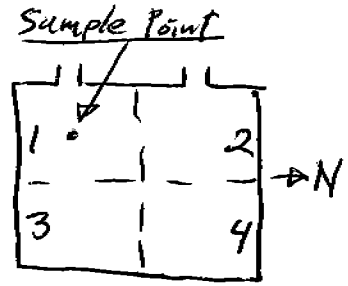
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	60
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.94
Nozzle diameter, inches	Dn	.501
Barometric pressure, inches Hg	Pb	29.20
$\frac{5.168\ (60 + 460)\ (.84)\ (3)\ (.94)\ (.501^2)}{\sqrt{29.20}}$	K	295.69

FIELD DATA

PLANT Pfizer
DATE 11-5-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-I-4-1 (2)
OPERATOR RCS
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 29.20
STATIC PRESSURE, (P_s) -.38" H_2O
FILTER NUMBER (s)



PROBE LENGTH AND TYPE 3' SS
NOZZLE I.D. .501
ASSUMED MOISTURE, % 6
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR .96
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp .059

Leak CK: Initial at 15" Hg, CFM .002 SCHEMATIC OF TRAVERSE POINT LAYOUT
12" Hg Final at Hg, CFM .003 READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 295.69 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1533		965.285									
ESP-I-4-1	3	1536	967.88	967.92	.085	2.63	2.7	646	62	64	9	234	
	6	1539	970.58	970.57	.090	2.81	2.80	620	66	64	9	234	65
	9	1542	973.37	973.30	.095	2.95	2.95	605	72	64	10	315	
	12	1545	976.00	975.95	.085	2.63	2.7	615	78	64	10	269	
	15	1548	978.79	978.69	.095	2.95	3.0	610	81	65	12	300	80
			13.394		.090		2.83	619.2		68			

COMMENTS.

EPA (Dur) 235

C-3-1-100

ISOKINETIC PERFORMANCE WORKSHEET

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

Date: 11-5-80
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}	619.2
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.20, Vm = 13.394, ΔH = 2.83, Tm = 68	Vm_{std}	13.160
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.17
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .090	Vs	1421
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (619.2 + 460)(13.16)}{(1421)(15)(29.17)(.94)(.501^2)}$	% I	100.6

Actual moisture = 5.0 %

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: ESP-I-4-1(2)
Sample Date: 11-5-80
Recovery Date: 11-5-80
Cleanup Person: Walker

Filter No.: 57
Sample No.:
Sample Material Description:

MOISTURE AND/OR SAMPLE

	1	2	3	4	5
Impinger Sequence					
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	Dry		
Final Volume (wt) b/	105	103	1		
Initial Volume (wt) b/	100	100			
Net Volume (wt) b/	5	3	1		
Sample No.(s)					

Combined impinger contents, Sample No.:
Liquid Level Marked: Container(s) Sealed:
Description of Impinger Solution:
Total Moisture, gm: 14.7

SILICA GEL

688.2	
682.5	
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. 117
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. 105
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. ~~EPI~~ 4-1 (2) PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
117		5	91.30623	77.16304	345 ml		
	57	6	0.99795	0.76954			
		6					
		6					
		7					
		8					
		9					
105		10	96.93587	96.93531	125 ml		

Comments:

Codes:

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

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Inlet

Test Run Number ESP-I-4-1(2)

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	11-5-80	1533-1548		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	11-5-80	1555	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-4-2

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

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Raja
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

NOMOGRAPH DATA

PLANT Pfizer

DATE 11-4-80

SAMPLING LOCATION ESP Inlet, ESP-I-4-2

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	6
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.06
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.03
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	613
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.085
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	.96	
CALCULATED NOZZLE DIAMETER, in.	.460	
ACTUAL NOZZLE DIAMETER, in.	.501	
REFERENCE Δp, in. H_2O	.06	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 11-4-80
Initial RCS

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

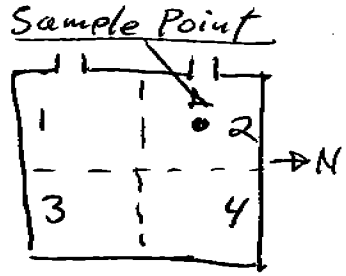
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	60
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	29.06
$\frac{5.168\ (60 + 460)\ (.84)\ (3)\ (.94)\ (.501^2)}{\sqrt{29.06}}$	K	296.40

FIELD DATA

PLANT Pfizer
DATE 11-4-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-I-4-2
OPERATOR RCS
AMBIENT TEMPERATURE 55
BAROMETRIC PRESSURE 29.06
STATIC PRESSURE, (P_s) -.38" H_2O
FILTER NUMBER (s) 56



PROBE LENGTH AND TYPE 3' SS
NOZZLE I.D. .501
ASSUMED MOISTURE, % 6
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
METER $\Delta H_@$ 1.84
C FACTOR .96
PROBE HEATER SETTING 100
HEATER BOX SETTING 400
REFERENCE Δp .96

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

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 296.40 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 950,920 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	1140											
ESP-I-4-2	3	1143	953.74	953.72	.10	3.0	3.1	645	51	51	10	238	
	6	1146	956.55	956.52	.10	3.0	3.1	655	55	52	9	236	
	9	1149	959.30	959.30	.095	2.9	3.1	640	58	52	10	243	
	12	1152	962.07	962.05	.095	2.9	3.0	630	60	52	11	240	
	15	1155	964.82	964.801	.095	2.9	3.0	643	62	53	12	244	
				13.881	.097		3.06	642.6		54.6			

COMMENTS

EPA Dwg 235

C-3-1-108

ISOKINETIC PERFORMANCE WORKSHEET

Plant: Pfizer
Sampling Location: ESP Inlet
Test Number: ESP-I-4-2

Date: 11-4-80
Initial: RCJ

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	642.6
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.06, ΔH = 3.06, Vm = 13.881, Tm = 54.6	Vm_{std}	13.935
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.03
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .097	Vs	1495
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (642.6 + 460)(13.935)}{(1495)(15)(29.03)(.94)(.501^2)}$	% I	103.9

Note: actual moisture for this test = 6.63 %

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: ESP-I-4-2
Sample Date: 11-4-80
Recovery Date: 11-4-80
Cleanup Person: Raja

Filter No.: 56
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/	112	104	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	12	4	1		
Sample No.(s)					

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

SILICA GEL

	682.5
	678.5
	4.0
Silica Gel	
Color	

Description of Impinger Solution:
Total Moisture, gm: 21.0

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 95
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~~ Blanks No. 114
Liquid Level Marked:
Sealed:

Filter Blank: Sample No.:
Sealed:

Sample Disposition:
Carrier: Date Shipped:
Remarks:

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

MIDWEST RESEARCH INSTITUTE

Run No. ~~E1-I-4-2~~ 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~~ BLANK No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
95		5	~~101.1855~~ ~~86.64714~~	86.64714	255 ml		
	56	6	1.33093	0.75777			
		6					
		6					
		7					
		8					
		9					
114		10	83.65408	83.65438	115		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-2(93)

Source Identification ESP Inlet

Test Run Number ESP-I-4-2

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	11-4-80	1140-1155		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	11-4-80	1200	Raja	
Train Disassembly	11-4-80		Raja	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-4-3

MRI Project Number 4891-L-93
Field Dates 10-29-80
Plant Pfizer
Sampling Location ESP - Inlet
Sampling Date 10-29-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whited
2
3

Engr. Technician 1 Stultz
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 10-29-80

SAMPLING LOCATION ESP - Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	60
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	~~35~~ 5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.5
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.47
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s / P_m	0.999
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	650
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.088
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.97	
CALCULATED NOZZLE DIAMETER, in.	0.455	
ACTUAL NOZZLE DIAMETER, in.	0.501	
REFERENCE Δp, in. H_2O	0.061	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Inlet
Test Number ESP-I-4-3

Date 10-29-80
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

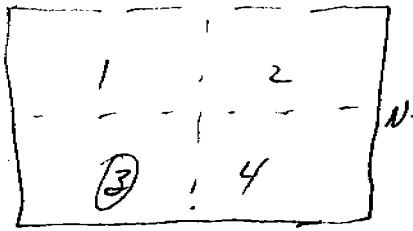
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	60
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	29.50
$\frac{5.168\ (60 + 460)\ (.84)\ (.95)\ (3)\ (.501^2)}{\sqrt{29.50}}$	K	297

FIELD DATA

PLANT Pfizer
DATE 10-29-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Total Particulate
RUN NUMBER ESP-I-4-3
OPERATOR Whited
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.50
STATIC PRESSURE, (P_s) 0.38" H_2O
FILTER NUMBER (s) 38 39



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 38"
NOZZLE I.D. 0.501
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 5
N → METER $\Delta H_@$ 1.84
C FACTOR 0.97
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 0.061

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

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 257.3 \times \sqrt{\frac{Ps}{Ts + 460}}$

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	1743	826.525										
	3	6	829.03	829.23	0.075	2.5	3.0	600	48	50	8	230	
	6	9	831.68	831.74	0.085	2.6	2.6	610	55	50	8	230	
	9	2	834.39	834.18	0.090	2.75	2.3	620	60	50	6		65
	12	5	837.09	836.67	0.090	2.75	2.5	630	65	53	7	250	
	15	1758	839.72	839.66	0.085	2.6	2.8	630	70	54			

Final = 839.667

V_m = 13.142 Δp_s = 0.085 ΔH = 2.64 T_s = 618 T_m = 55.5

COMMENTS

EPA Form 235

C-3-1-116

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Inlet
Test Number ESP-I-4-3

Date 10-29-80
Initial PW

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	618
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 2.64$, $Vm = 13.142$, $Tm = 55.5$, $Pb = 29.50$	Vm_{std}	13.35
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 4.47$	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	31.4
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	30.73
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	29.47
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\sqrt{\Delta P} = .291$, $Cp = .84$	Vs	1492.3
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\,(618 + 460)(13.35)}{(1492)(15)(29.47)(0.95)(.501^2)}$	% I	95.

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-I-4-3
Sample Date 10-28-80
Recovery Date
Cleanup Person

Filter No. 39
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/	106	103	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	6	3	0		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 13.2

SILICA GEL

676.7	
672.5	
4.2	

Silica Gel
Color

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 86
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. 79
Liquid Level Marked
Sealed

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

ESP-I-4-3

Run No. _____

MIDWEST RESEARCH INSTITUTE

PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ BLANK No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
86		5	95.56559	84.10184	180 ml		
	39	6	1.13979	0.77812			
		6					
		6					
		7					
		8					
		9					
70		10	78.44831	78.44736	110 ml		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L-93

Source Identification ESP Inlet

Test Run Number ESP- I-4-3

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80			
Probe Technician				
Meter Technician			United	
Other				
Transport of Train to Cleanup Site	10-29-80			
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-I-4-4

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

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
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)

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 ($P_m \pm 0.074$ 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

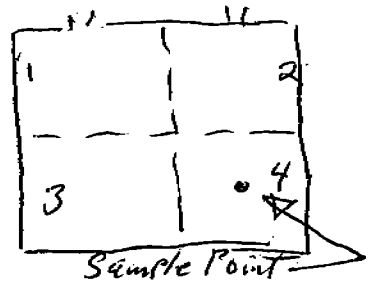
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	65
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.94
Nozzle diameter, inches	Dn	.501
Barometric pressure, inches Hg	Pb	29.05
$\frac{5.168\ (65 + 460)\ (.84)\ (5)\ (.94)\ (.501)}{\sqrt{29.05}}$	K	498.8

FIELD DATA

PLANT Pfizer
DATE 12-8-80
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE Must
RUN NUMBER ESP-I-4-4
OPERATOR [illegible]
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 29.05
STATIC PRESSURE, (P_s) -0.38"
FILTER NUMBER (s) 96



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 4' S.S
NOZZLE I.D. .501
ASSUMED MOISTURE, % 6
SAMPLE BOX NUMBER 12
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR .93
PROBE HEATER SETTING 100
HEATER BOX SETTING 306
REFERENCE Δp .062

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

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 294.3 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual (240.363)	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 / 1553											
	5 / 1602	244.34	244.29	.07	2.1	2.3	637	56	58	8		
	10 / 1607	248.45	[illegible]	[illegible]	[illegible]	2.5	634	64	50	8		
	15 / 1612	252.45	252.259	.07	2.1	2.5	629	70	58	10		
	~~20~~											
	~~25~~											
		V_m =	11.896	.072 avg		avg 2.43	avg 637.7	60.7				

COMMENTS

C-3-1-124

EPA Form 235

ISOKINETIC PERFORMANCE WORKSHEET

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

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}	637.7
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 2.43$, $Pb = 29.05$, $Vm = 11.896$, $Tm = 60.7$	Vm_{std}	11.779
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94 assumed
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 assumed
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.02
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\frac{\sqrt{\Delta Ps_{avg}}}{.072}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	1285
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.501
$\frac{1{,}039\ (637.7 + 460)(11.779)}{(1285)(15)(29.02)(.94)(.501^2)}$	% I	101.8

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: ESP-I-4-4
Sample Date: 12-8-80
Recovery Date: 12-8-80
Cleanup Person:

Filter No.: 96
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/	140	66	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	40	-34	0		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm: 10.8

SILICA GEL

Note: Water backed up from impingers into filter housing. Some H_2O not measured.

704.2	
699.4	
4.8	

Silica Gel
Color

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

RECOVERED SAMPLE

Probe Rinse: Sample No. 157-156
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. 145
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. ESP-I-4-4 PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
157		4 5	99.49899	85.40733			
156		5	96.00611	91.08833	285		
	96	6	1.95482	0.49961			
		6					
		6					
		7					
		8					
		9					
145		10	88.94321	88.94202	165		

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 _____

Task	Date	Time	Personnel	Remarks
Sampling	12-8-80	1557-1612		
Probe Technician			Hansen	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	12-8-80	1620	Hansen	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Pfizer
DATE 10-22-80
SAMPLING TIME (24-hr CLOCK) 1140
SAMPLING LOCATION Precip. Inlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS GRAB) Grab
ANALYTICAL METHOD Fyrite
AMBIENT TEMPERATURE 30°
OPERATOR C Whited

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	19.0		18.0		19.0		18.67	44/100	8.21
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	11.0		10.0		10.0		10.33	32/100	3.31
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							71	28/100	19.88
								TOTAL	31.40

EPA (Dur) 230
4.72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Pfizer
DATE 10-28-80
SAMPLING TIME (24-hr CLOCK) 0940
SAMPLING LOCATION ESP Inlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS GRAB) Grab
ANALYTICAL METHOD Fyrite
AMBIENT TEMPERATURE 48
OPERATOR Chiles

COMMENTS:

RUN / GAS	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	20		19		20		19.67	44/100	8.65
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	8.0 ~~10.5~~		8.5		7.5		8.0	32/100	2.56
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							72.33	28/100	20.25
								TOTAL	31.46

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Pfizer
DATE 10-29-90
SAMPLING TIME (24-hr CLOCK) _____
SAMPLING LOCATION _____
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS GRAB) _____
ANALYTICAL METHOD _____
AMBIENT TEMPERATURE _____
OPERATOR _____

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	19.0		20		20	~~19.67~~	19.67	44/100	8.65
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	9.0		9.0		10.0		9.33	32/100	2.99
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	~~19.0~~		~~20~~		~~20~~			28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							71	28/100	19.89
								TOTAL	31.53 ~~31.46~~

EPA (Dun) 230
4/72

C-3-1-131

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Pfizer
DATE 10-30-80
SAMPLING TIME (24-hr CLOCK) 1200
SAMPLING LOCATION ESP-Inlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS GRAB) Grab
ANALYTICAL METHOD Fyrite
AMBIENT TEMPERATURE 45°F
OPERATOR Raja

COMMENTS:

RUN / GAS	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	18.5		19.0		19.0		18.83	44/100	8.285
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	9.0		8.5		8.5		8.77	32/100	2.806
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	0		0		0		0	28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)	72.5		72.5		72.5		72.5	28/100	20.3
								TOTAL	31.391

EPA (Dun) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT PFIZER
DATE 10-4-80
SAMPLING TIME (24-hr CLOCK) 1.30
SAMPLING LOCATION ESP. Inlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS GRAB) Grab
ANALYTICAL METHOD Fyrite
AMBIENT TEMPERATURE 51
OPERATOR Raja

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	18.5		19.5		18.5		18.83	44/100	8.29
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	9.0		9.5		9.5		9.33	32/100	2.99
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							71.84	28/100	20.12
								TOTAL	31.40

EPA (Dur) 230
4/72

C-3-1-133

DRY MOLECULAR WEIGHT DETERMINATION

PLANT: Pfizer
DATE: 12-8-80
SAMPLING TIME (24-hr CLOCK): 1020
SAMPLING LOCATION: ESP Inlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS GRAB): Grab
ANALYTICAL METHOD: Fyrite
AMBIENT TEMPERATURE: 60
OPERATOR: RCS

COMMENTS: ambient O_2 = 19%

RUN / GAS	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	20.3		~~≈22~~		20.5	(4) ≈21.5	20.77	44/100	9.14
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	13.3		12.2		10.9		12.13	32/100	3.88
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							67.1	28/100	18.79
								TOTAL	31.81

EPA (Dur) 230
4/72

C-3-2 Particle Sizing

(92)

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-1-1

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location 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 29.40 " Hg

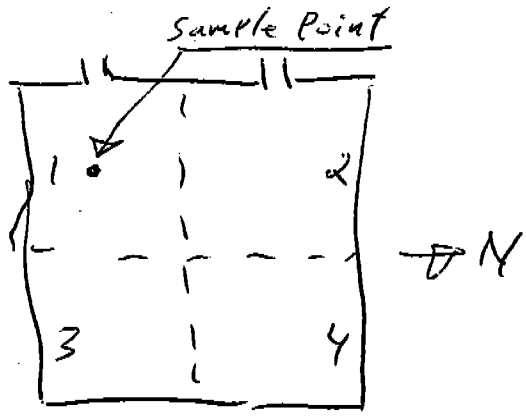
Sample Time 4 min

Probe Tip Diameter .116

Velocity at Sample Point 1372 FPS

Sample Rate .103 CFM

ΔP_s = .085" H_2O at ____



View from gate valve

Schematic of Traverse Point Layout with Dimensions

Gas Composition

CO_2 18.8

O_2 8.7

CO 0

N_2 72.5

H_2O 6%

Preheat Started 1515

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1529	2.59	2.5	64	Start	0
~~1530~~					
1531		2.5	64		.111
1532		2.5	64		.165
1533		2.5	64	Stop	.223

ISOKINETIC PERFORMANCE WORKSHEET

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

Date: 10-30-80
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}	613
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.40, Vm = .223, Tm = 64	Vm_{std}	.221
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.37
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\frac{\sqrt{\Delta Ps_{avg}}}{.085}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	1372
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\ (613 + 460)(.221)}{(1372)(4)(29.37)(.94)(.116^2)}$	% I	120.8

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-1-1 BRINK Date _____

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

ANALYSIS

Final Weights

By: Boomer Date: 11-3-80

Location: On Site Lab

Tare Weights

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

Location: On Site Lab

FILTER SET #25

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	25-C	.47644	.23136	.24508	* / **	* / **	
1	25-1	.44909	.43951	.00958			
2	25-2	.42686	.42379	.00307			
3	25-3	.43824	.43703	.00121			
4	25-4	.42087	.42013	.00074			
5	25-5	.42104	.42046	.00058			
Filter	25-F	.26875	.26735	.00140			
			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-L93

Source Identification ESP-Inlet

Test Run Number ESP-I-1-1

Pollutant(s) in Sample ~~Mass~~ Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1529-1533		
Probe Technician				
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-30-80	1533-1550	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			I. Parsons	On Site Lab
Write Up				

(84)

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN BP-I-1-2

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location 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-1-2 DATE 10-30-80

Flue Gas Temperature 580 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.55 " Hg

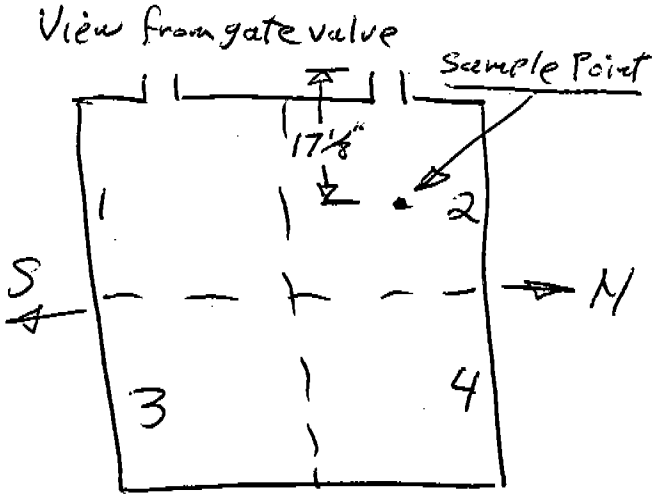
Sample Time 4 min

Probe Tip Diameter .116"

Velocity at Sample Point ~~1223~~ 1387 FPS

Sample Rate ~~.092~~ .103 CFM

$\Delta P_s = .07$



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .09" H_2O at 1149

Gas Composition

CO_2 18.8

O_2 8.8

CO 0

N_2 72.5

H_2O 6 %

Preheat Started - 1122

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1159	~~1.90~~ 2.47	2.47	65	Start	0
1200		2.47	65		.053
1201		2.47	65		.104
1202		2.47	65		.160
1203		2.47	65	Stop	.214

ISOKINETIC PERFORMANCE WORKSHEET

Plant: Pfizer
Sampling Location: 10-30-80
Test Number: ESP-I-1-A

Date: 10-30-80
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}	580
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.55, Vm = .214, Tm = 65	Vm_{std}	.212
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.52
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\frac{\sqrt{\Delta Ps_{avg}}}{.09}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	1387
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\ (580 + 460)(.212)}{(1387)(4)(29.52)(.94)(.116^2)}$	% I	110.6

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-1-2
MRI Project No. 4891-193

BRINK
Particle Size Analysis

Date 11-5-80
Recorded by JP

ANALYSIS

Final Weights

By: Boomer Date: 11-4-80

Location: On Site Lab

Tare Weights

By: JP Date: 10-20-80

Location: On Site Lab

Set # 14

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	14-C	.41835	.21266	.20569	* / **	* / **	
1	14-1	.41221	.40542	.00679			
2	14-2	.39984	.39633	.00351			
3	14-3	.41072	.40987	.00085			
4	14-4	.40805	.40758	.00047			
5	14-5	.33164	.33110	.00054			
Filter	14-F	.26214	.26087	.00127			
			Total	* / **			

CONCENTRATION CALCULATION

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

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

* With filter
** Without filter

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Inlet

Test Run Number ESP-I-1-2

Pollutant(s) in Sample Particle sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1159 – 1203 –		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-30-80	1215	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1400	J. Pawlowo	
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-1-3(2)

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

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. ESP-I-1-3(2) DATE 10-28-80

Flue Gas Temperature ~~633~~ 655 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.34 " Hg

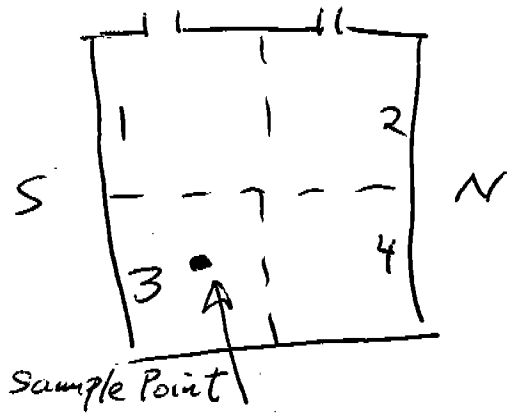
Sample Time 4 min

Probe Tip Diameter .115

Velocity at Sample Point 1359 FPS

Sample Rate .099 CFM

Pitot ΔP_s = .08" H_2O



View from gate value.

Schematic of Traverse Point Layout with Dimensions

Filter Set # 18

Gas Composition

CO_2 18.7

O_2 10.3

CO 0

N_2 71

H_2O 6%

Md = 31.40

Preheat Started - 1847

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1908	2.10	2.1	80	Start	0
1909		2.1	80		.056
1910		2.1	80		.102
1911		2.1	80		.154
1912		2.1	80	STOP	.200

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}	655
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.31, Vm = .200, Tm = 80	Vm_{std}	.192
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.31
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .08	Vs	1359
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (655 + 460)(.192)}{(1359)(4)(29.31)(.94)(.115^2)}$	% I	112.3

ESP-I-1-3(2) MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-1-3 | BRINK | Date 10-28-80

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

ANALYSIS

Final Weights

By: I.P. Date: 10-30-80

Location: On Site Lab

Tare Weights

By: I.P. Date: 10-24-80

Location: On Site Lab

SET #18

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	18-C	.50054	.21574	.28480	* / **	* / **	
1	18-1	.42322	.41312	.01010			
2	18-2	.41884	.41506	.00378			
3	18-3	.33894	.33757	.00137			
4	18-4	.36075	.35975	.00100			
5	18-5	.34676	.34602	.00074			
Filter	18-F	.25734	.25583	.00151			
			Total	* / **			

CONCENTRATION CALCULATION

Sampling Duration _____ min

Flow Rate (Brink) _____ cfm

Baro. Pressure _____ in. Hg

Temperature _____ °F

Particulate Concentration _____ $\mu g/m^3$, actual conditions

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

* With filter

** Without filter

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Inlet

Test Run Number ESP-I-1-3 ESP-I-1-3(2)

Pollutant(s) in Sample Particulate Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1908-1912		
Probe Technician			Cobb	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-28-80	1920	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1435	Rawlins	
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-1-04 (2)

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 Stulte
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-1-4 DATE 10-28-80

Flue Gas Temperature 633 °F

Static Pressure -.38 " H_2O

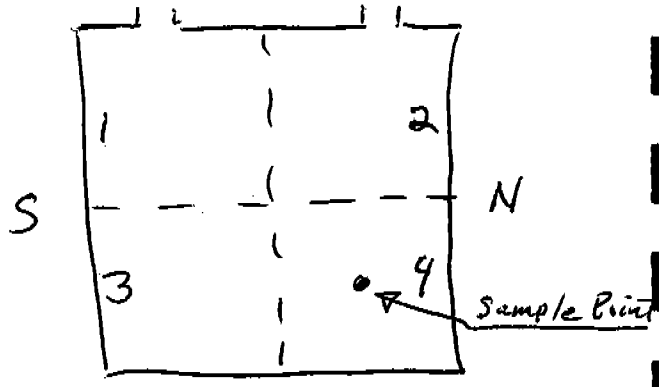
Barometric Pressure 29.25 " Hg

Sample Time 4 min

Probe Tip Diameter .116

Velocity at Sample Point 1260 FPS

Sample Rate .086 CFM



View from gate valve

Schematic of Traverse Point Layout with Dimensions

Pitot ΔPs = .085" H_2O at 1415

Gas Composition

CO_2 18.7

O_2 10.3

CO 0

N_2 71

H_2O 6 %

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1427	1.80 ~~1.55~~	1.80	95	Start	0
1428		1.80	95		.036
1429		1.80	96		.090
1430		1.80	96		.130
1431		1.80	96	Stop	.176

ISOKINETIC PERFORMANCE WORKSHEET

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

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ (.176; 29.25; 95.6)	Vm_{std}	.163
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.22
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ (.085)	Vs	1389
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\ (633 + 460)(.163)}{(1389)(4)(29.22)(.94)(.116^2)}$	% I	90.2

ESPI-1-4 (2) MIDWEST RESEARCH INSTITUTE

Run No. ESPI-1-4 | BRINK | Date 11-28-80

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

ANALYSIS

Final Weights

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

Location: On Site Lab

Tare Weights

By: J.P. Date: 10-24-80

Location: On Site Lab

SET #15

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	15-C	.51529	.21947	.29582	* **	* **	
1	15-1	.35088	.34240	.00848			
2	15-2	.34612	.34156	.00456			
3	15-3	.34355	.34209	.00146			
4	15-4	.33691	.33607	.00084			
5	15-5	.34993	.34891	.00102			
Filter	15-F	.26002	.25968	.00034			
			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-I-1-4 ESP-I-1-4(2)

Test Run Number ESP-I-1-4

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1427-1431		
Probe Technician			Stulte	
Meter Technician			Stulte	
Other				
Transport of Train to Cleanup Site	10-28-80	1445	Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1415	J. Pawlowski	
Write Up				

97

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-2-1

MRI Project Number 4891-L (93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-31-80

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-2-1 DATE 10-31-80

Flue Gas Temperature 613 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.28 " Hg

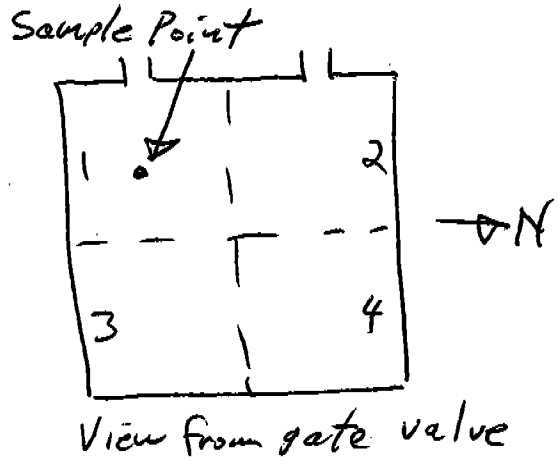
Sample Time 4 min

Probe Tip Diameter (Nozzle #B-5) .115

Velocity at Sample Point 1375 FPS

Sample Rate .103 CFM

ΔP_s = .085



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .085 at 0939

Gas Composition

CO_2 18.8

O_2 8.8

CO 0

N_2 72.5

H_2O 6%

M_d = 31.40

Preheat started-0901

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
0934	2.13	2.1	61	Start	0
0935		2.1	61		.051
0936		2.1	61		.100
0937		2.1	61		.150
0938		2.1	61	Stop	.201

ISOKINETIC PERFORMANCE WORKSHEET

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

Date: 10-31-80
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}	613
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.28, Vm = .201, Tm = 61	Vm_{std}	.199
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	29.26
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\frac{\sqrt{\Delta Ps_{avg}}}{.085}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	1375
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (613 + 460)(.199)}{(1375)(4)(29.26)(.94)(.115^2)}$	% I	110.9

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-2-1 BRINK Date 10-31-80

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

ANALYSIS

Final Weights	Tare Weights
By: Boomer Date: 11-4-80	By: AP Date: 10-30-80
Location: On Site Lab	Location: On-Site LAB

Set # 28

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	28-C	.39143	.24592	.14551	* **	* **	
1	28-1	.44894	.43606	.01288			
2	28-2	.43176	.42722	.00754			
3	28-3	.35016	.34915	.00101			
4	28-4	.35702	.35639	.00063			
5	28-5	.34913	.34873	.00040			
Filter	28-F	.28143	.28108	.00035			
			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-2-1

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-31-80	0934-0938		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-31-80	0945	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1605	Pavlonis	
Write Up				

93

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ~~B~~-I - 2 - 2

MRI Project Number 4891-L(97)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-30-80

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-2-2 DATE 10-30-80

Flue Gas Temperature 590 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.40 " Hg

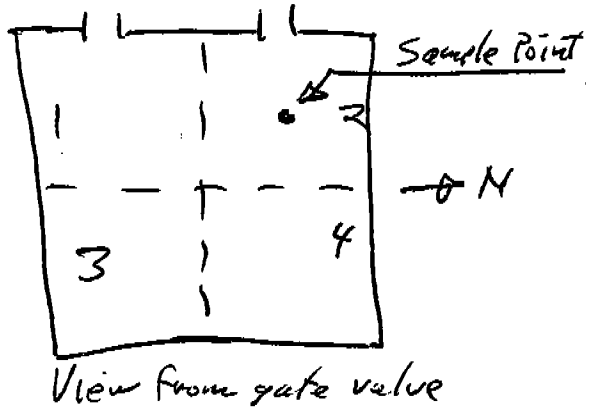
Sample Time 4 min

Probe Tip Diameter .116

Velocity at Sample Point 1350 FPS

Sample Rate .101 CFM

ΔP = .084



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .080 at 1703

Gas Composition

CO_2 18.8

O_2 8.8

CO 0

N_2 72.5

H_2O 6%

M_d = 31.40

Pocket started - 1648

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1709	~~2.10~~	2.1	59	Start	0
1710		2.1	59		.054
1711		2.1	60		.109
1712		2.1	60		.160
1713		2.1	60	STOP	.215

ISOKINETIC PERFORMANCE WORKSHEET

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

Date: 10-30-80
Initial: RCS

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	590
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb=29.40 Vm=.215 Tm=59.6	Vm_{std}	.215
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.37
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\frac{\sqrt{\Delta Ps_{avg}}}{.080}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	1317
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\ (590 + 460)(.215)}{(1317)(4)(29.37)(.94)(.116^2)}$	% I	119.9

MIDWEST RESEARCH INSTITUTE

Run No. ESPI-2-2
MRI Project No. _____

BRINK
Particle Size Analysis

Date 11-5-80
Recorded by J.R.

ANALYSIS

Final Weights

By: Boomer Date: 11-4-80

Location: On-Site Lab

Tare Weights

By: JD. Date: 10-29-80

Location: On-Site Lab

Filter set # 26

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	26-C	.45278	.23908	.21320	* **	* **	
1	26-1	.35946	.34937	.01009			
2	26-2	.36256	.35912	.00344			
3	26-3	.35106	.34997	.00109			
4	26-4	.43255	.43202	.00053			
5	26-5	.35216	.35124	.00092			
Filter	26-F	.28012	.27883	.00129			
			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-2-2

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1709-1713		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-30-80	1718	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1425	Pawlowski	
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-2-3

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-29-80

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-2-3 DATE 10-29-80

Flue Gas Temperature 633 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.50 " Hg

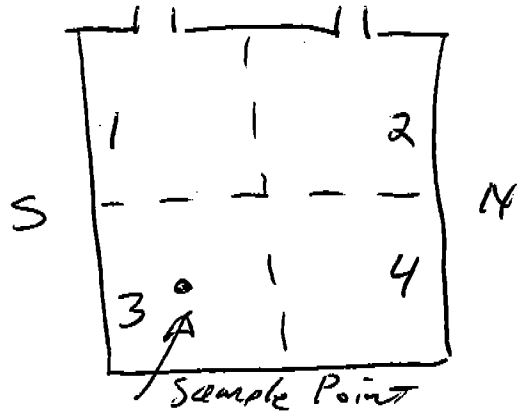
Sample Time 4 min

Probe Tip Diameter .115

Velocity at Sample Point 1112 FPS

Sample Rate .084 CFM

ΔP_s, Sample Point: .055" H_2O



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .080" H_2O @ 0925

Gas Composition

CO_2 19.7

O_2 9.3

CO 0

M_d = 31.40

N_2 71

H_2O 6 %

Preheat Started 0859

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
0936	~~1.47~~ 2.15	2.15	83	Start	0
0937		2.15	82		.051
0938		2.15	82		.098
0939		2.15	81		.142
0940		2.15	80	Stop	.193

ISOKINETIC PERFORMANCE WORKSHEET

Plant: Pfizer
Sampling Location: ESP Inlet
Test Number: ESP-T-2-3

Date: 10-29-80
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}	663
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.50, Vm = .193, Tm = 81.6	Vm_{std}	.185
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.48
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .08	Vs	1341
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (633 + 460)(.185)}{(1341)(4)(29.48)(.94)(.115^2)}$	% I	106.8

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-2-3
MRI Project No. 4891-L93

BRINK
Particle Size Analysis

Date 10-29-80
Recorded by JP

ANALYSIS

Final Weights

By: J.P. Date: 10-30-80
Location: On Site Lab

Tare Weights

By: J.P. Date: 10-25-80
Location: On Site Lab

Set #19

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	19-C	.46490	.22720	.23770	* **	* **	
1	19-1	.35254	.34368	.00886			
2	19-2	.34656	.34335	.00321			
3	19-3	.34251	.34147	.00104			
4	19-4	.41725	.41679	.00046			
5	19-5	.34302	.34208	.00094			
Filter	19-F	.26854	.26724	.00130			
			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-L93

Source Identification ESP Inlet

Test Run Number ESP-I-2-3

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	0936-0940		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-29-80	0955	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1:30 p.m	J. Pavelomo	
Write Up				

60

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-F-[redacted] 2-4

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

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. ESP-I-2-4 DATE 10-28-80

Flue Gas Temperature ~~633~~ 650 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.31 " Hg

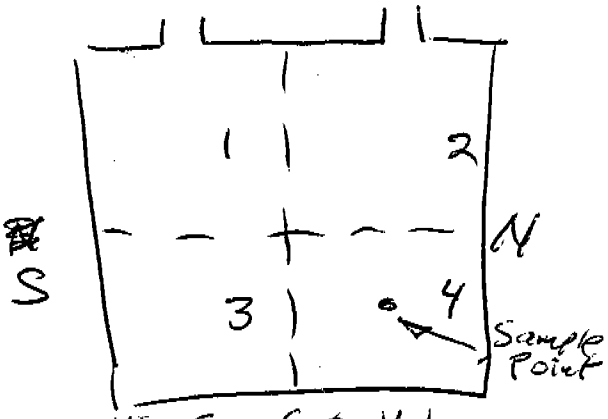
Sample Time 4 min

Probe Tip Diameter .116

Velocity at Sample Point ~~1388~~ 1614 FPS

Sample Rate ~~.094~~ CFM

Pitot ΔP_s = .085



View From Gate Valve

Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s at ~~[illegible]~~ = .115

Gas Composition

CO_2 19.7

O_2 8.0

CO 0

N_2 72.3

H_2O 6%

Filter Set # 17 Preheat Start - 1737

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1813	~~1.84~~ 2.52	2.5	80	Start	0
1814		2.5	80		.058
1815		2.5	80		.106
~~1816~~ 1817		2.5	80	Stop	.210

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-28-80
Initial R.C.

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 = 29.25 ~~ΔHavg~~ Vm = .210 Tm+460 = 540	Vm_{std}	.201
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ %H2O = 8.13	Mf	.919
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	31.46
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.37
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) Pg = -.38	Ps	29.22
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps x Ms}}$ ΔP = .085 Cp = .84	Vs	1394
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\ (633 + 460)(.201)}{(1394)(4)(29.22)(.919)(.116^2)}$	% I	113.3

MIDWEST RESEARCH INSTITUTE

Run No. ESP-T-2-4
MRI Project No. 4891-L93

BRINK
Particle Size Analysis

Date 10-28-80
Recorded by JP

ANALYSIS

Final Weights	Tare Weights
By: J.P. Date: 10-29-80	By: J.P. Date: 10-24-80
Location: On Site Lab	Location: On Site Lab

Set #17

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	17-C	.61721	.22441	.39280	* **	* **	
1	17-1	.36517	.33987	.02530			
2	17-2	.35357	.34724	.00633			
3	17-3	.35009	.34834	.00175			
4	17-4	.34004	.33897	.00107			
5	17-5	.35269	.35149	.00120			
Filter	17-F	.26134	.26124	.00010			
			Total	* **			

CONCENTRATION CALCULATION

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

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

* With filter
** Without filter

SAMPLE HANDLING LOG

Project Number 4891-L93

Source Identification ESP-Inlet

Test Run Number ESP-I-2-4

Pollutant(s) in Sample Mass (Particle sizing)

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1813-1817		
Probe Technician				
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-28-80	1820-1840	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1:30 pm	J. Parkhomo	
Write Up				

105

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-3-1

MRI Project Number 4891-L (27)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 11-3-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1 Raja
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 - 3-1 DATE 11-3-80

Flue Gas Temperature 613 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.10 " Hg

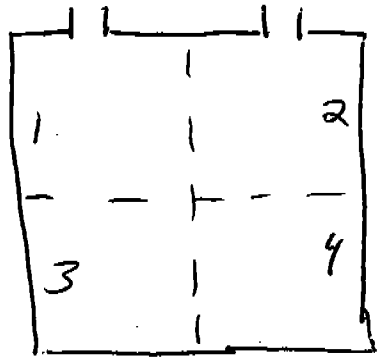
Sample Time 4 min

Probe Tip Diameter .115

Velocity at Sample Point 1379 FPS

Sample Rate .104 CFM

ΔP_s = .085



View from gate valve

Schematic of Traverse Point Layout with Dimensions

Pitop ΔP_s = .090 at 1642

Filter Set # 30

Gas Composition

CO_2 18.6

O_2 18.6

CO 0

N_2 72.5

H_2O 6%

M_d = 31.40

Preheat Started - 1542

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1648	2.1	2.15	78	Start	0
1649		2.15	78		.050
1650		2.15	78		.099
1651		2.15	78		.150
1652		2.15	78	STOP	.197

ISOKINETIC PERFORMANCE WORKSHEET

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

Date: 11-3-80
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}	613
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.10, Vm = .197, Tm = 78	Vm_{std}	.188
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.07
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .090	Vs	1419
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (613 + 460)(.188)}{(1419)(4)(29.07)(.94)(.115^2)}$	% I	102.2

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-3-1 | BRINK | Date 11-3-80

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

FILTER SET #30

ANALYSIS

Final Weights

By: Boomer Date: 11-4-80

Location: On Site Lab

Tare Weights

By: AP Date: 10-30-80

Location: On Site Lab

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	30-C	.52973	.23130	.29843	* / **	* / **	
1	30-1	.43998	.42833	.01165			
2	30-2	.34931	.34565	.00366			
3	30-3	.35899	.35796	.00103			
4	30-4	.42683	.42629	.00054			
5	30-5	.41429	.41368	.00061			
Filter	30-F	.28187	.28062	.00125			
			Total	* / **			

CONCENTRATION CALCULATION

Sampling Duration _____ min

Flow Rate (Brink) _____ cfm

Baro. Pressure _____ in. Hg

Temperature _____ °F

Particulate Concentration _____ μg/m^3, actual conditions

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

* With filter

** Without filter

SAMPLE HANDLING LOG

Project Number 4891-2(93)

Source Identification ESP Inlet

Test Run Number ESP-I-3-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	11-3-80	1648-1652-		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	11-3-80	1700	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1635	Pawlonis	
Write Up				

1011

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-~~[illegible]~~

MRI Project Number ~~[illegible]~~ 4891-L(93) 3-2
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-31-80

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-3-2 DATE 10-31-80

Flue Gas Temperature 589 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.27 " Hg

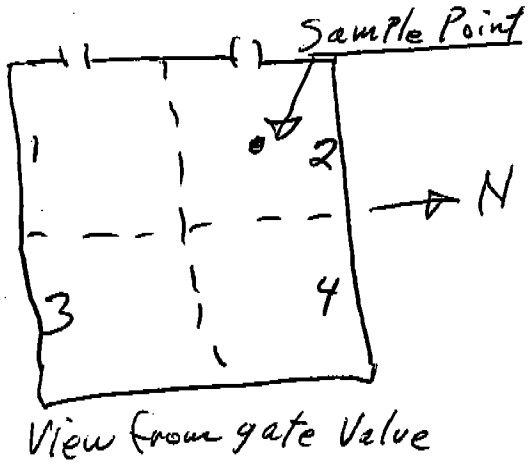
Sample Time 4 min

Probe Tip Diameter .116

Velocity at Sample Point 1399 FPS

Sample Rate .105 CFM

ΔP_s = .09



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .08 at 1102

Filter Set #29

Gas Composition

CO_2 18.5

O_2 8.8

CO 0

N_2 72.5

H_2O 6%

Md = 31.40

Start Preheat - 1021

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1108	2.27	2.2	66	Start	0
1109		2.2	66		.053
1110		2.2	66		.104
1111		2.2	66		.158
1112		2.2	66	STOP	.208

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP-I ~~Inlet~~
Test Number ESP-I-3-2

Date 10-31-80
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}	589
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ~~ΔH~~ Pb = 29.27 Vm = .208 Tm+460 = 526	Vm_{std}	.204
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ Assume = 6%	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	31.4
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.6
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) Ps = -.38	Ps	29.24
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ ΔP = ~~21.08~~ Cp = .84	Vs	1319
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\ (589 + 460)(.204)}{(1319)(4)(29.24)(.94)(.116^2)}$	% I	113.9

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-3-2 | BRINK | Date 10-31-80

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

ANALYSIS

Final Weights

By: Boomer Date: 11-4-80

Location: On Site Lab

Tare Weights

By: JP Date: 10-30-80

Location: On Site Lab

Set # 29

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	29-C	.46550	.24317	.22233	* / **	* / **	
1	29-1	.36788	.35747	.01041			
2	29-2	.35350	.34909	.00441			
3	29-3	.41948	.41833	.00115			
4	29-4	.35840	.35785	.00055			
5	29-5	.34575	.34540	.00035			
Filter	29-F	.27291	.27237	.00054			
			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-L93

Source Identification ESP-INLET

Test Run Number ESP-I-3-2

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-31-80	1108-1112		
Probe Technician				
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-31-80	1112-1130	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1550	Pavlovic	
Write Up				

(72)

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-3-3

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-29-80

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 - 3 - 3 DATE 10-29-80

Flue Gas Temperature 633 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.49 " Hg

Sample Time 4 min

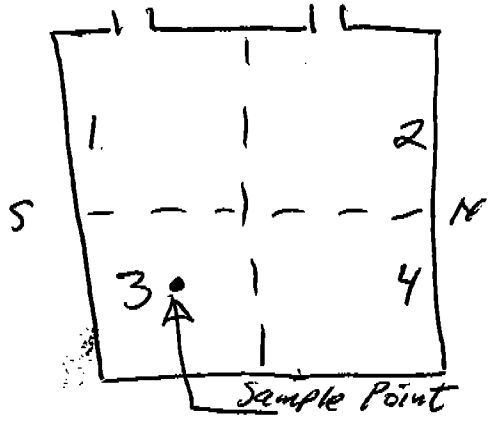
Probe Tip Diameter .115

Velocity at Sample Point 1423 FPS

Sample Rate .107 CFM

ΔP_s = .09

View from Gate Valve



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .085 @ 1640

Gas Composition

CO_2 19.7

O_2 9.3

CO 0

N_2 71

H_2O 6%

Preheat Started — 1610

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1645	2.51	2.5	88	Start	0
1646		2.5	88		.052
1647		2.5	88		.108
1648		2.5	88		.158
1649		2.5	88	Stop	.212

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-29-80
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 = 29.49, Tm = 88, Vm = .212	Vm_{std}	.201
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	29.46
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\frac{\sqrt{\Delta Ps_{avg}}}{.085}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	1383
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (633 + 460)(.201)}{(1383)(4)(29.46)(.94)(.115^2)}$	% I	112.7

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-3-3 BRINK Date 10-29-80

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

ANALYSIS

Final Weights	Tare Weights
By: J.P Date: 10-30-80	By: J.P. Date: 10-28-80
Location: On Site Lab	Location: On-Site Lab

Set #21

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	21-C	.45860	.22598	.23262	* **	* **	
1	21-1	.42579	.41690	.00889			
2	21-2	.36006	.35667	.00339			
3	21-3	.40856	.40779	.00077			
4	21-4	.42745	.42704	.00041			
5	21-5	.40669	.40606	.00063			
Filter	21-F	.26768	.26738	.00030			
			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 4891-2(F3)

Source Identification ESP Inlet

Test Run Number ESP-I-3-3

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	1645-1649		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-29-80	1655	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1400	J. Pavlovnis	
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP I-3-4

MRI Project Number 4891-2(93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-29-80

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-3-4 DATE 10-29-80

Flue Gas Temperature 637 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.52 " Hg

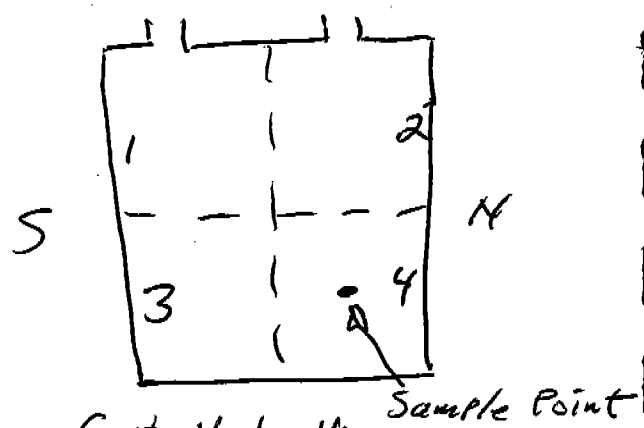
Sample Time 4 min

Probe Tip Diameter #4 = .116"

Velocity at Sample Point 1561 FPS

Sample Rate .117 CFM

ΔP_s = .108



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .11" H_2O at 1455

Gas Composition

CO_2 19.9

O_2 9.3

CO 0

N_2 71

H_2O 6%

Md = 31.40

Preheat Started 1427

SAMPLING LOG Meter flow rate = .052 CFM

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1500	3.12	3.1	87	Start	0
1501		3.1	87		.058
1502		3.1	87		.119
1503		3.1	88		.180
1504		3.1	88	STOP	.240

ISOKINETIC PERFORMANCE WORKSHEET

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

Date: 10-29-80
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}	637
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.52, Tm = 87.4, Vm = .240	Vm_{std}	.228
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	29.46
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .11	Vs	1576
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\ (637 + 460)(.228)}{(1576)(4)(29.46)(.94)(.116^2)}$	% I	110.6

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-3-4
MRI Project No. 4891-L93

BRINK
Particle Size Analysis

Date 10-29-80
Recorded by JP

ANALYSIS

Final Weights

By: J.P. Date: 10-30-80

Location: On Site Lab

Tare Weights

By: J.P. Date: 10-28-80

Location: On Site Lab

Set # 20

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	20-C	.61537	.23164	.38373	* **	* **	
1	20-1	.43924	.42430	.01494			
2	20-2	.42283	.41908	.00375			
3	20-3	.42945	.42828	.00117			
4	20-4	.40297	.40239	.00058			
5	20-5	.39897	.39840	.00057			
Filter	20-F	.26964	.26886	.00078			
			Total	* **			

CONCENTRATION CALCULATION

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

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

* With filter
** Without filter

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Inlet

Test Run Number ESP-I-3-4

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	1500-1504		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-29-80	1520	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1330	J. Pavlonis	
Write Up				

113

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-4-1

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

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. ESP-I-4-1 DATE 11-4-80

Flue Gas Temperature 635 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.06 " Hg

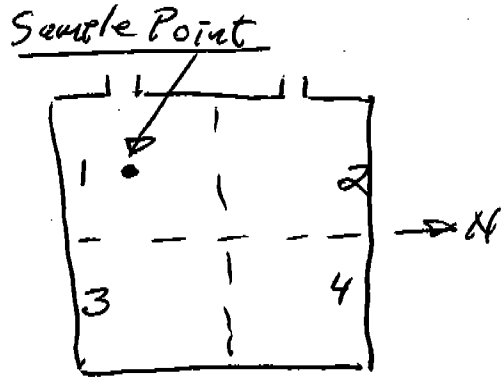
Sample Time 4 min

Probe Tip Diameter .116

Velocity at Sample Point 1435 FPS

Sample Rate .107 CFM

ΔP_c = .09



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .090 at 1206 Filter Set # 32

Gas Composition

CO_2 18.8

O_2 9.3

CO 0

N_2 71.6

H_2O 6 %

M_d = 31.40

Preheat Started - 1122

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1212	2.2	2.2	62	Start	0
1213		2.2	62		.048
1214		2.2	62		.090
1215		2.2	62		.139
1216		2.2	62	Stop	.188

ISOKINETIC PERFORMANCE WORKSHEET

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

Date: 11-4-80
Initial: RCS

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	635
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb=29.06 Vm=.188 Tm=62	Vm_{std}	.185
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.03
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .090	Vs	1435
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\ (635 + 460)(.185)}{(1435)(4)(29.03)(.94)(.116^2)}$	% I	99.9

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-4-1 | BRINK | Date 11-5-80

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

ANALYSIS

Final Weights

By: J.P. Date: 11-7-80

Location: On Site Lab

Tare Weights

By: AP. Date: 10-31-80

Location: On Site Lab

Set # 32

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	32-C	.47040	.23297	0.23143	* / **	* / **	
1	32-1	.37266	.36275	0.00991			
2	32-2	.42822	.42474	0.00348			
3	32-3	.43497	.43383	0.00114			
4	32-4	.42239	.42171	0.00068			
5	32-5	.43962	.43905	0.00057			
Filter	32-F	.27577	.27473	0.00104			
			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-4-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	11-4-80	1212-1216		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	11-4-80	1220	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J. PAVELONIS	ON SITE LAB
Write Up				

117

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-4-2 (2)

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 11-5-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. ESP-I-4-2(2) DATE 11-5-80

Flue Gas Temperature 600 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.20 " Hg

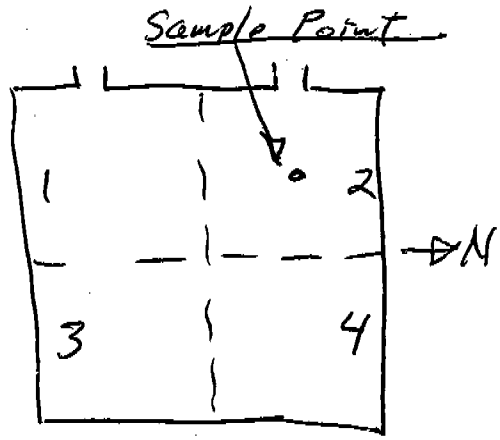
Sample Time 4 min

Probe Tip Diameter .115"

Velocity at Sample Point 1369 FPS

Sample Rate .102 CFM

ΔP_s = .085



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .085 at 1601 Filter Set #

Gas Composition

CO_2 18.8

O_2 9.3

CO 0

N_2 71.8

H_2O 6%

Md = 31.40

Pre-heat Started -

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1607	2.16	2.16	90	Start	0
1608		2.16	90		.055
1609		2.16	90		.103
1610		2.16	90		.159
1611		2.16	90	STOP	.209

ISOKINETIC PERFORMANCE WORKSHEET

Plant: Pfizer
Sampling Location: ESP Inlet
Test Number: ESP-I-4-2

Date: 11-5-80
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}	600
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.20, Vm = .209, Tm = 90	Vm_{std}	.196
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.17
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .085	Vs	1369
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (600 + 460)(.196)}{(1369)(4)(29.20)(.94)(.115^2)}$	% I	108.6

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-4-2 (2)
MRI Project No. 4891-293

BRINK
Particle Size Analysis

Date
Recorded by JP

ANALYSIS

Final Weights

By: BOOMER Date: 11-7-80
Location: ON SITE LAB

Tare Weights

By: J.P. Date: 10-31-80
Location: ON SITE LAB

FILTER SET #33

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	33-C	.52121 ~~.23863~~	.23863	0.28258	* **	* **	
1	33-1	.44403 ~~.43911~~	.43911	0.00492			
2	33-2	.43804 ~~.42700~~	.42700	0.01104			
3	33-3	.41656 ~~.41561~~	.41561	0.00095			
4	33-4	.36417 ~~.36369~~	.36369	0.00048			
5	33-5	.35205 ~~.35166~~	.35166	0.00039			
Filter	33-F	.27898 ~~.27847~~	.27847	0.00051			
			Total	* **			

CONCENTRATION CALCULATION

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

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

* With filter
** Without filter

SAMPLE HANDLING LOG

Project Number 4891-L (93)

Source Identification ESP Inlet

Test Run Number ESP-I-4-1(2)

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	11-5-80	1607-1611		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	11-5-80	1620	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J. Pavelonis	On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-4-3

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location 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-4-3 DATE 10-30-80

Flue Gas Temperature 633 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.56 " Hg

Sample Time 4 min

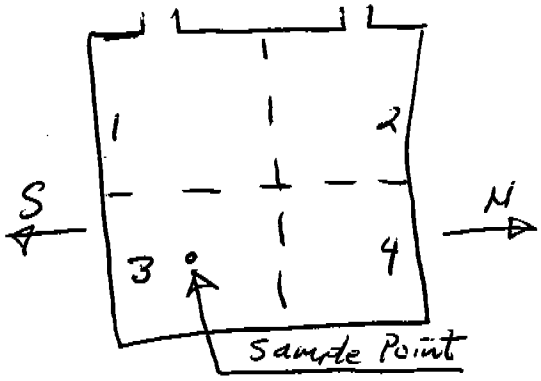
Probe Tip Diameter .115

Velocity at Sample Point 1421 FPS

Sample Rate .107 CFM

ΔP_s = .09

View from gate valve



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .08 at 0921

Gas Composition

CO_2 18.8

O_2 8.8

CO 0

N_2 72.5

H_2O 6%

~~Sam~~ Preheat Started - 0855

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	P. Temp.	Comments	Vol.
0928	~~2.1~~ 2.15	2.1	73	Start	0
0929	2.15	2.1	74		.052
0930		2.1	74		.100
0931		2.1	76		.150
0932		2.1	76	STOP	.200
			74.6 avg		

ISOKINETIC PERFORMANCE WORKSHEET

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

Date: 10-30-80
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 = 29.56, Vm = .200, Tm = 74.6	Vm_{std}	.195
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	29.53
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\frac{\sqrt{\Delta Ps_{avg}}}{.08}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	1340
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (633 + 460)(.195)}{(1340)(4)(29.53)(.94)(.115^2)}$	% I	112.5 ~~92.6~~

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-4-3 | BRINK | Date 11-5-80

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

ANALYSIS

Final Weights

By: Boomer Date: 11-3-80

Location: On Site Lab

Tare Weights

By: JP Date: 10-28-80

Location: On Site Lab

Set #23

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	23-C	.48051	.22722	.25329	* / **	* / **	
1	23-1	.43804	.42717	.01087			
2	23-2	.42700	.42277	.00423			
3	23-3	.41873	.41756	.00117			
4	23-4	.40718	.40644	.00074			
5	23-5	.34602	.34620	-.00018			
Filter	23-F	.26274	.26241	.00033			
			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 4891-493

Source Identification ESP Inlet

Test Run Number ESP-I-4-3

Pollutant(s) in Sample Particle Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	0928-0932		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-30-80	0945	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	1630	Pavlonis	
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Brinks

RUN ESP-I-4-4

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP Inlet
Sampling Date 10-29-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Stultz
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

BRINKS DATA SHEET

TEST NO. ESP-I-4-4 DATE 10-29-80

Flue Gas Temperature 676 °F

Static Pressure -.38 " H_2O

Barometric Pressure 29.51 " Hg

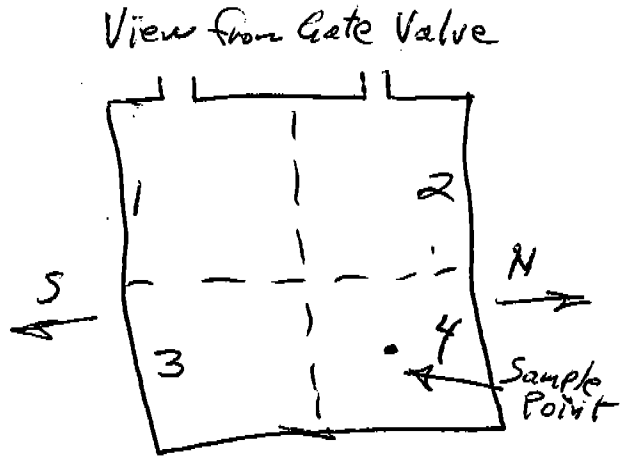
Sample Time 4 min

Probe Tip Diameter .116

Velocity at Sample Point 1561 FPS

Sample Rate .117 CFM

ΔP_s = .108



Schematic of Traverse Point Layout with Dimensions

Pitot ΔP_s = .11 at 1826

Filter Set # 22

Gas Composition

CO_2 19.7

O_2 9.3

CO 0

N_2 71

H_2O 6 %

Md. = 31.40

Preheat Started - 1743

SAMPLING LOG

TIME	ΔP Manometer (in. Hg) Desired	ΔP Manometer (in. Hg) Actual	Dry Meter Temp.	Comments	Dry Meter Vol.
1832	3.12	3.2	102	start	0
1833		3.1	102		.063
1834		3.1	102		.125
1835		3.1	102		.183
1836		3.1	102	stop	.243

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-29-80
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}	676
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.57, Vm = .243, Tm = 102	Vm_{std}	.225
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.94
Molecular wt. dry stack gas, lb/lb-mole $(\%CO_2 \times 0.44) + (\%O_2 \times 0.32) + (\%N_2 + \%CO \times 0.28)$	Md	31.40
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.49
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ .11	Vs	1603
Total sample time, minutes	θ	4
Nozzle diameter, inches	Dn	.116
$\frac{1{,}039\ (676 + 460)(.225)}{(1603)(4)(29.49)(.94)(.116^2)}$	% I	111.0

MIDWEST RESEARCH INSTITUTE

Run No. ESP-I-4-4
MRI Project No. 4891493

BRINK
Particle Size Analysis

Date 10-29-80
Recorded by [illegible]

ANALYSIS

Final Weights	Tare Weights
By: _____ Date: _____	By: J.R. Date: 10-24-80
Location: _____	Location: DN SITE LAB

Set #22

Stage	Paper No.	Final Weight (gm)	Tare Weight (gm)	Net Weight (gm)	% of Total Weight	Cum. % of Ttl. Weight	Dp (μ)
CYC	22-C	.57729	.22425		* **	* **	
1	22-1	.43705	.42186				
2	22-2	.43162	.42535				
3	22-3	.41901	.41759				
4	22-4	.43291	.43207				
5	22-5	.41778	.41661				
Filter	22-F	.26807	.26739				
			Total	* **			

CONCENTRATION CALCULATION

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

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

* With filter
** Without filter

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Inlet

Test Run Number ESP-I-4-4

Pollutant(s) in Sample Particulate sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	1832-1836		
Probe Technician			Stultz	
Meter Technician			Stultz	
Other				
Transport of Train to Cleanup Site	10-29-80	1850	Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

C-4 Electrostatic Precipitator Outlet

C-4-1 Mass

MIDWEST RESEARCH INSTITUTE

RUN ESP-O-1-1(2)

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

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

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

Process Engineer 1
2

Other 1
2

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-28-80

SAMPLING LOCATION ESP - Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	45
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6.2
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.26
STATIC PRESSURE IN STACK, in. Hg + .52 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.30
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	~~470~~ 500
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.12
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.92	
CALCULATED NOZZLE DIAMETER, in.	3/8" (.375) .412	
ACTUAL NOZZLE DIAMETER, in.	.444	
REFERENCE Δp, in. H_2O	~~0.086~~ .09	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-28-80
Initial MDH

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

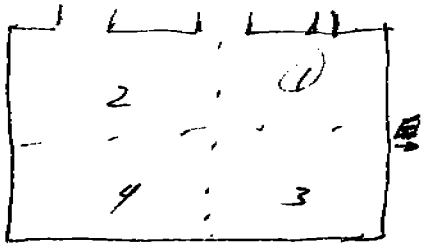
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	45
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.938
Nozzle diameter, inches	Dn	.444
Barometric pressure, inches Hg	Pb	29.26
$\frac{5.168\ (45 + 460)\ (.84)\ (3)\ (.938)\ (.444^2)}{\sqrt{29.26}}$	K	224.83

FIELD DATA

PLANT Pfizer
DATE 10-28-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE Mass
RUN NUMBER ESP-O-1-1
OPERATOR M. Hansen
AMBIENT TEMPERATURE 40°F
BAROMETRIC PRESSURE 29.26
STATIC PRESSURE, (P_s) +0.52
FILTER NUMBER (s) 78



PROBE LENGTH AND TYPE 3 ft. S.S.
NOZZLE I.D. .444 inch.
ASSUMED MOISTURE, % 6.2
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR 0.92
PROBE HEATER SETTING 100
HEATER BOX SETTING 550
REFERENCE Δp ~~0.92~~ .09

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

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

VM = ~~224.83~~ x $\sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 735.20 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	1346											
1 quad	3	1349	737.50	737.41	.10	2.0	2.0	498	39	39	8.5	185	43
	6	1352	739.92	739.72	.11	2.2	2.25	492	43	39	10.0	—	—
	9	1355	742.28	742.01	.105	2.1	2.20	496	45	40	10.0	—	43
	12	1358	744.64	744.34	.105	2.1	2.3	494	48	40	10.5	202	47
	15	1401	746.94	746.70	.10	2.0	2.3	497	50	40	11.0	—	—
	18	1404	749.24	749.01	.10	2.0	2.2	494	51	41	11.0	197	51
	21	1407	751.54	751.37	.10	2.0	2.35	492	52	42	11.5	—	—
	24	1410	753.97	753.78	.11	2.2	2.40	483	53	42	12.0	205	54
	27	1413	756.33	756.17	.105	2.1	2.35	492	54	43	13.0	204	—
	30	1416	758.72	758.69	.11	2.2	2.55	486	56	43	13.0	—	—
			V_m = 23.49		ΔP = .105	ΔH =	2.29	T_s = 492.4	T_m =	45			

COMMENTS

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-28-80
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}	492.4
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 2.29$, $Pb = 29.26$, $Vm = 23.49$, $Tm+460 = 505$	Vm_{std}	24.15
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 5.71$	Mf	.943
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	30.61
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	29.3
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .105$, $C_p = .84$	Vs	1439
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.444
$\frac{1{,}039\,(492.4 + 460)(24.5)}{(1439)(30)(29.3)(.943)(.444^2)}$	% I	103.1

PARTICULATE SAMPLE RECOVERY AND INTEGRITY ESP-0-1-1(2)

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

Run No. ESP-0-1-1
Sample Date 10-28-80
Recovery Date
Cleanup Person

Filter No. 16
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/	112	111	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	12	11	2		
Sample No.(s)					

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

SILICA GEL

697.2	
691.3	
5.9	

Silica Gel Color

Description of Impinger Solution
Total Moisture, gm 30.9

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 107
Liquid Level Marked
Sealed

Impinger Rinse: Sample No.
Liquid Level Marked
Sealed

Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed

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

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

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

Run No. ESP-0-1-1 PARTICULATE CLEAN-UP AND ANALYSIS

Date 10-30-80 FIELD ANALYSIS Performed by JJ

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~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
107		X5	81.96072	81.57138	160	JJ	10-22
~~107~~		5		~~85.22717~~	~~160~~		
	18	6	0.80501	0.30411			
		6					
		6					
		7					
		8					
		9					
83		10	89.91564	89.91034	100 mls	DV	

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-293

Source Identification ESP outlet

Test Run Number ESP-0-1-1 ESP-0-1-1 (2)

Pollutant(s) in Sample Moss

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1346-1416		
Probe Technician				
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	10-28-80	1416-1430	Raja, Vogel	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

56

MIDWEST RESEARCH INSTITUTE

RUN ESP-0-1-2(2)

MRI Project Number 4841-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP-Outlet
Sampling Date 10-28-80

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

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

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-28-80

SAMPLING LOCATION ESP-Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	45
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6.2
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.26
STATIC PRESSURE IN STACK, in. Hg (+0.52) ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.30
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	490
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.07
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.92	
CALCULATED NOZZLE DIAMETER, in.	~~.470~~ .470	
ACTUAL NOZZLE DIAMETER, in.	~~.444~~ .468	
REFERENCE Δp, in. H_2O	0.07	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-28-80
Initial MDH

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

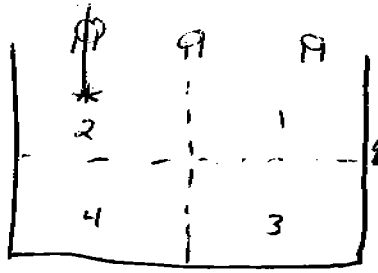
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	45
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.938
Nozzle diameter, inches	Dn	.468
Barometric pressure, inches Hg	Pb	29.26
$\frac{5.168\ (45 + 460)\ (.84)\ (3)\ (.938)\ (.468^2)}{\sqrt{29.26}}$	K	249.79

FIELD DATA

PLANT Pfizer
DATE 10-28-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE Mass
RUN NUMBER ESP-O-1-2 (2)
OPERATOR M. Hansen
AMBIENT TEMPERATURE 40°F
BAROMETRIC PRESSURE 29.26
STATIC PRESSURE, (P_s) -0.52
FILTER NUMBER (s) 20



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 3ft, S.S.
NOZZLE I.D. .468
ASSUMED MOISTURE, % 6.2
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR 0.92
PROBE HEATER SETTING 100
HEATER BOX SETTING 550
REFERENCE Δp .007

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

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 249.79 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 759.10 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
2 quad	0 / 1540											
	3 / 1543	761.24	761.24	.07	1.85	2.00	490	40	40	9.0	174	—
	6 / 1546	763.39	763.41	.07	1.85	1.95	483	43	40	8.5	175	42
	9 / 1549	765.54	765.56	.07	1.85	1.90	483	44	40	8.5	193	42
	12 / 1552	767.69	767.69	.07	1.85	1.90	486	46	40	8.5	—	40
	15 / 1555	769.84	769.83	.07	1.85	1.95	486	47	40	9.0	—	—
	18 / 1558	771.99	771.98	.07	1.85	1.90	486	48	41	9.0	—	—
	21 / 1601	774.14	774.11	.07	1.85	1.90	484	50	41	9.0	197	43
	24 / 1604	776.29	776.28	.07	1.85	1.95	482	49	41	9.5	—	43
	27 / 1607	778.44	778.44	.07	1.85	1.95	484	49	41	9.5	195	44
	30 / 1610	780.59	780.60	.07	1.85	1.90	485	49	42	9.5	—	—
		V_m=21.50		ΔP=.07		ΔH=1.93		T_m=	43.55			
							Ts=484.9					

COMMENTS.

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-28-80
Initial MDH

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	484.9
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1.93$ $T_m = 43.55$ $Pb = 29.26$ $Vm = 21.50$	Vm_{std}	22.14
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ 7.6 % H_2O	Mf	.924
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	30.35
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) +0.52	Ps	29.30
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P_s = 0.07$	Vs	1175
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.468
$\frac{1{,}039\ (484.9 + 460)(22.14)}{(1175)(30)(29.3)(.924)(.468^2)}$	% I	103.99

PARTICULATE SAMPLE RECOVERY AND INTEGRITY ESP-O-1-2 (2)

Plant Pfizer
Sample Location ESP outlet
Sample Box No. ~~MASS~~ 12
Sample Type Mass

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

Filter No. 20
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/	126	106	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	26	6	1		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 38.6

SILICA GEL

702.8	
697.2	
5.6	

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~~ BLANK No. 99
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~~ BLANK No. 83
Liquid Level Marked
Sealed

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

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

Run No. ESP-0-1-2 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~~ BLANK No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
99		5	86.42661	86.30996	145		
	20	6	0.59324	0.30898			
		6					
		6					
		7					
		8					
		9					
83		10	89.91564	89.91034	100		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L93

Source Identification ESP-Outlet

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

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1540-1610		
Probe Technician				
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	10-28-80	1540-1610	Hansen, Vogel, Kaja	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

87

MIDWEST RESEARCH INSTITUTE

RUN ESP-0-1-3

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-1-3

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84	
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	40	
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6.3	
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.55	
STATIC PRESSURE IN STACK, in. Hg +0.52 (P_m ±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	29.59	
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00	
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	~~510~~	490
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	~~.16~~	~~.14~~ .13
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—	
C FACTOR	.90		
CALCULATED NOZZLE DIAMETER, in.	~~.382~~ .405		
ACTUAL NOZZLE DIAMETER, in.	.374 #34		
REFERENCE Δp, in. H_2O	~~.174~~		.172

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer

Sampling Location ESP - Outlet

Test Number ESP-O-1-3

Date 10-30-80

Initial MAH

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

ΔPs = Velocity head of S pitot, inches H_2O

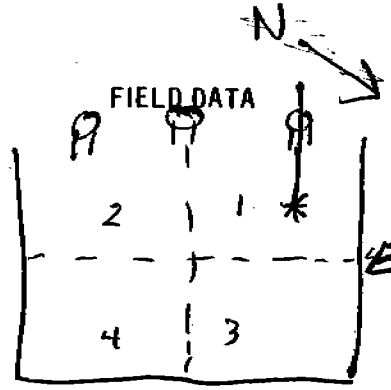
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	40
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.937
Nozzle diameter, inches	Dn	.374
Barometric pressure, inches Hg	Pb	29.55
$\frac{5.168\ (40 + 460)\ (.84)\ (3)\ (.937)\ (.374^2)}{\sqrt{29.55}}$	K	~~156.~~ 157.00

33.25" intostack

FIELD DATA

PLANT Pfizer
DATE 10-30-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE MABS
RUN NUMBER ESP-O-1-3
OPERATOR M. Hansen
AMBIENT TEMPERATURE 35°F
BAROMETRIC PRESSURE 29.55
STATIC PRESSURE, (P_s) -0.52
FILTER NUMBER (s) 49



PROBE LENGTH AND TYPE 4 ft. SS.
NOZZLE I.D. .374
ASSUMED MOISTURE, % 6.3
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .90
PROBE HEATER SETTING 100°F
HEATER BOX SETTING 550°F
REFERENCE Δp ~~.174~~ .172

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

$VM = 157.0 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
Quad	0	1110	928.40										
3	3	1113	930.30	930.40	.14	1.50	1.6	492	41	40	8.0	a/	—
	6	1116	932.20	932.30	.14	1.50	1.5	494	44	40	7.5		40
	9	1119	934.11	934.17	.14	1.50	1.40	488	45	40	7.5		42
	12	1122	936.05	936.04	.145	1.55	1.45	494	48	41	8.0		44
	15	1125	937.95	937.94	.14	1.50	1.50	492	48	41	8.0		45
	18	1128	939.85	939.84	.14	1.50	1.50	494	49	42	8.0		46
	21	1131	941.75	941.73	.14	1.50	1.45	493	50	43	8.0		46
	24	1134	943.66	943.62	.14	1.50	1.50	489	51	43	8.0		48
	27	1137	945.60	945.55	.145	1.55	1.50	488	51	44	9.0		48
	30	1140	947.50	947.51	.140	1.50	1.55	492	52	44	10.0		49
			V_m = 19.11			ΔH=	1.495		T_m =	44.85			
					ΔP=.141			T_s= 491.6					

COMMENTS: a/ electrical short in T.C. giving low reading.

EPA Form 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-0-1-3

Date 10-30-80
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}	491.6
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1.495$, $P_b = 29.55$, $V_m = 19.11$, $T_m+460 = 504.85$	Vm_{std}	~~42~~ 19.80
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 4.29$	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	31.41
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	30.83
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$ $P_g = +.52$	Ps	29.59
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .141$, $C_p = .84$	Vs	1,652
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.374
$\frac{1{,}039\,(491.60 + 460)(19.8)}{(1{,}652)(30)(29.59)(.957)(.374^2)}$	% I	99.72

- measured 10-30-80 by D.V.

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: ESP-O-1-3
Sample Date: 10-30-80
Recovery Date: 10-30-80
Cleanup Person: MDH, G.C.

Filter No.: 49
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/	113	~~100.5~~	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	13	~~0.5~~	2		
Sample No.(s)					

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

SILICA GEL

	661.8
	658.0
	3.8
Silica Gel	
Color	

Description of Impinger Solution:
Total Moisture, gm: 18.8

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 63
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:

MIDWEST RESEARCH INSTITUTE

Run No. ESP-0-1-3 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~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
63		5	86.71006	86.34906	172		
	49	6	0.69302	0.29696			
		6					
		6					
		7					
		8					
		9					
2.5 90		10	91.40781	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 Outlet

Test Run Number ESP-O-1-3

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1110-1140	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	10-30-80	1110-1140	M. Hansen	
Other				
Transport of Train to Cleanup Site	10-30-80	1150	M. Hansen	
Train Disassembly	10-30-80	1200-1210	M. Hansen, G. Cobb	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-0-1-4(2)

MRI Project Number 4891-L-93
Field Dates
Plant Pfizer
Sampling Location ESP Outlet
Sampling Date 12-7-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 E. Whited
2
3

Engr. Technician 1 E. Olson
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 12-8-80

SAMPLING LOCATION ESP Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	75
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5½%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.15
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	0.999
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	480
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.16
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	0.370	
ACTUAL NOZZLE DIAMETER, in.	0.374	
REFERENCE Δp, in. H_2O	0.155	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-0-1-4(2)

Date 12-8-80
Initial ec

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

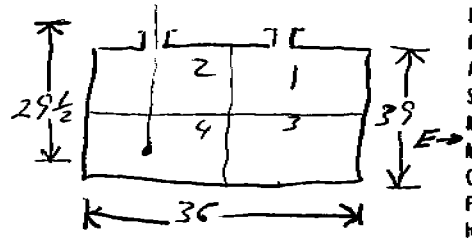
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	75
Pitot coefficient	Cp	0.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.945
Nozzle diameter, inches	Dn	0.374
Barometric pressure, inches Hg	Pb	29.15
$\frac{5.168\ (75 + 460)\ (.84)\ (3)\ (.945)\ (.374^2)}{\sqrt{29.15}}$	K	170.6

FIELD DATA

PLANT Pfizer
DATE 12-8-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE Particulate
RUN NUMBER ~~B~~ PSP 0-1-4(2)
OPERATOR Whitlock
AMBIENT TEMPERATURE 55
BAROMETRIC PRESSURE 29.15
STATIC PRESSURE, (P_s) -0.52 "H_2O
FILTER NUMBER (s) 98



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 4 ft SS
NOZZLE I.D. 0.374
ASSUMED MOISTURE, % 5½ %
SAMPLE BOX NUMBER 6
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING 95
HEATER BOX SETTING 300
REFERENCE Δp 0.155

Leak CK: Initial at 15" Hg, CFM 0.001
Final at Hg, CFM 0.005

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 170.6 \times \sqrt{\frac{Ps}{Ts + 460}}$

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	1340	141.698										
	3	1343	144.34	142.80	.18	2.0	2.0	490	58	58	6	300	<50
	6	1346	146.89	145.30	.23	2.7	2.7	490	60	58	10	250	↑
	9	1349	148.70	147.4	.23	2.7	2.7	490	60	60	10	280	
	12	1352	152.35	150.1	.23	2.7	3.0	490	60	60	10	280	
	15	1355	155.00	153.35	.26	3.1	4.0	490	62	60	10	280	
	18	1358	156.16	156.29	.26	3.1	3.0	490	66	58	10	280	
	21	1401	159.10	159.07	.28	3.2	3.3	490	65	58	10	280	
	24	1404	161.95	161.95	.26	3.2	3.2	490	65	58	10	280	
	27	1407	164.76	164.85	.26	3.2	3.3	490	65	58	10	280	
	30	1410	167.70	167.68	.28	3.2	3.3	490	65	58	10	280	
	33	1413	170.62	170.543	.28	3.2	3.2	490	65	58	10	280	<50
			Vm = 28.845		Δp_s = 0.25		ΔH = 3.06	T_m = 490	T_m = 60.94				

COMMENTS

C-4-1-28

EPA Run 23

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-O-P-4(2)

Date 12-8-80
Initial ev

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 = 3.06, Pb = 29.15, Vm = 28.895, Tm = ~~490~~ 60.84	Vm_{std}	28.69
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	.945
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	31.00
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.285
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) −.52	Ps	29.11
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ ΔPs = .25	Vs	2236
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	0.374
$\frac{1{,}039\ (490 + 460)(28.69)}{(2236)(30)(29.11)(.945)(.374^2)}$ 33	% I	99.7

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location ESP Outlet
Sample Box No. 6
Sample Type Particulate

Run No. ESP-0-1-4(2)
Sample Date 12-8-80
Recovery Date
Cleanup Person

Filter No. 98
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/	130	107	3		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	30	7			
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 47.9

SILICA GEL

693.9	
683.7	
10.2	

Silica Gel Color

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

RECOVERED SAMPLE

Probe Rinse: Sample No. 146
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. 145
Liquid Level Marked
Sealed

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

ESP-0-1-4(2)

Run No. _____

MIDWEST RESEARCH INSTITUTE

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	92.09595	91.86004			
146		5	~~91.86004~~	~~92.09595~~	222		
	98	6	0.95925	0.49506			
		6					
		6					
		7					
		8					
		9					
145		10	88.94321	88.94202	165		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L-93

Source Identification ESP Outlet

Test Run Number ESP-O-1-4(2)

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	12-8-80			
Probe Technician				
Meter Technician	12-8-80		Whitel	
Other				
Transport of Train to Cleanup Site	12-8-80		E Olson	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ~~ESP-O-1~~ 2-1

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

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

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

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-28-80

SAMPLING LOCATION ESP Outlet-2-1

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	7.6
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.31
STATIC PRESSURE IN STACK, in. Hg +0.52 (P_m ±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	29.35
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	490
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.105
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.91	
CALCULATED NOZZLE DIAMETER, in.	.43	
ACTUAL NOZZLE DIAMETER, in.	.444	
REFERENCE Δp, in. H_2O	.09	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-28-80
Initial MDH

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

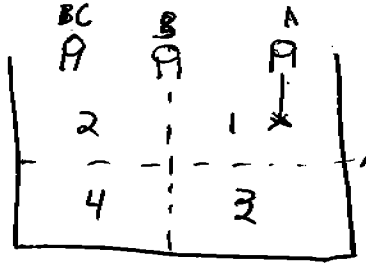
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	45
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.924
Nozzle diameter, inches	Dn	.444
Barometric pressure, inches Hg	Pb	29.31
$\frac{5.168\ (45 + 460)\ (.84)\ (3)\ (.924)\ (.444^2)}{\sqrt{29.31}}$	K	221.28

FIELD DATA

PLANT Pfizer
DATE 10-28-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE MASS
RUN NUMBER ESP-O-2-1
OPERATOR M. Hansen
AMBIENT TEMPERATURE 40°F
BAROMETRIC PRESSURE 29.31
STATIC PRESSURE, (P_s) +0.52
FILTER NUMBER (s) 43



PROBE LENGTH AND TYPE 3ft, S.S.
NOZZLE I.D. .444
ASSUMED MOISTURE, % 7.6
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .91
PROBE HEATER SETTING 100°F
HEATER BOX SETTING 550°F
REFERENCE Δp 0.09

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

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 321.28 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 780.80 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	0 / 1737											
1	3 / 1740 ~~1440~~	783.36	783.33	.13	2.7	2.8	512	36	35	10.5	130	41
	6 / 1743 ~~1443~~	785.92	785.89	.13	2.7	2.8	515	41	36	10.5	161	42
	9 / 1746 ~~1446~~	788.47	788.47	.13	2.7	2.8	522	44	36	11.0	176	42
	12 / 1749 ~~1449~~	791.07	791.10	.135	2.8	2.9	515	49	37	12.0	—	43
	15 / 1752	793.62	793.69	.13	2.7	2.8	517	52	37	11.5	197	43
	18 / 1755	796.17	796.26	.13	2.7	2.7	520	54	38	12.0	197	—
	21 / 1758	798.82	798.85	.14	2.9	2.8	517	56	39	12.5	—	45
	24 / 1801	801.37	801.45	.13	2.7	2.8	517	58	40	13.0	205	46
	27 / 1804	803.92	804.02	.13	2.7	2.7	517	60	40	12.5	—	46
	30 / 1807	806.47	806.66	.13	2.7	2.6	517	60	41	12.0	—	45
		V_m = 25.8		Δp = .13								
					ΔH =	2.77						
							T_s = 516.9	T_m =	44.45			

COMMENTS

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-28-80
Initial MDH

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	516.9
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.31 ΔH = 2.77 Tm 44.45 Vm = 25.8 Pb = 29.31	Vm_{std}	26.63
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ %H_2O = 5.86	Mf	.941
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	30.58
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) Ps = 29.52	Ps	29.35
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ ΔP = .13 Cp = .84	Vs	1621
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.444
$\frac{1{,}039\ (576.9 + 460)(26.63)}{(1621)(30)(29.35)(.941)(.444^2)}$	% I	102.1

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-0-2-1
Sample Date
Recovery Date
Cleanup Person

Filter No. 43
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	H2O	H2O	Dry		
Final Volume (wt) b/	118	108	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	18	8	1		
Sample No.(s)					

SILICA GEL

667.8	
659.8	
8.0	
Silica Gel	
Color	

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 35

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 93
Liquid Level Marked
Sealed
Impinger Rinse: Sample No.
Liquid Level Marked
Sealed
Water Blank: Sample No.
Liquid Level Marked

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

Sample Disposition
Carrier Date Shipped:
Remarks:

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

MIDWEST RESEARCH INSTITUTE

Run No. ESP-0-2-1 PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
93		5	88.21986	88.04990	125		
	43	6	0.63196	0.30421			
		6					
		6					
		7					
		8					
		9					
83		10	89.91564	89.91034	100		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-293

Source Identification ESP-Outlet

Test Run Number ESP-O-2-1

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1737-1807		
Probe Technician				
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	10-28-80	1810-1830	Rojo, Hansen, Vogel	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ~~EB~~ ESP-0-2-2

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP outlet
Sampling Date 10-29-80

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 10-29-80

SAMPLING LOCATION ESP-Outlet-2-2

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	40°F
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.50
STATIC PRESSURE IN STACK, in. Hg (+0.52) ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.538
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	490
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.07
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.90	
CALCULATED NOZZLE DIAMETER, in.	.472	
ACTUAL NOZZLE DIAMETER, in.	.468 (#20)	
REFERENCE Δp, in. H_2O	.073	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-O-2-2

Date 10-29-80
Initial MDH

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

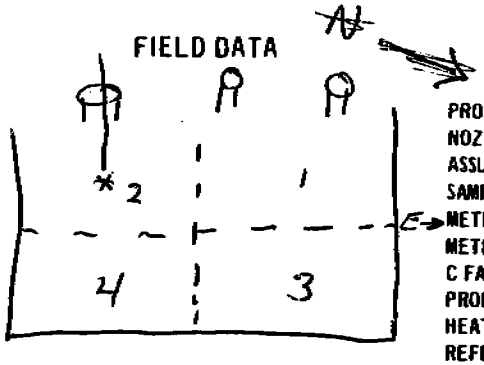
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	40
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.94
Nozzle diameter, inches	Dn	.468
Barometric pressure, inches Hg	Pb	29.50
$\frac{5.168\ (40 + 460)\ (.84)\ (3)\ (.94)\ (.468^2)}{\sqrt{29.50}}$	K	246.83

FIELD DATA

PLANT Pfizer
DATE 10-29-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE MASS
RUN NUMBER ESP-0-2-2
OPERATOR M. Hansen
AMBIENT TEMPERATURE 35°F
BAROMETRIC PRESSURE 29.50
STATIC PRESSURE, (P_s) +0.52
FILTER NUMBER (s) 44



PROBE LENGTH AND TYPE 3ft, S.S.
NOZZLE I.D. .468
ASSUMED MOISTURE, % 6
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .90
PROBE HEATER SETTING 100 °F
HEATER BOX SETTING 550°F
REFERENCE Δp 0.073

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 17.5 Hg, CFM 0.0

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

VM = 246.83x $\sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)		GAS METER READING (V_m), ft^3 807.20		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
Quad	0	0855	Desired	Actual		DESIRED	ACTUAL		INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F			
2	3	0858	809.73	809.70	.10	2.5	2.5	490	32	30	13.0	187	33
	6	0901	812.26	812.15	.10	2.5	2.6	492	37	30	12.0	192	35
	9	0904	814.79	814.66	.10	2.5	2.7	492	41	31	13.5	202	37
	12	0907	817.32	817.24	.10	2.5	2.8	490	45	31	14.5	—	39
	15	0910	819.86	819.82	.10	2.5	2.8	487	48	32	15.0	214	—
	18	0913	822.39	822.37	.10	2.5	2.7	489	50	33	15.0	—	42
	21	0916	824.93	824.89	.10	2.5	2.7	488	52	34	15.0	213	46
	24	0919	827.52	827.49	.105	2.6	2.75	492	52	34	16.5	—	47
	27	0922	830.11	830.09	.105	2.6	2.8	490	53	35	17.0	212	48
	30	0925	832.65	832.69	.10	2.5	2.75	487	52	36	17.5	—	48
			Vm = 25.49		ΔP = .101		ΔH = 2.71	Ts = 489.1		Tm = 39.4			

COMMENTS

EPA-Qwr-235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-0-2-2

Date 10-29-80
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}	489.7
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 2.71$ $T_m = 39.4$ $V_m = 25.49$ $P_b = 29.50$	Vm_{std}	26.74
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ 5.0% measured	Mf	~~.94~~ .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	31.37
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) +0.52	Ps	29.53
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta Ps = .101$	Vs	1,404
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.468
$\frac{1{,}039\ (489.7 + 460)(26.74)}{(1{,}404)(30)(29.53)(.95)(.468^2)}$	% I	101.95

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-O-2-2
Sample Date 10-29-80
Recovery Date 10-29-80
Cleanup Person R. K.

Filter No. 44
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/	89	134	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	-11	34	2		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 29.8

SILICA GEL

672.6	
667.8	
4.8	

Silica Gel Color

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ BEAKER No. 76
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. 70
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. ESP-0-2-2 PARTICULATE CLEAN-UP AND ANALYSIS

Date 10-30-80 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~~ Beaker No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
76		5	84.78958	84.54591	110		10-29
	44	6	0.72140	0.30857			10-21
		6					
		6					
		7					
		8					
		9					
70		10	78.44831	78.44736	110		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP-Outlet

Test Run Number ESP-O-2-2

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	0855-0925	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	10-29-80	0855-0925	M. Hansen	
Other				
Transport of Train to Cleanup Site	10-29-80	0930	Raja K.	
Train Disassembly	10-29-80	0945	R.K.	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-O-2-3

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

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-30-80

SAMPLING LOCATION ESP Outlet-2-3

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	55
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	4.3
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.41
STATIC PRESSURE IN STACK, in. Hg +0.52 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.45
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	490
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.14
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.97	
CALCULATED NOZZLE DIAMETER, in.	.388	
ACTUAL NOZZLE DIAMETER, in.	.374 #34	
REFERENCE Δp, in. H_2O	0.162	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-O-2-3

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

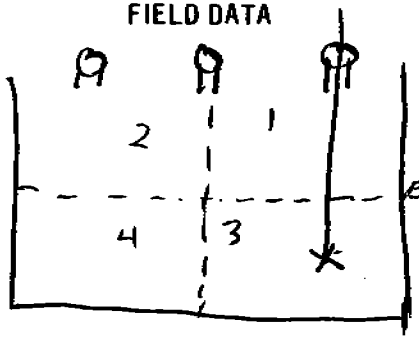
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	55
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.957
Nozzle diameter, inches	Dn	.374
Barometric pressure, inches Hg	Pb	29.41
$\frac{5.168\ (55 + 460)\ (.84)\ (3)\ (.957)\ (.374^2)}{\sqrt{29.41}}$	K	165.55

FIELD DATA

PLANT Pfizer
DATE 10-30-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE MASS
RUN NUMBER ESP-0-2-3
OPERATOR M. Hansen
AMBIENT TEMPERATURE 45°F
BAROMETRIC PRESSURE 29.41
STATIC PRESSURE, (P_s) +0.52
FILTER NUMBER (s) 75



PROBE LENGTH AND TYPE 4ft. S.S.
NOZZLE I.D. .374
ASSUMED MOISTURE, % 4.3
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .97
PROBE HEATER SETTING 100°F
HEATER BOX SETTING 550°F
REFERENCE Δp .162

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 = 165.55 x $\sqrt{\Delta Ps / (Ts + 460)}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
Quad	0	~~1634~~	968.31										
3	3	1637	970.48	970.51	.165	1.90	1.95	500	48	48	10.0	127a/	44
	6	1640	972.65	972.69	.165	1.90	1.90	500	52	48	9.5	127a/	45
	9	1643	974.79	974.84	.160	1.80	1.85	496	54	48	9.0		47
(Stop	12	1646	976.93	976.97	.160	1.80	1.80	498	56	48	9.0		—
1648)	15	1653 ~~1649~~	979.11	979.13	.165	1.90	1.90	494	52	48	9.5		—
Start 1652	18	1656 ~~1652~~	981.25	981.26	.160	1.80	1.80	494	53	49	8.0		47
	21	1659 ~~1655~~	983.39	983.38	.160	1.80	1.80	494	55	49	8.0		—
	24	1702 ~~1658~~	985.57	985.56	.165	1.90	1.90	494	57	49	8.5		—
	27	1705 ~~1701~~	987.71	987.72	.160	1.80	1.85	494	58	50	8.5		49
	30	1708 ~~1704~~	989.85	989.86	.160	1.80	1.80	494	59	50	8.0		49
			Vm = 21.55		ΔP = .162	ΔH =	1.86	Ts = 495.8	Tm = 51.55				

COMMENTS a/ Sample box is hotter than T.C. indicates.

EPA Part 235 [redacted] Probe slipped out of [redacted]. Probe tip [redacted] ~~no problem~~ [redacted]

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP outlet
Test Number ESP-0-2-3

Date 10-30-80
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}	495.8
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.86, Pb = 29.41, Vm = 21.55, Tm+460 = 511.6	Vm_{std}	21.95
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ %H_2O = 7.04	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)	Md	31.14
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) Pg = +.52	Ps	29.45
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps x Ms}}$ ΔP = .162, Cp = .84	Vs	1797
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.374
$\frac{1{,}039\ (495.8 + 460)(21.95)}{(1797)(30)(29.45)(.93)(.374^2)}$	% I	105.5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-0-2-3
Sample Date 10-30-80
Recovery Date
Cleanup Person

Filter No. 75
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

	1	2	3	4	5
Impinger Sequence					
Impinger Type a/					
Impinger Solution					
Final Volume (wt) b/	120	104	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	20	4	1		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 35.2

SILICA GEL

672.00
661.80
10.20
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. 82
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:

MIDWEST RESEARCH INSTITUTE

Run No. ESP-0-2-3 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~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
82		5	82.57498	82.29153	158		
	75	6	0.70321	0.31128			
		6					
		6					
		7					
		8					
		9					
90		10	91.40781	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 Outlet

Test Run Number ESP-O-2-3

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1634-1706	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	10-30-80		M. Hansen	
Other				
Transport of Train to Cleanup Site	10-31-80	1710-1730	Hansen, Koja	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

100

MIDWEST RESEARCH INSTITUTE

RUN ESP-O-2-4

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP-Outlet
Sampling Date 10-31-80

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 10-31-80

SAMPLING LOCATION ESP-Outlet-2-4

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	35
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.29
STATIC PRESSURE IN STACK, in. Hg ±0.52 (P_m ±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	29.33
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	480
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.152
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.94	
CALCULATED NOZZLE DIAMETER, in.	.382	
ACTUAL NOZZLE DIAMETER, in.	.374 #34	
REFERENCE Δp, in. H_2O	.165	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-O-2-4

Date 10-31-80
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

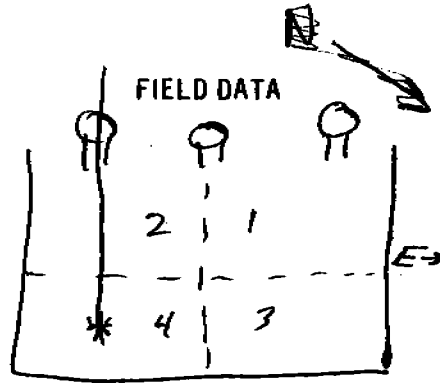
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	35
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.374
Barometric pressure, inches Hg	Pb	29.29
$\frac{5.168\ (35 + 460)\ (.84)\ (3)\ (.95)\ (.374^2)}{\sqrt{29.29}}$	K	158.28

FIELD DATA

PLANT Pfizer
DATE 10-31-80
SAMPLING LOCATION ESP outlet
SAMPLE TYPE MASS
RUN NUMBER ESP-O-2-4
OPERATOR M. Hansen
AMBIENT TEMPERATURE 30°F
BAROMETRIC PRESSURE 29.29
STATIC PRESSURE, (P_s) +0.52
FILTER NUMBER (s) ~~78~~ 79



PROBE LENGTH AND TYPE 4ft. S.S.
NOZZLE I.D. .374
ASSUMED MOISTURE, % 5
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .94
PROBE HEATER SETTING 100°F
HEATER BOX SETTING 550°F
REFERENCE Δp .165

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 3" Hg, CFM 0.0

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 158.28 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
Quad	0	0855	990.14										
4	3	0858	992.20	992.30	.16	1.80	1.80	487	38	37	7.5	a/ —	40
	6	0901	994.26	994.40	.16	1.80	1.80	485	41	38	6.5	—	41
	9	0904	996.26	996.43	.16	1.80	1.70	488	42	38	6.0		42
	12	0907	998.33	998.46	.16	1.80	1.65	476	43	38	6.0		—
	15	0910	1000.33	1000.42	.15	1.70	1.55	482	44	39	6.0		43
	18	0913	2.36	2.41	.155	1.75	1.60	480	44	39	6.5		44
	21	0916	4.43	4.45	.16	1.80	1.70	480	44	40	7.0		44
	24	0919	6.49	6.51	.16	1.80	1.75	483	45	40	7.0		44
	27	0922	8.49	8.52	.15	1.70	1.60	479	46	40	7.0		44
	30	0925	10.53	10.53	.155	1.75	1.60	473	46	41	6.5		44
			V_m = 20.39		ΔP_s = .157	ΔH = 1.68		T_s = 481	T_m = 41.15				

COMMENTS a/ Heater box T.C. Not giving true reading. Very Windy!

EPA (Dur) 235

C-4-1-60

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-O-2-4

Date 10-31-80
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}	481
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Vm = 20.39, Tm = 41.15, ΔH = 1.68, Pb = 29.29	Vm_{std}	21.11
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 5% (assumed)	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	31.14
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) +0.52	Ps	29.33
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\sqrt{\Delta Ps} = .396$	Vs	1750.34
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	0.374
$\frac{1{,}039\ (481 + 460)(21.11)}{(1750)(30)(29.33)(.95)(.374^2)}$	% I	100.87

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-O-2-4
Sample Date 10-31-80
Recovery Date
Cleanup Person

Filter No. ~~78~~ → 79
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

	1	2	3	4	5
Impinger Sequence	1	2	3	4	5
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	Dry		
Final Volume (wt) b/	119	104	0	~~707.3~~	
Initial Volume (wt) b/	100	100	0	~~702.4~~	
Net Volume (wt) b/	19	4			
Sample No.(s)					

SILICA GEL

707.3	
702.4	
4.9	

Silica Gel Color

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

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 88
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. 91
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. ESP-0-2-4 PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
88		5	90.58791	89.81624	130		
	79	6	0.61985	0.30495			
		6					
		6					
		7					
		8					
		9					
91		10	84.80300	84.79945	154		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Outlet

Test Run Number ESP-O-2-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-31-80		M. Hansen	
Probe Technician	—	—	—	
Meter Technician	10-31-80		M. Hansen	
Other				
Transport of Train to Cleanup Site	10-31-80		Hansen, Vogel	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE LAB
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-O-3-1

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP-Outlet
Sampling Date 10-29-80

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. Puvelonis
3 J. Johnson

Process Engineer 1
2

Other 1
2

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-29-80

SAMPLING LOCATION ESP-Outlet-3-1

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	5.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.52
STATIC PRESSURE IN STACK, in. Hg +0.52 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.56
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	515
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.13
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.97	
CALCULATED NOZZLE DIAMETER, in.	.40	
ACTUAL NOZZLE DIAMETER, in.	.444	
REFERENCE Δp, in. H_2O	.085	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP - Outlet
Test Number ESP-O-3-1

Date 10-29-80
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

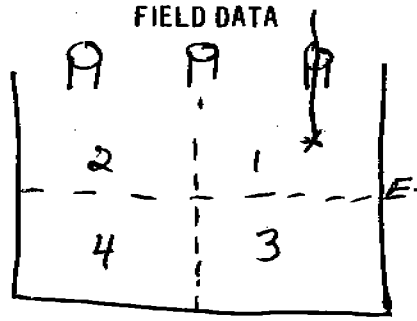
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	60
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.444
Barometric pressure, inches Hg	Pb	29.52
$\frac{5.168\ (60 + 460)\ (.84)\ (3)\ (.95)\ (.444^2)}{\sqrt{29.52}}$	K	233.43

FIELD DATA

PLANT Pfizer
DATE 10-29-80
SAMPLING LOCATION ESP-Outlet
SAMPLE TYPE Mass
RUN NUMBER ESP-O-3-1
OPERATOR M. Hansen
AMBIENT TEMPERATURE 60°F
BAROMETRIC PRESSURE 29.52
STATIC PRESSURE, (P_s) +0.52
FILTER NUMBER (s) 45



PROBE LENGTH AND TYPE 3ft, S.S.
NOZZLE I.D. .444
ASSUMED MOISTURE, % 5
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .97
PROBE HEATER SETTING 100°F
HEATER BOX SETTING 550°F
REFERENCE Δp .085

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 26" Hg, CFM 0.0

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 233.43 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 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	0	1425	~~832.90~~	833.00									
1	3	1428	835.98	835.89	.16	3.5	3.6	522	46	43	15.5	179	41
	6	1431	838.97	838.83	.16	3.5	3.7	517	52	44	17.0	—	42
	9	1434	841.97	841.83	.16	3.5	3.8	507	58	44	18.0	207	46
	12	1437	845.15	844.85	.18	3.9	3.8	507	60	45	19.0	—	50
	15	1440	848.15	847.84	.16	3.5	3.65	507	62	46	19.0	213	50
	18	1443	850.96	850.78	.14	3.0	3.60	509	64	47	19.0	—	54
	21	1446	853.86	853.70	.15	3.20	3.45	514	65	48	19.0	218	54
	24	1449	856.75	856.56	.15	3.20	3.40	516	66	49	19.0	—	—
	27	1452	859.65	859.42	.15	3.20	3.35	512	66	49	19.5	207	53
	30	1455	862.55	862.30	.15	3.20	3.30	510	67	50	19.5	—	53
			Vm	=29.3		ΔH=	3.57			T_m=	53.55		
					ΔP=.156			T_s=512.1					

COMMENTS: at ΔP_s = .18 I could not pull the 3.9 ΔH.
Pump vacuum is 19.5" [redacted] ΔH [redacted] 12 min. to end of test.

EPA Dwg 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Rizer
Sampling Location EPP- Outlet
Test Number ESP-0-3-1

Date 10-29-80
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}	512.1
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 3.57$ $P_b = 29.52$ $V_m = 29.3$ $T_m+460 = 513.5$	Vm_{std}	29.98
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 6.46$	Mf	.935
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	30.5
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) $P_g = +.52$	Ps	29.56
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .156$ $C_p = .84$	Vs	1767
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.444
$\frac{1{,}039\ (512.1 + 460)(29.98)}{(1767)(30)(29.56)(.935)(.444^2)}$	% I	104.8

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No.: ESP-O-3-1
Sample Date: 10-29-80
Recovery Date:
Cleanup Person:

Filter No.: 45
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/	122	111	2	~~[illegible]~~	
Initial Volume (wt) b/	100	100	0	~~[illegible]~~	
Net Volume (wt) b/	22	11	2	~~[illegible]~~	
Sample No.(s)					

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

SILICA GEL

681.2	
672.6	
8.6	

Silica Gel Color:

Description of Impinger Solution:
Total Moisture, gm: 43.6

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ BEAKER No. 59
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. 70
Liquid Level Marked:
Sealed:

Filter Blank: Sample No.:
Sealed:

Sample Disposition:
Carrier: Date Shipped:
Remarks:

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

MIDWEST RESEARCH INSTITUTE

Run No. ESP-0-3-1 PARTICULATE CLEAN-UP AND ANALYSIS

Date 10-30-80 FIELD ANALYSIS Performed by 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~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
59		5	87.42359	86.66237	160	JJ	10-30
	45	6	0.30830	0.30365		JJ	10-30
		6					
		6					
		7					
		8					
		9					
70		10	78.44831	78.44736	110		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L93

Source Identification ESP-Outlet

Test Run Number ESP-O-3-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	1425-1455		
Probe Technician				
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	10-29-80	1455-1515	Kaje, Hansen	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

75

MIDWEST RESEARCH INSTITUTE

RUN ESP-0-3-2

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP-Outlet
Sampling Date 10-29-80

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. Paucionis
3 J. Johnson

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

C-4-1-73

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-29-80

SAMPLING LOCATION ESP Outlet-3-2

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	55
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5.5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.49
STATIC PRESSURE IN STACK, in. Hg + 0.52 (P_m ±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	29.53
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	490
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.10
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.95	
CALCULATED NOZZLE DIAMETER, in.	.43	
ACTUAL NOZZLE DIAMETER, in.	.444	
REFERENCE Δp, in. H_2O	.085	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ~~ESP-0-3-2~~ Outlet
Test Number ESP-0-3-2

Date ~~MDH~~ 10-29-80
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

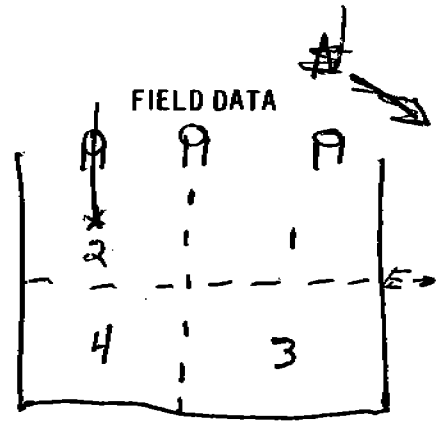
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	55
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.945
Nozzle diameter, inches	Dn	.444
Barometric pressure, inches Hg	Pb	29.49
$\frac{5.168\ (55 + 460)\ (.84)\ (3)\ (.945)\ (.444^2)}{\sqrt{29.49}}$	K	230.09

FIELD DATA

PLANT Pfizer
DATE 10-29-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE MASS
RUN NUMBER ESP-O-3-2
OPERATOR M. Hansen
AMBIENT TEMPERATURE 45°F
BAROMETRIC PRESSURE 29.49
STATIC PRESSURE, (P_s) +0.52
FILTER NUMBER (s) 46



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 3ft. S.S.
NOZZLE I.D. .444
ASSUMED MOISTURE, % 5.5
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .95
PROBE HEATER SETTING 100°F
HEATER BOX SETTING 550°F
REFERENCE Δp .085

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

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 230.09 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
Quad	0	1607	862.50										
2	3	1610	864.85	864.91	.10	2.2	2.3	497	49	47	11.5	182	45
	6	1613	867.20	867.27	.10	2.2	2.3	497	53	47	10.5	—	—
	9	1616	869.55	869.63	.10	2.2	2.25	496	57	48	10.5	— a	46
	12	1619	871.90	871.93	.10	2.2	2.15	497	58	48	10.0	a	—
	15	1622	874.25	874.24	.10	2.2	2.2	502	60	48	10.0	213	—
	18	1625	876.60	876.60	.10	2.2	2.25	500	61	48	11.0	217	47
	21	1628	878.95	878.97	.10	2.2	2.25	496	62	49	12.0	231	47
	24	1631	881.30	881.33	.10	2.2	2.2	497	63	49	12.0	236	47
	27	1634	883.71	883.71	.105	2.3	2.3	497	64	50	12.5	242	48
	30	1637	886.12	886.12	.105	2.3	2.3	500	64	50	13.0	247	48
			Vm=23.62										
					ΔP=.101	ΔH =	2.25	Ts = 497.9	Tm 53.75				

COMMENTS a/ Sample box - not heating properly. Problem was loose lead wire to monitor temp.

EPA-Durl 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP-Outlet
Test Number ESP-O-3-2

Date 10-29-80
Initial R.K

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	497.9
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 2.25$ $Tm = 53.75$ $Vm = 23.62$ $Pb = 29.49$	Vm_{std}	24.05
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 3.93$	Mf	0.96
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	31.37
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) +0.52 $Pb = 29.49$	Ps	29.53
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $Ts = 497.9$ $Cp = 0.84$	Vs	1404.19
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.444
$\frac{1{,}039\ (497.9 + 460)(24.05)}{(\cancel{1404.19})(30)(29.53)(.96)(.444^2)}$	% I	101.67

1404.19

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-0-3-2
Sample Date 10-24-80
Recovery Date
Cleanup Person

Filter No. 46
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/	109	105	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	9	5	2		
Sample No.(s)					

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

SILICA GEL

686.0	
681.2	
4.8	

Silica Gel Color

Description of Impinger Solution
Total Moisture, gm 20.8

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ BEAKER No. 60
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. 70
Liquid Level Marked
Sealed

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

MIDWEST RESEARCH INSTITUTE

Run No. ESP 6-3-2

PARTICULATE CLEAN-UP AND ANALYSIS

Date 10-30-86

FIELD ANALYSIS

Performed by JJ

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~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
60		5	92.86632	92.62857	185	JJ	10-23
	46	6	0.67769	0.30830		JJ	10-23
		6					
		6					
		7					
		8					
		9					
70		10	78.44831	78.44736	110		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Outlet

Test Run Number ESP-O-3-2

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	1607-1637	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	10-29-80		M. Hansen	
Other				
Transport of Train to Cleanup Site	10-29-80	1640-1700	Hansen, Rajo	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

104

MIDWEST RESEARCH INSTITUTE

RUN ESP-0-3-3

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ~~10-31-80~~ ESP Outlet
Sampling Date 10-31-80

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 10-31-80

SAMPLING LOCATION ESP-Outlet-3-3

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	40
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.28
STATIC PRESSURE IN STACK, in. Hg +0.52 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.32
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	495
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.16
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.92	
CALCULATED NOZZLE DIAMETER, in.	.362	
ACTUAL NOZZLE DIAMETER, in.	.374 #34	
REFERENCE Δp, in. H_2O	.17	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP - Outlet
Test Number ESP-O-3-3

Date 10-31-80
Initial MDH

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

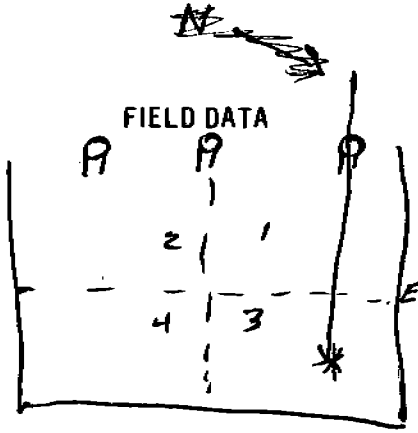
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	40
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.374
Barometric pressure, inches Hg	Pb	29.28
$\frac{5.168\ (40 + 460)\ (.84)\ (3)\ (.95)\ (.374^2)}{\sqrt{29.28}}$	K	159.9

FIELD DATA

PLANT Pfizer
DATE 10-31-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE MASS
RUN NUMBER ESP-O-3-3
OPERATOR M. Hansen
AMBIENT TEMPERATURE 35°F
BAROMETRIC PRESSURE 29.28
STATIC PRESSURE, (P_s) +0.52
FILTER NUMBER (s) 80



PROBE LENGTH AND TYPE 4ft. SS.
NOZZLE I.D. .374
ASSUMED MOISTURE, % 5.0
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .92
PROBE HEATER SETTING 100°F
HEATER BOX SETTING 550°F
REFERENCE Δp .17

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 7" Hg, CFM 0.0

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 159.9 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
Quad	0 / 1035	10.647										
3	3 / 1038	12.73	12.78	.16	1.75	1.80	487	43	43	6.5	a/	42
	6 / 1041	14.74	14.83	.15	1.65	1.70	487	46	43	6.5		43
	9 / 1044	16.75	16.79	.15	1.65	1.55	487	47	43	6.0		—
	12 / 1047	18.83	18.85	.16	1.75	1.75	490	48	43	6.5		44
	15 / 1050	20.87	20.89	.155	1.70	1.70	490	50	44	6.5		45
	18 / 1053	22.95	22.94	.16	1.75	1.70	488	50	44	7.0		46
	21 / 1056	25.03	25.01	.16	1.75	1.75	488	50	45	7.0		47
	24 / 1059	27.04	27.05	.15	1.65	1.65	488	51	45	7.0		48
	27 / 1102	29.06	29.07	.15	1.65	1.65	483	52	46	7.0		48
	30 / 1105	31.14	31.14	.16	1.75	1.70	487	52	46	7.5		48
		Vm = 20.493			ΔH = 1.7			Tm = 46.55				
				ΔP = .156			Ts = 487.5					

COMMENTS: a/ Sample Box T.C. not giving true Temp-values.

EPA-Durr 235

C-4-1-84

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP-Outlet
Test Number ESP-O-3-3

Date 10-31-80
Initial MDH

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	487.5
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.7, Pb = 29.28, Vm = 20.493, Tm+460 = 506.55	Vm_{std}	20.985
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 5.91	Mf	.941
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	30.36
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) +0.52, Pb = 29.28	Ps	29.32
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ ΔP = .156, Cp = .84	Vs	1756
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.374
$\frac{1{,}039\ (487.5 + 460)(20.985)}{(1756)(30)(29.32)(.941)(.374^2)}$	% I	101.6

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-O-3-3
Sample Date 10-31-80
Recovery Date
Cleanup Person

Filter No. 80
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/	118	104	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	18	4	2		
Sample No.(s)					

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

SILICA GEL

711.2	
707.3	
3.9	

Silica Gel Color

Description of Impinger Solution
Total Moisture, gm 77.9

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Blaker No. 72
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~~ Blaker No. 91
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 4841-L(93)

Source Identification ESP Outlet

Test Run Number ESP-O-3-3

Pollutant(s) in Sample Particulate Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-31-80	1035-1105	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	10-31-80		M. Hansen	
Other				
Transport of Train to Cleanup Site	10-31-80	1105-1125	Rajan, Hansen	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

Run No. ESP-0-3-3 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~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
72		5	82.14450	81.90368	125ml		
	80	6	0.64251	0.30377			
		6					
		6					
		7					
		8					
		9					
91		10	84.80300	84.79945	154		

3.55

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)

108

MIDWEST RESEARCH INSTITUTE

RUN ESP-0-3-4

MRI Project Number 4891-L-93
Field Dates 11-3-80
Plant Pfizer
Sampling Location ESP Outlet
Sampling Date 11-3-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whited
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

NOMOGRAPH DATA

PLANT Pfizer

DATE 11-3-80

SAMPLING LOCATION ESP-0-3-4

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	29.10
STATIC PRESSURE IN STACK, in. Hg 0.52 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.06
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.999
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	480
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.16
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	0.365	
ACTUAL NOZZLE DIAMETER, in.	0.374 #34	
REFERENCE Δp, in. H_2O	0.145	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 11-3-80
Initial PW

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

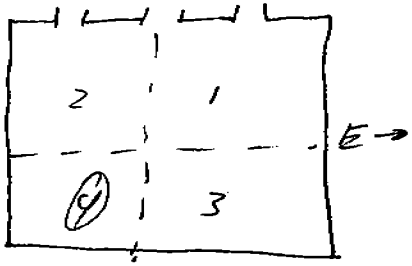
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	75
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	0.95
Nozzle diameter, inches	Dn	.374
Barometric pressure, inches Hg	Pb	29.1
$\frac{5.168\ (75 + 460)\ (.84)\ (.95)\ (3)\ (.374^2)}{\sqrt{29.10}}$	K	171 ~~206~~

FIELD DATA

PLANT Pfizer
DATE 11-3-80
SAMPLING LOCATION ESP OUTLET
SAMPLE TYPE Particulate
RUN NUMBER ESP-0-34
OPERATOR Whited
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 29.10
STATIC PRESSURE, (P_s) -.52" H_2O
FILTER NUMBER (s) 73



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 4' SS
NOZZLE I.D. .374
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 12
METER BOX NUMBER 69
METER $\Delta H_@$ 1.84
C FACTOR .9986
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 1.45

Leak CK: Initial at 15" Hg, CFM 0.01
Final at Hg, CFM 0.000

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 171 \times \frac{Ps}{\sqrt{Ts + 460}}$

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	1601	31,254										
	3		38,150 33.9	33,50	1.85	1.95	2.0	500	68	68	6½		
	6	35.8	43.49	35.98	1.80	2.3	2.5	480	71	70	6½	250	
	9	38.1	50.79	38.86	1.70	2.15	2.3	480	75	70	7	250	
	12	40.9	57.91	40.76	1.65	2.1	2.3	500	77	71	8		
	15	42.7 1615	65.03	43.255	1.65	2.1	2.3	490	79	71	8	250	
	18	44.9	72.19	45.51	1.60	2.05	2.2	490	81	71	8		
	21	47.13	79.22	47.88	1.6	2.05	2.2	495	82	72	8	250	
	24		86.23	51.21	1.6	2.05	2.3	490	82	72	8		
	27	1628	93.07	52.52	1.5	1.95	2.1	485	82	72	8	85	
	30	1631	100.26	54.84	1.65	2.1	2.1	480	82	72	8	245	
				23.59	0.163		2.23	489	75				
		55.915	~~Final = 54.84~~										
	0	1736	58.06	57.83	.150	1.9	1.95	500	68	70	6	245	
	3	1739	60.25	60.12	.155	1.95	2.15	500	72	70	6		
	6	1742	62.44	62.49	.155	1.95	2.2	495	72	70	6	200	
	9	1745	64.63	64.75	0.155	1.95	2.0	495	78	70	6½	210	
	12	1748	66.85	66.92	0.160	2.0	2.0	495	80	72	6½	220	
	15	1751	69.04	69.00	0.155	1.95	1.5	495	82	74	6½	220	
	18	1754	71.32	71.25	0.165	2.1	1.8	475	83	74	7	225	
	21	1757	73.58	73.46	0.165	2.1	1.9	495	83	74	7	230	60
	24	1800	75.77	75.62	0.155	1.95	2.0	495	84	74	7	230	
	27	1803	78.03	77.93	0.165	2.1	2.1	495	84	74	7	233	
	30	1806	80.34	80.30	0.17	2.15	2	495	84	74	8	235	

COMMENTS

Final = 80.308
V_m = 24.393 Δp = 0.159 ΔH = 1.96 T_s = 494.11 T_m = 75.77

EPA Form 235

C-4-1-92

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 11-3-80
Initial [illegible]

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	494.1
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH: ~~1.86~~ 1.96 V_m = 24.393 T_m = 75.8 P_b = 29.1	Vm_{std}	23.49
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$	Mf	0.95
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	31.14 ~~30.9~~
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.48 ~~29.78~~
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) −0.52" H_2O	Ps	29.06
Stack velocity, fpm $\sqrt{\Delta P}$ = .3987 $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$	Vs	1783 ~~1834.5~~ ~~1803.3~~
Total sample time, minutes	θ	~~30~~ 33
Nozzle diameter, inches	Dn	0.374
$\frac{1{,}039\ (494 + 460)(23.49)}{(1783)(33)(29.06)(.95)(.374^2)}$	% I	102.5

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-0-3-4
Sample Date 11-3-80
Recovery Date /
Cleanup Person

Filter No. 73
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

	1	2	3	4	5
Impinger Sequence					
Impinger Type a/	M	S	M		
Impinger Solution	H_2O	H_2O	Dry		
Final Volume (wt) b/	115	108	4		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	15	8	4		
Sample No.(s)					

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

SILICA GEL

~~726.8~~	726.8
~~718.5~~	718.5
~~718.5~~	8.3

Silica Gel Color

Description of Impinger Solution
Total Moisture, gm 35.3

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 51
Liquid Level Marked
Sealed

Impinger Rinse: Sample No.
Liquid Level Marked
Sealed

Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed

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

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

ESP-0-3-4

Run No. _____

MIDWEST RESEARCH INSTITUTE

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~~ Beaker No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
51		5	91.71336	91.33651	180		
	73	6	0.63315	0.30738			
		6					
		6					
		7					
		8					
		9					
114		10	83.65408	83.65438	115		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number '18P1-C-52

Source Identification ESP Outlet

Test Run Number ESP-0-3-4

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	11-3-80	1730-1806	Whited	
Probe Technician				
Meter Technician			Whited	
Other				
Transport of Train to Cleanup Site	10-3-80	1830	Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On site lab
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-O-4-1

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location ESP-Outlet
Sampling Date 10-29-80

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. Pauelonis
3 J. Johnson

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 10-29-80

SAMPLING LOCATION ESP-Outlet-4-1

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	55
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5.5
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.51
STATIC PRESSURE IN STACK, in. Hg +0.52 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.55
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	515
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.155
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	0.96	
CALCULATED NOZZLE DIAMETER, in.	.382	
ACTUAL NOZZLE DIAMETER, in.	.374	
REFERENCE Δp, in. H_2O	.170	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 10-29-80
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

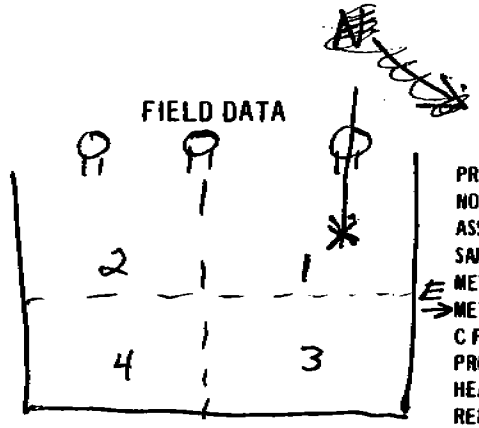
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	55
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.945
Nozzle diameter, inches	Dn	.374
Barometric pressure, inches Hg	Pb	29.51
$\frac{5.168\ (55 + 460)\ (.84)\ (3)\ (.945)\ (.374^2)}{\sqrt{29.51}}$	K	163.20

FIELD DATA

PLANT Pfizer
DATE 10-29-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE MASS
RUN NUMBER ESP-0-4-1
OPERATOR M. Hansen
AMBIENT TEMPERATURE 45°F
BAROMETRIC PRESSURE 29.51
STATIC PRESSURE, (P_s) +0.52
FILTER NUMBER (s) 47



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 3ft, S.S.
NOZZLE I.D. .374
ASSUMED MOISTURE, % 5.5
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .96
PROBE HEATER SETTING 100°F
HEATER BOX SETTING 550°F
REFERENCE Δp .170

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

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 163.2 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3		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
			886.40										
Quad	0	1742	Desired	Actual		DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
1	3	1745	888.29	888.39	.13	1.45	1.50	514	46	46	8.0	187	45
	6	1748	890.17	890.32	.13	1.45	1.50	517	50	46	7.5	196	44
	9	1751	892.05	892.20	.13	1.45	1.40	516	53	46	7.0	203	47
	12	1754	893.82	893.95	.115	1.25	1.20	517	56	47	6.5	207	—
	15	1757	895.70	895.80	.13	1.45	1.40	515	58	48	7.5	214	48
	18	1800	897.59	897.65	.13	1.45	1.40	512	59	48	7.5	214	49
	21	1803	899.55	899.57	.14	1.55	1.50	508	61	49	8.0	222	49
	24	1806	901.44	901.49	.13	1.45	1.45	512	61	50	8.0	232	49
	27	1809	903.33	903.37	.13	1.45	1.40	511	61	51	8.0	235	49
	30	1812	905.22	905.245	.13	1.45	1.40	505	61	51	8.0	235	49
			V_m = 18.845										
					ΔP = .13	ΔH = 1.42							
								T_s = 512.7	T_m = 52.4				

COMMENTS

EPA Form 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-0-4-1

Date ~~AA~~ 10-29-80
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}	512.7
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.51 ΔH = 1.42 Vm = 18.845 Tm = 52.4	Vm_{std}	19.21
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ 6.3 % measured.	Mf	.937
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	30.53
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) +0.52	Ps	29.55
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = .13	Vs	1,613
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.374
$\frac{1{,}039\ (512.7 + 460)(19.21)}{(1{,}613)(30)(29.55)(.937)(.374^2)}$	% I	103.59

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-0-4-1
Sample Date ~~F~~ 10-29-80
Recovery Date 10-29-80
Cleanup Person R.K.

Filter No. 47
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/	116	106	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	16	6	1		
Sample No.(s)					

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

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

SILICA GEL

~~686.0~~ 690.5
~~690.5~~ 686.0
4.5

Silica Gel
Color

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ BEAKER No. 80
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. 70
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. ESP-0-4-1 PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ Beaker No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
80		5	84.16221	83.94557	175ml		
	47	6	0.70353	0.30570			
		6					
		6					
		7					
		8					
		9					
70		10	78.44831	78.44736	110		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L(93)

Source Identification ESP Outlet

Test Run Number ESP-O-4-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	1742-1812	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	10-29-80	1742-1812	M. Hansen	
Other				
Transport of Train to Cleanup Site	10-29-80	1820	Raju K.	
Train Disassembly	10-29-80	1830	Raju K.	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN ESP-0-~~3~~4-2

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-4-2

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	40
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	6.3
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.56
STATIC PRESSURE IN STACK, in. Hg +0.52 (P_m ±0.074 STACK GAUGE PRESSURE in in. H_2O)	P_s	29.60
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	495
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.10
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.90	
CALCULATED NOZZLE DIAMETER, in.	.435	
ACTUAL NOZZLE DIAMETER, in.	.444	
REFERENCE Δp, in. H_2O	.90	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-O-4-7

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

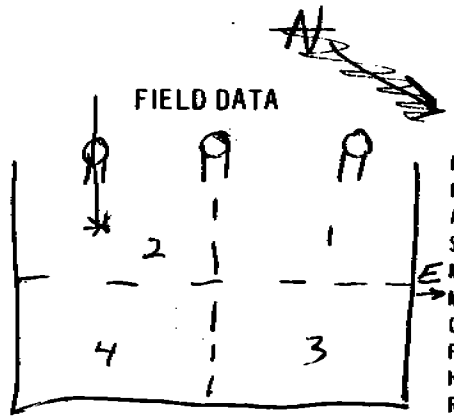
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	40
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.937
Nozzle diameter, inches	Dn	.444
Barometric pressure, inches Hg	Pb	29.56
$\frac{5.168\ (40 + 460)\ (.84)\ (3)\ (.937)\ (.444^2)}{\sqrt{29.56}}$	K	221.23

FIELD DATA

PLANT Pfizer
DATE 10-30-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE MASS
RUN NUMBER ESP-0-4-2
OPERATOR M. Hansen
AMBIENT TEMPERATURE 20°F
BAROMETRIC PRESSURE 29.56
STATIC PRESSURE, (P_s) -0.52
FILTER NUMBER (s) 48



PROBE LENGTH AND TYPE 3ft. S.S.
NOZZLE I.D. .444
ASSUMED MOISTURE, % 6.3
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .90
PROBE HEATER SETTING 100°F
HEATER BOX SETTING 550°F
REFERENCE Δp .90

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 11.0 Hg, CFM 0.0

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

$VM = 221.23 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER Quad	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK) 0854	GAS METER READING (V_m), ft³ 905.40 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
2	3	0857	907.67	907.92	.10	2.60	2.70	487	33	33	10.0	158	38
	6	0900	909.94	910.35	.10	2.60	2.40	487	38	33	9.0	178	39
	9	0903	912.22	912.69	.10	2.60	2.30	482	41	34	8.5	144 a/	40
	12	0906	914.50	914.88	.10	2.60	2.00	484	43	34	8.0	180	40
	15	0909	916.78	917.05	.10	2.60	2.00	484	45	34	8.0	180 a/	41
	18	0912	919.06	919.18	.10	2.60	1.90	482	46	35	8.0	165	42
	21	0915	921.34	921.38	.10	2.60	2.10	482	46	36	9.5	142 a/	41
	24	0918	923.62	923.60	.10	2.60	2.10	480	46	36	10.0	132 a/	41
	27	0921	925.90	925.59	.10	2.60	2.15	482	47	37	10.0	109 a/	41
	30	0924	928.19	928.19	.10	2.60	2.20	474	48	37	11.0	133 a/	42
			V_m =	22.79									
								Ts = 482.4					
					ΔP = .10	ΔH =	2.185		T_m =	39.1			

COMMENTS: a/ Lead wires to console not giving true reading.

EPA (Dec) 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP - Outlet
Test Number ESP-0-4-2

Date 10-30-80
Initial t.c.

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	482.4
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 2.185$ $Pb = 29.56$ $Vm = 22.79$ $Tm+460 = 499.1$	Vm_{std}	23.94
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 5.95$	Mf	.941
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	31.137
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	29.3
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) $P_s = +.52$	Ps	29.6
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .10$ $C_p = .84$	Vs	1420
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.444
$\frac{1{,}039\ (482.4 + 460)(23.94)}{(1420)(30)(29.6)(.941)(.444^2)}$	% I	100.2

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP. 0-4-2
Sample Date 10-30-80
Recovery Date
Cleanup Person

Filter No. 48
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/	119	105	2		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	19	5	2		
Sample No.(s)					

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

SILICA GEL

658.0	
652.0	
6.0	

Silica Gel
Color

Description of Impinger Solution
Total Moisture, gm 32

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 69, 81
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:

MIDWEST RESEARCH INSTITUTE

Run No. ESP0-4-2 PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ Beaker No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
69.81		5 ~~4~~ 69 81	87.15647 82.67603	86.93314 82.29327	382		
~~69.81~~		~~5~~ ~~69~~ ~~81~~	~~86.93314~~ ~~82.29327~~		~~382~~		
	48	6	0.67117	0.30164			
		6					
		6					
		7					
		8					
		9					
90		10	91.40781	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-L93

Source Identification ESP-Outlet

Test Run Number ESP-O-4-2

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	0854-0924		
Probe Technician				
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	10-30-80	0930-0935	Hansen, Rajan	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

120

MIDWEST RESEARCH INSTITUTE

RUN ESP-0-4-3(2)

MRI Project Number 4891-L-93
Field Dates 11-5-80
Plant Pfizer
Sampling Location ESP Outlet
Sampling Date 11-5-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Whited
2
3

Engr. Technician 1
2
3

Lab Technician 1
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 11-5-80

SAMPLING LOCATION ESP Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.68
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	57
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.20
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O) −0.52" H_2O	P_s	29.16
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.999
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	500
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.13
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.97	
CALCULATED NOZZLE DIAMETER, in.	0.395	
ACTUAL NOZZLE DIAMETER, in.	0.374	
REFERENCE Δp, in. H_2O	0.16	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location ESP OUTLET
Test Number ESP - O - 4-3-(2)

Date 11-5-80
Initial PG

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

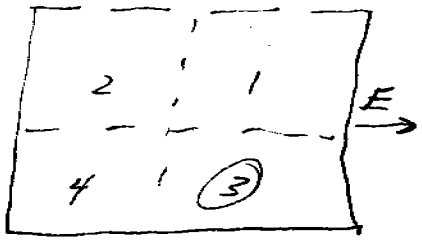
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	57
Pitot coefficient	Cp	0.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	~~3.20~~ .95
Nozzle diameter, inches	Dn	0.374
Barometric pressure, inches Hg	Pb	29.20
$\frac{5.168\ (57 + 460)\ (3)\ (.84)\ (\cancel{3.2}\ .95)\ (.374^2)}{\sqrt{29.20}}$	K	165.6

FIELD DATA

PLANT Pfizer
DATE 11-5-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-O-4-3(2)
OPERATOR Whitel
AMBIENT TEMPERATURE 45
BAROMETRIC PRESSURE 29.20
STATIC PRESSURE, (P_s) 0.52 "H_2O
FILTER NUMBER (s) 76



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 4' SS
NOZZLE I.D. 0.374
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 6
METER BOX NUMBER 8
METER $\Delta H_@$ 1.84
C FACTOR 0.97
PROBE HEATER SETTING 75
HEATER BOX SETTING 600
REFERENCE Δp .160

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

READ AND RECORD ALL DATA EVERY _____ MINUTES

$VM = 165.6 \times \sqrt{\frac{Ps}{Ts + 460}}$

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 / 1525	121.487										
	3 / 1528	123.46	122.95	0.140	1.60	1.60	520	47	47	3	340	47
	6 / 1531	125.44	124.47	0.140	1.60	1.60	520	48	47	3	320	
	9 / 1534	127.38	126.71	0.135	1.55	1.60	520	50	48	3	320	
	12 / 1537	129.36	129.39	0.140	1.60	2.5	525	55	50	5	320	
	15 / 1540	131.37	131.39	0.145	1.65	1.7	525	55	50	3	290	
	18 / 1543	133.39	133.30	0.145	1.65	1.5	515	55	50	3	290	
	21 / 1547	135.40	135.35	0.145	1.65	1.65	520	56	50	3	295	
	24 / 1550	137.41	137.43	0.145	1.65	1.80	525	56	50	4	290	
	27 / 1553	139.44	139.41	0.145	1.65	1.70	520	57	50	4	290	
	30 / 1556	141.47	~~141.395~~ 141.542	0.145	1.65	1.60	505	57	50	4	295	

$Vm = 20.055$ $\Delta p_s = 0.1425$ $\Delta H = 1.725$ $T_s = 519.5$ $Tm = 51.4$

COMMENTS

C-4-1-116

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP - 0-4-3-(2)

Date 11-5-80
Initial CU

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	519.5
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1.73$, $Pb = 29.20$, $Vm = 20.06$, $Tm = 51.4$	Vm_{std}	20.31
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	31.14
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) -.52	Ps	29.16
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\sqrt{\Delta P} = \sqrt{0.143} = 0.378$	Vs	1709.6
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	0.374
$\frac{1{,}039\ (519.5 + 460)(20.31)}{(1709.6)(30)(29.16)(.95)(.374^2)}$	% I	104.0

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-0-4-3(2)
Sample Date 11-5-80
Recovery Date
Cleanup Person

Filter No. 76
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/	90	115	1		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	-10	15	1		
Sample No.(s)					

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

SILICA GEL

731.1	
720.4	
10.7	

Silica Gel
Color

Description of Impinger Solution
Total Moisture, gm 16.7

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

RECOVERED SAMPLE

Probe Rinse: ~~Sample~~ Beaker No. 100
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. 105
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:

ESP-0-4-3(2)

Run No. _____

MIDWEST RESEARCH INSTITUTE

PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ BEAKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
100		5	81.11600	80.78831	225		
	76	6	0.54731	0.30516			
		6					
		6					
		7					
		8					
		9					
105		10	96.93587	96.93531	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 ESP Outlet

Test Run Number ESP 0-4-3 (2)

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	11-5-80	1525-1555	Whited	
Probe Technician				
Meter Technician	11-5-80		Whited	
Other				
Transport of Train to Cleanup Site	11-5-80	1600	~~Whited~~ Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				On Site Lab
Write Up				

116

MIDWEST RESEARCH INSTITUTE

RUN ESP-0-4-4

MRI Project Number 4851-L-23
Field Dates 11-4-80
Plant Pfizer
Sampling Location ESP Outlet
Sampling Date 11-4-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 United
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 11-4-80

SAMPLING LOCATION ESP Outlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	53
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	5%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.01
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O) ~ .152" H_2O	P_s	29.06
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.9987
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	500
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.16
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	
C FACTOR	0.95	
CALCULATED NOZZLE DIAMETER, in.	0.378	
ACTUAL NOZZLE DIAMETER, in.	0.374	
REFERENCE Δp, in. H_2O	0.166	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 11-4-80
Initial CC

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

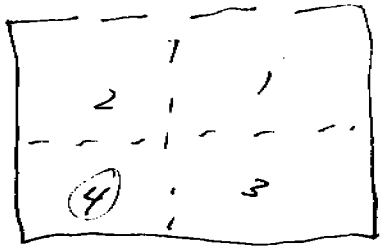
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	53
Pitot coefficient	Cp	0.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.95
Nozzle diameter, inches	Dn	.374
Barometric pressure, inches Hg	Pb	29.10
$\frac{5.168\ (53 + 460)\ (.84)\ (.95)\ (3)\ (.374^2)}{\sqrt{29.10}}$	K	164.6

FIELD DATA

PLANT Pfizer
DATE 11-4-80
SAMPLING LOCATION ESP OUTLET
SAMPLE TYPE Particulate
RUN NUMBER ESP-0-4-4
OPERATOR Whited
AMBIENT TEMPERATURE 48
BAROMETRIC PRESSURE 29.06
STATIC PRESSURE, (P_s) .52" H_2O
FILTER NUMBER (s) 77



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 4' SS
NOZZLE I.D. 0.224
ASSUMED MOISTURE, % 5%
SAMPLE BOX NUMBER 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR ~~.98~~ .98
PROBE HEATER SETTING 75
HEATER BOX SETTING 400
REFERENCE Δp 0.166

Leak CK: Initial at 15" Hg, CFM 0.003
Final at Hg, CFM 0.002

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 164.6 \times \sqrt{\frac{Ps}{Ts + 460}}$

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 / 1140	100.609		.18		1.8						
	3 / 1143	102.52	102.59	0.13	1.5	1.6	495	48	48	7	160.0	48
	6 / 1146	104.44	104.40	0.13	1.5	1.2	495	52	50	5½	200	
	9 / 1149	106.37	106.32	0.13	1.5	1.5	490	53	51	7	210	
	12 / 1152	108.29	108.20	0.13	1.5	1.4	500	54	51	7	220	
	15 / 1155	110.17	110.05	0.125	1.45	1.4	495	55	51	7	150	
	18 / 1158	112.06	111.94	0.125	1.45	1.4	490	55	51	7	170	
	21 / 1202	113.90	113.83	0.120	1.35	1.4	495	55	51	7	170	
	24 / 1205	115.90	115.71	0.14	1.60	1.4	490	55	51	7	160	
	27 / 1208	117.86	117.60	0.135	1.55	1.5	495	55	51	7	170	
	30 / 1212	119.86	119.62	0.140	1.60	1.5	495	55	51	7	165	
		Final =	119.625									
		Ym = 19.01		Δp_s = 0.1305		ΔH = 1.43	Ts = 493.5		Tm = 54.5			

COMMENTS

EPA Form 235

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 11-4-80
Initial AW

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	493.5
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.43, Pb = 29.06, Vm = 19.01, Tm = 55	Vm_{std}	18.99
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	31.20
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.54
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) -.52"	Ps	29.02
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\sqrt{\Delta p}$ = 0.3612	Vs	1614
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.374
$\frac{1{,}039\ (493.5 + 460)(18.99)}{(1614)(30)(29.02)(.95)(.374^2)}$	% I	100.76

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

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

Run No. ESP-0-4-4
Sample Date 11-4-80
Recovery Date 11/4/80
Cleanup Person DW

Filter No. 77
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	104	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	14	4	0		
Sample No.(s)					

Combined impinger contents, Sample No.
Liquid Level Marked Container(s) Sealed
Description of Impinger Solution
Total Moisture, gm 21.9

SILICA GEL

	681.4
~~684~~	677.5
~~675~~	3.9

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. 97
Liquid Level Marked
Sealed

Impinger Rinse: Sample No.
Liquid Level Marked
Sealed

Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed

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

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

ESP-0-4-4

Run No. _____

MIDWEST RESEARCH INSTITUTE

PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

~~Sample~~ BERKER No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
97		5	90.03047	89.81016	245		
	77	6	0.49370	0.30123			
		6					
		6					
		7					
		8					
		9					
114		10	83.65408	83.65438	115		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-L-93

Source Identification ESP OUTLET

Test Run Number ESP-O-4-4

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	11-4-80	1140-1212	Whited	
Probe Technician				
Meter Technician	"		Whited	
Other				
Transport of Train to Cleanup Site	11-4-80	1215	Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE LAB
Write Up				

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Pfizer
DATE 12-8-80
SAMPLING TIME (24-hr CLOCK)
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS GRAB) Grab
ANALYTICAL METHOD Fyrite
AMBIENT TEMPERATURE 55°F
OPERATOR E Olson

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	15.0		17.5		16.0		16.2	44/100	7.11
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	10.0		10.5		11.5		10.67	32/100	3.41
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							73.13	28/100	20.48
								TOTAL	30.99

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Pfizer
DATE 11-4-80
SAMPLING TIME (24-hr CLOCK) 1135
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS GRAB) Grab
ANALYTICAL METHOD Fyrite
AMBIENT TEMPERATURE 48°F
OPERATOR Whited

COMMENTS:

RUN / GAS	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	19		15½		16½		17	44/100	7.48
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	12½		12		11½		11.83	32/100	3.79
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							71.17	28/100	19.93
								TOTAL	31.20

EPA (Dun) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Pfi-Zar
DATE 10-30-80
SAMPLING TIME (24-hr CLOCK) 1400
SAMPLING LOCATION ESP-Outlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS GRAB) Grab
ANALYTICAL METHOD Fyrite
AMBIENT TEMPERATURE 50
OPERATOR Raja

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	17.0		16.5		16.5		16.67	44/100	7.335
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	11.5		12		11.5		11.67	32/100	3.734
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	0		0		0		0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)	71.5		71.5		72		71.67	28/100	20.068
								TOTAL	31.137

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Pfizer
DATE 10-27-80
SAMPLING TIME (24-hr CLOCK) 1120
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS GRAB) Grab
ANALYTICAL METHOD Fyrite
AMBIENT TEMPERATURE 60°
OPERATOR Vogel

COMMENTS:

RUN / GAS	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	17.5		18		17.5		17.66	44/100	7.77
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	14		13.5		13.5		13.66	32/100	4.37
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	0		0		0		0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)	68.5		68.5		69		68.67	28/100	19.23
								TOTAL	31.37

EPA (Dur) 230
4-72

C-4-2 Particle Sizing

59

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-1-1(2)

MRI Project Number 4891-L93
Field Dates
Plant PI173K
Sampling Location ESP-outlet
Sampling Date 10-28-80

FIELD CREW

Crew Chief M. Cobb

Testing Engineer 1 D. 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(2)

Date 10/28/80
Initial D. Dozel

.455

Velocity head at sampling location, in. H_2O	ΔPs	.11
Stack temperature at sample point, °F	Ts	490
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	~~40~~ 42
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	.455

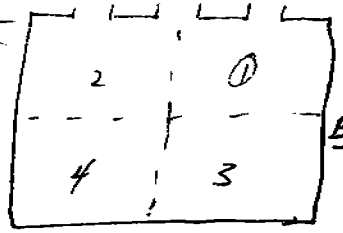
502

.11 @ 15 min
2 min
.113 @ 15 min

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10/28/80
SAMPLING LOCATION ESP outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-P-1-(2)
OPERATOR Vogel
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 29.28
STATIC PRESSURE, (P_s) -7.52
Filter Set 17

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired)	.455
Probe Tip Diameter	.330
CO_2	17.7
O_2	13.7
CO	0
N_2	68.7
% 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
QUAD 1	0	1910	219.300										
	2	1912	220.21	220.21	.11	.65	.67	490	42	45	3	NA	NA
	4	1914	221.12	221.126			.68	490	45	45	3	NA	NA
	6	1916	222.03	222.034			.67	490	47	45	3	NA	NA
								490°F					
						ΔH	Ave	T_s, Ave					
			V_m (ft^3)		Δp_s .11								
			V_m = 2.724		ΔP = .11	ΔH =	.673	T_s = 490	T_m =	44.8			

COMMENTS:

C-4-2-3

EPA Dur 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP - Outlet
Test Number ESP-0-1-1(2)

Date 10-25-80
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}	490
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .673$, $Pb = 29.28$, $Vm = 2.724$, $Tm+460 = 504.8$	Vm_{std}	2.792
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 7.6	Mf	.924
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	30.35
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) +.52	Ps	29.32
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P = .11$, $C_p = .84$	Vs	1476
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.33
$\frac{1{,}039\ (490 + 460)(2.792)}{(1476)(6)(29.32)(.924)(.33^2)}$	% I	105.5

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 17

Test No. ESP-0-1-1(2)
Date 10-28-80
Time
Location ESP Outlet

Final Weights
By Boomer Date 11-5-80
Location On Site Lab

Tare Weights
By J.P. Date 10-20-80
Location On Site Lab

PRES. 545.13 480.97 64.16

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0	17-0	439.48	437.96	1.52			
1	17-1	414.51	412.72	1.79			
2	17-2	453.10	444.91	8.19			
3	17-3	424.77	417.76	7.01			
4	17-4	436.74	430.68	6.06			
5	17-5	425.52	421.70	3.82			
6	17-6	436.30	435.23	1.07			
7	17-7	438.23	437.55	0.68			
F	17-F	456.21	455.27	0.94			
		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 4891-293

Source Identification ESP - Outlet

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

Pollutant(s) in Sample Particle Sizing

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 ~~1916~~	1916-1930	Vogel	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J Pavelonis	On Site Lab
Write Up				

(51)

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-1-2 (2)

MRI Project Number 4891-L93
Field Dates
Plant PFIZER
Sampling Location ESP outlet
Sampling Date 10/29/80

FIELD CREW

Crew Chief M. Cobb

Testing Engineer 1 David 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-O-1-R(2)

Date 10-28-80
Initial D. Vogel

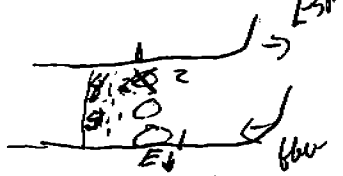
Velocity head at sampling location, in. H_2O	ΔPs	.11
Stack temperature at sample point, °F	Ts	296
Barometric pressure, in. Hg	Pb	29.28
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.31
Percent moisture in gas stream by volume	% H_2O	6.0%
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	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. .70 Fs $24\sqrt{\frac{Fs/Vs}{\pi}}$, 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	50
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) ~~460~~ 950	Fm	~~.440~~ .440

.88 @ 2 min

FIELD DATA - ANDERSEN

PLANT PF 12 EK
DATE 10/08/80
SAMPLING LOCATION ESP-outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP90-1-2 (2)
OPERATOR Vogel
AMBIENT TEMPERATURE 50°
BAROMETRIC PRESSURE 29.28
STATIC PRESSURE, (P_s) +.52
Filter Set 14

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



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired)	.440
Probe Tip Diameter	.330
CO_2	17.7
O_2	13.7
CO	0
N_2	68.7
% 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 / 1359	205.501										
QUAD 2	2 / 1401	206.381	206.38	.11	.58	.59	490	45	45	3	NA	NA
	4 / 1403	207.261	207.23			.59	490	46	45	3	↓	↓
	6 / 1405	208.141	208.130			.60	490	48	46	3		
	Tind =	2.629			ΔH = .593		Ts = 490	~~46~~	= Tm	45.6		
	Closure	Vm		ΔP = .11								
	12 sec.											

COMMENTS:

EPA (Dur) 235
4 77

C-4-2-9

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pf. Zeg.
Sampling Location ESP-Outlet
Test Number ESP-0-1-2(2)

Date 10-28-80
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}	490
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .593$ $Pb = 29.28$ $Vm = 2.629$ $Tm+460 = 505.8$	Vm_{std}	2.69 ~~2.67~~
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % $H_2O = 5.71$	Mf	.943 ~~.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 ~~31.37~~
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.61 ~~30.57~~
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) $P_s = -.52$	Ps	29.31 ~~29.31~~
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P = .11$ $C_p = .84$	Vs	1470
Total sample time, minutes	θ	6.2 ~~6.12~~
Nozzle diameter, inches	Dn	.330
$\frac{1{,}039\ (490 + 460)(2.69)}{(1470)(6.2)(29.31)(.943)(.330^2)}$	% I	~~97.56~~ 96.79

ANDERSEN PARTICLE SIZE ANALYSIS

ESP-0-1-2(2) Filter Set # 14

Test No. ESP-0-1-2
Date 10-28-80
Time
Location ESP-Outlet

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

Tare Weights
By J.P. Date 10-20-80
Location On-Site Lab

Press 539.21 514.04 25.17

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	14-0	472.41	467.28	5.13			
1	14-1	435.76	433.97	1.79			
2	14-2	463.67	457.03	6.64			
3	14-3	445.91	440.28	5.63			
4	14-4	446.67	441.36	5.31			
5	14-5	446.99	442.94	4.05			
6	14-6	448.01	444.85	3.16			
7	14-7	454.24	450.43	3.81			
F	14-F	485.40	482.94	2.46			
		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-0-1-2 ESP-0-1-2(2)

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1359-1405		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-28-80	1405-1430	Vogel, Kajajtarsen	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	11-5-80	9:00 AM	J. Parkhurst	
Write Up				

(90)

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-1-3

MRI Project Number 4891-L93
Field Dates
Plant PC-2m
Sampling Location ESP Outlet
Sampling Date 10-30-80

FIELD CREW

Crew Chief 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 Inlet
Test No. ESP-D-1-3

Date 10/30/80
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	29.47
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	29.50
Percent moisture in gas stream by volume	% H_2O	6.0
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	Mf	.96
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	31.84
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1630.
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.282
Actual nozzle diameter, in.	D_{n_a}	.338
Assumed meter temperature, °F	Tm	48
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.985
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.496

930

.333

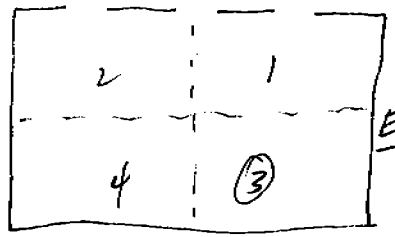
282

[redacted] .124 @ 15 sec.

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10/30/80
SAMPLING LOCATION Spent Lif
SAMPLE TYPE Particulate
RUN NUMBER ESP-0-1-3
OPERATOR Mr Vogel
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 29.47
STATIC PRESSURE, (P_s) +.52
Filter Set 24

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired) .496
Probe Tip Diameter .320
CO_2 16.7
O_2 11.7
CO 0
N_2 71.7
% H_2O 6.6

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
QUAD	0	1426	257,000										
3	2	1428	257,992	257,990	.14	.71	.73	490	52	50	4	NA	NA
	4	1430	258,984	258,93			.73	490	53	52	4	NA	NA
	6	1432	259,976	259,991			.74	490	54	52	4	NA	NA
					ΔP= .14			T_s = 490					
			Vm=	2.991		ΔH=	.733		Tm=	52.2			

COMMENTS:

EPA Dur 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP-Outlet
Test Number ESP-0-1-3

Date 10-30-80
Initial C.C.

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .733$, $Pb = 29.47$, $Vm = 2.991$, $Tm+460 = 512.2$	Vm_{std}	3.041
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	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 $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P = .14$, $C_p = .84$	Vs	1654
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.33
$\frac{1{,}039\ (490 + 460)(3.041)}{(1654)(6)(29.51)(.956)(.33^2)}$	% I	98.45

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 24

Test No. ESP-0-1-3
Date 10-30-80
Time
Location ESP-0 outlet

Final Weights
By BOOMER Date 11-7-80
Location On SITE LAB

Tare Weights
By JP. Date 10-21-80
Location On SITE LAB

PRES. 550.55 502.89 47.66

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	24-0	408.24	406.96	1.28			
1	24-1	429.10	426.15	2.95			
2	24-2	460.61	446.91	13.70			
3	24-3	443.60	432.87	10.73			
4	24-4	447.06	439.18	7.88			
5	24-5	431.39	426.93	4.46			
6	24-6	440.26	439.09	1.17			
7	24-7	451.36	449.88	1.48			
F	24-F	545.51	543.93	1.58			
			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 ~~7879~~4891-293

Source Identification ESP-Outlet

Test Run Number ESP-0-1-3

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1426-1432		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-30-80	1432-1445	Vogel	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			A. Pawzlomis	On Site Lab
Write Up				

(86)

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-1-4

MRI Project Number 4891-293
Field Dates
Plant PFIZER
Sampling Location ESP-Outlet
Sampling Date 10-30-80

FIELD CREW

Crew Chief G Cobb

Testing Engineer 1 Daniel Vogel
2
3

Engr. Technician 1
2
3

Lab Technician 1
2
3

Process Engineer 1
2

Other 1
2

ANDERSEN SAMPLING CALCULATIONS

29 1/4

Plant Pfizer
Sampling Location ESP-outlet
Test No. ESP-0-1-4

Date 10/30/80
Initial D. Doyle

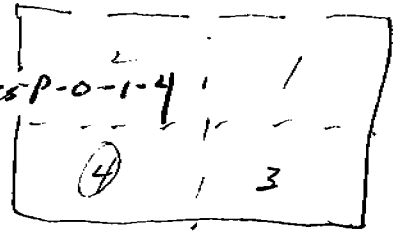
Velocity head at sampling location, in. H_2O	ΔPs	.14
Stack temperature at sample point, °F	Ts	495
Barometric pressure, in. Hg	Pb	29.55
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	29.58
Percent moisture in gas stream by volume	% H_2O	6.0
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	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	~~31.54~~ 31.84
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1635
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.334
Actual nozzle diameter, in.	D_{n_a}	.333
Assumed meter temperature, °F	Tm	43
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.985
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	~~.989~~ .490

[redacted] 98 @ 2 min [redacted]
.122 at 15 sec

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10/30/80
SAMPLING LOCATION ESP-outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-0-~~4~~
OPERATOR Vogel
AMBIENT TEMPERATURE 45
BAROMETRIC PRESSURE 29.55
STATIC PRESSURE, (P_s) +.52
Filter Set 23

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired) .490
Probe Tip Diameter .337
CO_2 16.7
O_2 11.7
CO 0
N_2 71.7
% 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
QUAD	0	1127	252.500										
4	2	1129	253.48	253.40	.14	.67	.68	495	44	43	3.5	NA	NA
	4	1131	254.46	254.32			.69	495	45	43	3.5	NA	NA
	6	1133	255.44	255.399			.71	495	46	43	3.5	NA	NA
			V_m =	2.899		ΔH =	.693		T_m =	44			
					ΔP = .14			T_s = 495					

COMMENTS:

EPA (Dur) 235
1 72

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}	495
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .693, Pb = 29.55, Vm = 2.899, Tm+460 = 504	Vm_{std}	3.003
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ %H_2O = .957	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	31.137
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	29.59
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = .14, C_p = .84	Vs	1656
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.333
$\frac{1{,}039\ (495 + 460)(3.003)}{(1656)(6)(29.59)(.957)(.333^2)}$	% I	95.5

ANDERSEN PARTICLE SIZE ANALYSIS
Filter Set # 23

Test No. ESP-0-1-4
Date 10-30-80
Time
Location ESP Outlet

Final Weights
By Boomer Date 11-5-80
Location On Site Lab

Tare Weights
By J.P Date 10-21-80
Location On-Site Lab

Press, 501.41 483.71 17.70

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	23-0	438.32	436.94	1.38			
1	23-1	430.68	428.66	2.02			
2	23-2	449.30	440.50	8.80			
3	23-3	433.34	424.53	8.81			
4	23-4	440.17	433.44	6.73			
5	23-5	428.17	424.52	3.65			
6	23-6	439.99	439.04	0.95			
7	23-7	452.57	451.03	1.54			
F	23-F	531.72	530.10	1.62			
			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-1-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	1127-1133		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-30-80	1140-1155	Vogel, Rajai	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J PAVELONIS	On SITE LAB
Write Up				

66

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-2-1

MRI Project Number 4891-L93
Field Dates
Plant PFIZER
Sampling Location ESP outlet
Sampling Date 10/29/80

FIELD CREW

Crew Chief M. Cobb

Testing Engineer 1 David 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 PF123R
Sampling Location ESP outlet
Test No. ESP-0-2-1

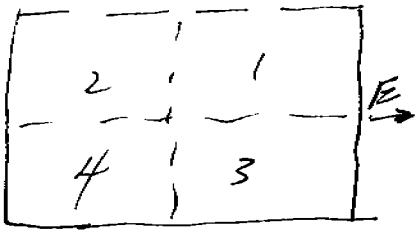
Date 10/28/80
Initial D. Vogel

Velocity head at sampling location, in. H_2O	ΔPs	.12
Stack temperature at sample point, °F	Ts	500
Barometric pressure, in. Hg	Pb	29.50
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.53
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	1534
Calculated nozzle diameter, in. .7 to Fs $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.290
Actual nozzle diameter, in.	D_{n_a}	.333
Assumed meter temperature, °F	Tm	40
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.930
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)$ (Mf)	Fm	.455

.113 @ 15 sec.

FIELD DATA - ANDERSEN

PLANT PF, ZER
DATE 10/29/80
SAMPLING LOCATION ESP OUTLET
SAMPLE TYPE Particulate
RUN NUMBER ESP-O-21
OPERATOR Lee El
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.50
STATIC PRESSURE, (P_s) +.52
Filter Set 19
Leak CK: Inital at 15" Hg, CFM NA
Final at ____ Hg, CFM NA



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) .455
Probe Tip Diameter .330
CO_2 17.7
O_2 13.7
CO 0
N_2 68.7
% H_2O 6.0

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired 225.300	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
Guard	0 0910											
1	2 0912	224.71	224.70	.12	.66	.69	500	36	35	3	NA	NA
	4 0914	225.62	225.60			.69	500	37	36	3	NA	NA
	6 0916	226.530	226.522			.70	500	40	36	3	NA	NA
						.693						
		Vm =	2.722		ΔH:			Tm =	36.7			
				ΔP = .12			Ts = 500					

COMMENTS.

EPA (Dur) 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-29-80
Initial EC

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	500
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .693$, $Pb = 29.5$, $Vm = 2.722$, $Tm+460 = 496.7$	Vm_{std}	2.857
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	29.53
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$	Vs	1539
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.330
$\frac{1{,}039\ (500\ (960) + 460)(2.557)}{(1539)(6.0)(29.53)(.94)(.330^2)}$	% I	~~102.99~~ 102.09

ANDERSEN PARTICLE SIZE ANALYSIS
Filter Set # 19

Test No. ESP-0-2-1
Date 10-29-80
Time
Location ESP-outlet

Final Weights
By Boomer Date 11-5-80
Location On Site Lab

Tare Weights
By JP Date 10-20-80
Location On Site Lab

Pres. 560.48 504.18 56.30

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	19-0	454.33	449.54	4.79			
1	19-1	425.61	423.40	2.21			
2	19-2	451.09	442.93	8.16			
3	19-3	420.41	412.27	8.14			
4	19-4	447.80	441.47	6.33			
5	19-5	418.61	415.35	3.26			
6	19-6	447.63	446.43	1.20			
7	19-7	452.84	451.26	1.58			
F	19-F	449.24	446.15	3.09			
			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.

SAMPLE HANDLING LOG

Project Number 4891 2(93)

Source Identification ESP outlet

Test Run Number ESP

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10/29/80	0910 916 →	MR. VOGEL	
Probe Technician			MR. VOGEL	
Meter Technician			MR. VOGEL	
Other				
Transport of Train to Cleanup Site	10/29/80	925 930	RAJO Kakolapaty	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J. Powalonis	On Site Lab
Write Up				

62

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ~~ESP 0-1-1~~ ESP-0-2-2

MRI Project Number 4891-L93
Field Dates
Plant PFIZER
Sampling Location ESP-outlet
Sampling Date 10/28/80

FIELD CREW

Crew Chief G Cobb

Testing Engineer 1 Daniel S Vogel
2
3

Engr. Technician 1
2
3

Lab Technician 1 J. Johnson
2 T. Walker
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-0-2-2

Date 10-28-80
Initial D. Vogel

Velocity head at sampling location, in. H_2O	ΔPs	.07
Stack temperature at sample point, °F	Ts	490
Barometric pressure, in. Hg	Pb	29.31
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.34
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	31.34
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	~~36.56~~ 30.57
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1173 ~~1172~~
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.333
Actual nozzle diameter, in.	D_{n_a}	.333
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	~~.708~~ 0.709
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	~~.354~~ 0.355

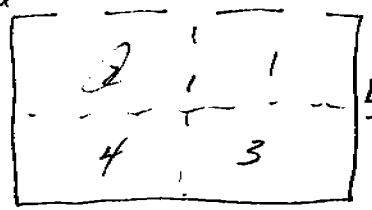
506
4.001

.108 ⊘ 2
.088 ⊘ 15 sec

FIELD DATA - ANDERSEN

PLANT Pf 12 ESP
DATE 10/28/80
SAMPLING LOCATION ESP-outlet
SAMPLE TYPE PARTICULATE
RUN NUMBER ESP-0-2-2
OPERATOR Mr. Vogel
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 29.31
STATIC PRESSURE, (P_s) +.52
Filter Set 16

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



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired)	.354
Probe Tip Diameter	.330
CO_2	17.7
O_2	13.7
CO	0
N_2	68.7
% H_2O	6.0

TRAVERSE POINT NUMBER (QUAD)	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 / 1745	214.900										
2	2	215.608	215.602	.07	.39	.40	490	44	44	3	NA	NA
	4	216.316	216.315	.07		.41	490	43	42	3	NA	NA
	6 / 1754	217.024	217.035			.41	490	45	43	3	NA	NA
			217.035									
		Vm = 2.125				ΔH =	.407		Tm = 43.5			
				ΔPs = .07								
							Ts =	490				

COMMENTS:

C-4-2-33

EPA (Dur) 235
1 73

ISOKINETIC PERFORMANCE WORKSHEET

Plant P fizer
Sampling Location ESP- Outlet
Test Number ESP-0-2-2

Date 10-28-80
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}	490
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .407$ $Pb = 29.31$ $Vm = 2.125$ $Tm+460 = 503.5$	Vm_{std}	2.18
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 5.86	Mf	.941
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	30.58
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) Ps = +.52	Ps	29.35
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P = .07$ $C_p = .84$	Vs	1173
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.330
$\frac{1{,}039\ (490 + 460)(2.18)}{(1173)(6)(29.35)(.941)(.33^2)}$	% I	101.7

ANDERSEN PARTICLE SIZE ANALYSIS
Filter Set # 16

Test No. ESP-0-2-2
Date 10-28-80
Time
Location ESP-Outlet

Final Weights
By [illegible] Date 10-28-80
Location On Site Lab

Tare Weights
By JP Date 10-30-80
Location On Site Lab

Press. 540.34 516.73 23.61

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	16-0	454.55	447.97	6.58			
1	16-1	433.51	430.04	3.47			
2	16-2	450.35	442.77	7.58			
3	16-3	438.23	431.46	6.77			
4	16-4	466.67	460.31	6.36			
5	16-5	703.59	699.75	3.84			
6	16-6	457.12	455.66	1.46			
7	16-7	453.20	452.57	0.63			
F	16-F	454.94	454.46	0.48			
			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-0-2-2

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	10-28-80	1746-1754		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-28-80		Vogel, Lyon, Hansen	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			I. PAVELONIS	ON SITE LAB
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-8-2-3

MRI Project Number 4891-L 93
Field Dates
Plant PF12ER
Sampling Location ESP-Outlet
Sampling Date 10/31/80

FIELD CREW

Crew Chief G Cobb

Testing Engineer 1 Daniel S Vogel
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

ANDERSEN SAMPLING CALCULATIONS

Plant Pf125R
Sampling Location ESP-outlet
Test No. ESP-0-2-3

Date 10/31/80
Initial D. Dozy

Velocity head at sampling location, in. H_2O	ΔPs	.16
Stack temperature at sample point, °F	Ts	415
Barometric pressure, in. Hg	Pb	29.29
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	29.32
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	~~31.4~~ 31.14
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	~~26.02~~ 30.48
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	~~1006.~~ 1781
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min .71	D_{n_c}	.261 .270
Actual nozzle diameter, in.	D_{n_a}	.270
Assumed meter temperature, °F	Tm	39 - (39)
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.707
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.351

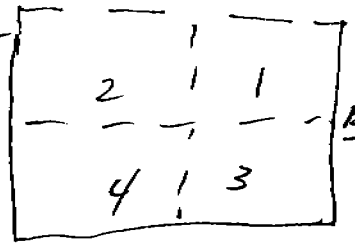
955

.202 @ 2 min
.687 @ 15 sec.

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10/31/80
SAMPLING LOCATION ESP-outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-0-2-3
OPERATOR Vogel
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 28.29
STATIC PRESSURE, (P_s) -1.52
Filter Set 07

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired) .351
Probe Tip Diameter .270
CO_2 16.7
O_2 11.7
CO 0
N_2 71.7
% H_2O 5%

TRAVERSE POINT NUMBER (QUAD)	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 / 0904	270.050										
3	2 / 0908	270.752	270.797		.42	.45	495	40	39	3	NA	NA
	4 / 0910	271.45	271.52			.45	495	41	40	3	↓	↓
	6 / 0912	272.156	272.290			.44	495	42	40	5	↓	↓
		V_m = 2.020			ΔH = 0.447		T_s = 495	T_m = 40.33				

COMMENTS.

EPA (Dur) 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-31-80
Initial D

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 0.447$, $Pb = 29.29$, $Vm = 2.20$, $Tm = 40.33$	Vm_{std}	2.27
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ 5% assumed	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	31.14
Molecular wt. stack gas, lb/lb-mole $(Md)(Mf) + 18(1 - Mf)$	Ms	30.483
Static pressure in stack, absolute, in. Hg $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	29.26
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\sqrt{\Delta P} = \sqrt{0.16} = 0.4$, $Cp = 0.84$	Vs	1845
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	0.270
$\frac{1{,}039\,(495 + 460)(2.27)}{(1845)(6)(29.26)(0.95)(.27^2)}$	% I	100.40

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 27

Test No. ESP-0-2-3
Date 10-31-80
Time
Location ESP-Outlet

Final Weights
By JP Boomer Date 11-5-80
Location On Site Lab

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

PRES. 594.82 480.53 114.29

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	27-0	452.07	450.10	1.97			
1	27-1	445.07	443.05	2.02			
2	27-2	466.16	452.69	13.47			
3	27-3	465.81	454.70	11.11			
4	27-4	474.40	459.52	14.88			
5	27-5	467.71	457.80	9.91			
6	27-6	461.04	458.98	2.06			
7	27-7	455.52	454.97	0.55			
F	27-F	559.03	555.30	3.13			
		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 4891-293

Source Identification ESP Outlet

Test Run Number ESP-0-2-3

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-31-80	0906-0912		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-31-80	0915-0930	Vogel	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J. Powelson	On Site Lab
Write Up				

95

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-2-4

MRI Project Number 4891-L93
Field Dates
Plant PFIZER
Sampling Location ESP-OUTLET
Sampling Date 10-30-80

FIELD CREW

Crew Chief G. C. B.

Testing Engineer 1 DANIEL VOGEL
2
3

Engr. Technician 1
2
3

Lab Technician 1 J. Johnson
2 Walker
3

Process Engineer 1
2

Other 1
2

ANDERSEN SAMPLING CALCULATIONS

Plant PFIZER
Sampling Location ESP-OUTLET
Test No. ESP-0-

Date 10/30/80
Initial MR. D. Vogel

Velocity head at sampling location, in. H_2O	ΔPs	.15
Stack temperature at sample point, °F	Ts	480
Barometric pressure, in. Hg	Pb	29.41
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	~~29.48~~ 29.44
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	31.14
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	26.62 30.48
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1343
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.309
Actual nozzle diameter, in.	D_{n_a}	.332
Assumed meter temperature, °F	Tm	55
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.806
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.419

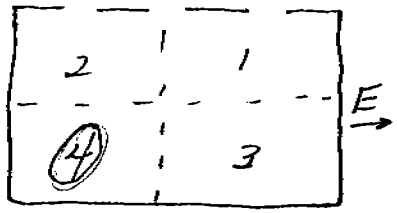
460

[redacted] .938 ⓐ 2 .104 ⓐ 15 [redacted]

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10/30/80
SAMPLING LOCATION ESP outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-0-2-4
OPERATOR M.R. Vogel
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 28.41
STATIC PRESSURE, (P_s) -.52
Filter Set 25

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired) 419
Probe Tip Diameter .332
CO_2 16.7
O_2 11.7
CO 0
N_2 71.7
% 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
	0 / 1652	263.200										
QUAD 4	2 / 1654	264.038	264.070	.15	.57	.60	480	50	49	4	NA	NA
	4 / 1656	264.88	~~265.000~~ 264.92			.60	480	50	49	4	NA	NA
	6 / 1658	265.714	265.774			.60	480	50	50	4	NA	NA
			265.774									
							480					
							T_s AVE	T_m = 49.67				
		V_m = 2.574		Δp = .15	ΔH =	0.60						

COMMENTS.

C-4-2-45

EPA (Dur) 235
3 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant PFIZER
Sampling Location ESP. outlet
Test Number ESP-0-2-4

Date 10/30/80
Initial MR. 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}	480
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .6$ $Pb = 29.41$ $Vm = 2.574$ $Tm+460 = 509.67$	Vm_{std}	2.624
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 7.04$	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	31.14
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) $P_s = .52$	Ps	29.45
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .15$ $C_p = .84$	Vs	1715
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.332
$\frac{1{,}039\ (480 + 460)(2.624)}{(1715)(6)(29.45)(.93)(.332^2)}$	% I	82.49

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET #25

Test No. ESP-0-2-4
Date 10-30-80
Time
Location ESP-Outlet

Final Weights
By Boomer Date 11-5-80
Location On Site Lab

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

Pres. 527.51 497.64 29.87

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	25-0	432.86	431.65	1.21			
1	25-1	417.40	415.56	1.84			
2	25-2	440.76	431.17	9.59			
3	25-3	424.72	415.34	9.38			
4	25-4	439.36	431.27	8.09			
5	25-5	422.47	418.19	4.28			
6	25-6	435.38	434.67	0.71			
7	25-7	448.49	448.16	0.33			
F	25-F	543.83	542.86	0.97			

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 ESP-OUTLET

Test Run Number ESP-O-2-4

Pollutant(s) in Sample PARTICULATE

Task	Date	Time	Personnel	Remarks
Sampling	10/30/80	1652/1658	Vogel	
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10/30/80	1700/1705	Vogel	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J. Pawlowski	On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-3-1

MRI Project Number 4891-L93
Field Dates
Plant PFIZER
Sampling Location
Sampling Date 10-29-80

FIELD CREW

Crew Chief G. 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

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant PFIZER
Sampling Location ESP outlet
Test No. ESP-0-3-1

Date 10/29/80
Initial MR. D. VOGEL

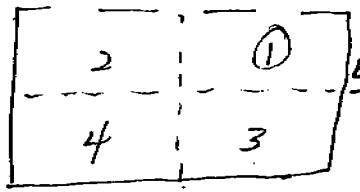
Velocity head at sampling location, in. H_2O	ΔPs	.12
Stack temperature at sample point, °F	Ts	500
Barometric pressure, in. Hg	Pb	29.49
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.52
Percent moisture in gas stream by volume	% H_2O	6.0
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	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	30.56
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1539
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.290
Actual nozzle diameter, in.	D_{n_a}	.333
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	.930
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)$ (Mf)	Fm	.965 ~~.460~~

.93 @ 2 mm
.116 @ 15 sec.

FIELD DATA - ANDERSEN

PLANT PF12ER
DATE 10/29/80
SAMPLING LOCATION ESP-outlet
SAMPLE TYPE particulate
RUN NUMBER ESP-0-3-1
OPERATOR Mr. D. Vogel
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 29.49
STATIC PRESSURE, (P_s) +.52
Filter Set 20

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired)	.465
Probe Tip Diameter	.333
CO_2	17.7
O_2	13.7
CO	0
N_2	68.7
% H_2O	6%

TRAVERSE POINT NUMBER (QUAD)	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 / 1618	237.261										
1	2	238.131	238.128	.12	.70	.71	500	46	44	3.5	NA	NA
	4	239.061	239.06			.71	500	46	44	3.5	NA	NA
	6 1624	239.991	239.991			.71	500	47	44	3.5	NA	NA
		Vm =	2.79	ΔP = .12		ΔH = .71	Ts = 500	Tm =	45.2			

COMMENTS:

EPA (Dur. 235
4 72

C-4-2-51

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP-Outlet
Test Number ESP-O-3-1

Date 10-29-80
Initial PP.

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	500
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .71$ $Pb = 29.49$ $Vm = 2.79$ $Tm+460 = 505.2$	Vm_{std}	2.878
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 3.93	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	31.37
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	29.53
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .12$ $C_p = .84$	Vs	1532
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.333
$\frac{1{,}039\ (500 + 460)(2.878)}{(1532)(6)(29.53)(.96)(.333^2)}$	% I	99.34

ANDERSEN PARTICLE SIZE ANALYSIS
Filter Set # 20

Test No. ESP-0-3-1
Date 10-29-80
Time
Location ESP-Outlet

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

Tare Weights
By SP Date 10-20-80
Location On Site Lab

Pres. 509.83 465.15 44.68

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	20-0	449.92	444.69	5.23			
1	20-1	420.87	416.34	4.53			
2	20-2	437.77	425.04	12.73			
3	20-3	412.32	399.58	12.74			
4	20-4	412.18	401.43	10.75			
5	20-5	396.23	386.85	9.38			
6	20-6	447.06	444.62	2.44			
7	20-7	473.88	471.59	2.29			
F	20-F	459.47	454.94	4.53			
		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-3-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	1618-1624		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-29-80	1625-1645	Vogel, Rap	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J. PAUCLONIS	ON SITE LAB
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-3-2

MRI Project Number 4891-L93
Field Dates
Plant PF-1ZER
Sampling Location ESP outlet
Sampling Date 10/29/80

FIELD CREW

Crew Chief G Cobb

Testing Engineer 1 Mr. Dennis B. 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-0-3-2

Date 10/29/80
Initial [illegible]

Velocity head at sampling location, in. H_2O	ΔPs	.1
Stack temperature at sample point, °F	Ts	490
Barometric pressure, in. Hg	Pb	29.52
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	29.55
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	31.84
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	~~1369~~ 1369
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.308
Actual nozzle diameter, in.	D_{n_a}	.338
Assumed meter temperature, °F	Tm	55
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.812
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.414

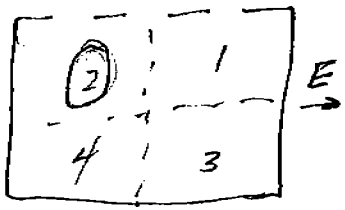
.9409553

.1635 @ 15 gal
.828 - @ 2 min

FIELD DATA - ANDERSEN

PLANT PFIZER
DATE 10/29/80
SAMPLING LOCATION ESP outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-0-3-2
OPERATOR MR. Dogel #
AMBIENT TEMPERATURE 53
BAROMETRIC PRESSURE 29.52
STATIC PRESSURE, (P_s) 7.52
Filter Set 18

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired) 414
Probe Tip Diameter .330
CO_2 12.7
O_2 13.7
CO 0
N_2 68.7
% 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
GUAGE	0	1435	230.801										
2	2	1437	232.629	232.65	.1	.53	.55	490	54	52	3.5	NA	NA
	4	1439	233.457	233.43			.53	490	54	53	3.5	NA	NA
	6	1441	234.285	234.275			.55	490	55	54	3.5	NA	NA
			2.474			.543		490	~~53.6~~ Tm 54				
			V_m = 2.474		ΔP = .10	ΔH = .54.3		T_s = 490	Tm = 53.67				

COMMENTS

C-4-2-57

EPA Dur 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant PC-3ea
Sampling Location ESP-Outlet
Test Number ESP-O-3-2

Date 10-29-80
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}	490
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .54.3$ $Pb = 29.52$ $Vm = 2.474$ $Tm+460 = 513.7$	Vm_{std}	2.511
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 6.46$	Mf	.935
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	30.5
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.56
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P = .1$ $C_p = .84$	Vs	1398
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.330
$\frac{1{,}039\ (490 + 460)(2.511)}{(1398)(6)(29.56)(.935)(.33^2)}$	% I	98.17

ANDERSEN PARTICLE SIZE ANALYSIS
Filter Set #18

Test No. ESP-0-3-2
Date 10-29-80
Time
Location ESP-Outlet

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

Tare Weights
By I.P. Date 10-30-80
Location On Site Lab

Pres. 528.46 506.22 22.24

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	18-0	455.22	454.53	0.69			
1	18-1	449.29	447.84	1.45			
2	18-2	476.05	469.14	6.91			
3	18-3	453.21	445.64	7.57			
4	18-4	461.59	453.10	8.49			
5	18-5	451.67	445.70	5.97			
6	18-6	458.05	456.69	1.36			
7	18-7	439.89	439.19	0.70			
F	18-F	474.69	472.34	2.35			
			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-3-2

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	10-29-80	1435-1441		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-29-80	1441-1500	Vogel, Raja	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J Powelson	On Site LAB
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-A-3-3

MRI Project Number 4891-L93
Field Dates
Plant PF-2
Sampling Location ESP-Outlet
Sampling Date 11-3-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Cobb
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pf-2nd
Sampling Location ESP-Outlet
Test No. ESP-O-3-3

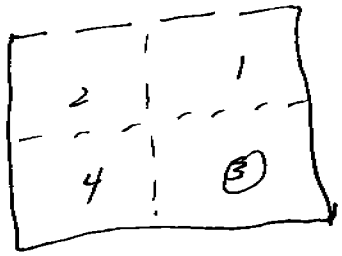
Date 11-3-80
Initial PC

Velocity head at sampling location, in. H_2O	ΔPs	.16
Stack temperature at sample point, °F	Ts	490
Barometric pressure, in. Hg	Pb	29.1
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O) + .52	Ps	29.14
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	28.43 ?
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1845
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}	.266
Actual nozzle diameter, in.	D_{n_a}	.27
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	.733
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.381

FIELD DATA - ANDERSEN

PLANT Fiber
DATE 11-3-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-0-3-3
OPERATOR Cobb
AMBIENT TEMPERATURE 65
BAROMETRIC PRESSURE 29.1
STATIC PRESSURE, (P_s) +.52
Filter Set 30

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) .381 (.095)
Probe Tip Diameter .207
CO_2 16.7
O_2 11.7
CO 0
N_2 71.7
% 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	18:07	~~279.851~~ 280.05										
Quad 3	2	18:09	280.81	280.80	.16	.41	.44	490	74	74	N/A	N/A	N/A
	4	18:11	281.57	281.56			.41		74	74			
	6	18:13	282.34	282.29			.41		75	74			
			V_m = 2.24		Δp_s = .16	ΔH = 0.42		T_s = 490	T_m = ~~74.2~~ = 74.17				

COMMENTS:

EPA (Dur) 235
1 72

C-4-2-63

ISOKINETIC PERFORMANCE WORKSHEET

Plant PFIZER
Sampling Location OUTLET
Test Number ESP 0-3-3

Date 11-3-80
Initial R.K.

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.1, ΔH = 0.42, Tm = 74.17, Vm = 2.24	Vm_{std}	2.155
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	31.14
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	28.43
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) Ps = -.52	Ps	29.06
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = .16, Cp = .84	Vs	1848
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.27
$\frac{1{,}039\ (490 + 460)(2.155)}{(1848)(6)(29.06)(.94)(.27^2)}$	% I	96.3

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 30

Test No. ESP-D-3-3
Date 11-3-80
Time
Location

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

Tare Weights
By AP. Date 10-31-80
Location On Site Lab

PRES. 536.06 502.01 34.05

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	30-0	465.01	462.50	2.51			
1	30-1	436.69	435.48	1.21			
2	30-2	460.02	453.25	6.77			
3	30-3	437.96	431.21	6.75			
4	30-4	461.25	455.01	6.24			
5	30-5	437.40	432.45	4.95			
6	30-6	457.52	456.48	1.04			
7	30-7	466.87	466.47	0.40			
F	30-F	562.24	560.60	1.64			
			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 4891-293

Source Identification ESP Outlet

Test Run Number ESP-0-33

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	11-3-80	1607-1613		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	11-3-80	1615-1630	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J. Pourhomis	On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-D 3-4

MRI Project Number 4891-L93
Field Dates
Plant PFIZER
Sampling Location ESP-OUTLET
Sampling Date

FIELD CREW

Crew Chief B. CORR

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

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant PFIZER
Sampling Location ESP-OUTLET
Test No. ESP-06-3-4

Date 10/31/80
Initial D. Vogel

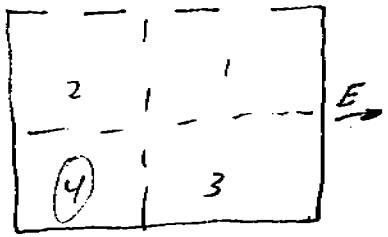
Velocity head at sampling location, in. H_2O	ΔPs	.16
Stack temperature at sample point, °F	Ts	~~490~~ 490
Barometric pressure, in. Hg	Pb	29.28
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.31
Percent moisture in gas stream by volume	% H_2O	5%
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	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	31.14
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.48 ~~29.58~~
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1777
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.270
Actual nozzle diameter, in.	D_{n_a}	.270
Assumed meter temperature, °F	Tm	43
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.706
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$ .9509	Fm	.355

.089 @ 15 psi

FIELD DATA - ANDERSEN

PLANT Pfizer O-3
DATE 10/31/80
SAMPLING LOCATION ESP - OUTLET
SAMPLE TYPE PARTICULATE
RUN NUMBER ESP-O-3-4
OPERATOR Vogel
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.26
STATIC PRESSURE, (P_s) -1.52
Filter Set 29

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired) 355
Probe Tip Diameter .027d
CO_2 16.7
O_2 11.7
CO 0
N_2 71.7
% H_2O 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	1047	~~274.0~~ 274.640										
QUAD 4	2	1049	275.35	275.34	.16	.39	.43	490	46	43	3	NA	NA
	4	1051	276.04	276.09			.43	490	46	44	3	NA	NA
	6	1053	276.770	276.84			.43	490	47	45	3	NA	NA
			V_m = 2.2			ΔH = .43			$\bar{t}_m$ =	45.17			
					ΔP = .16			T_s = 490					

COMMENTS:

C-4-2-69

EPA (Dur 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Rh-Zinc
Sampling Location ESP-Outlet
Test Number ESP-O-3-4

Date 10-31-80
Initial EC.

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .43$ $Pb = 29.25$ $Vm = 2.2$ $Tm+460 = 505.17$	Vm_{std}	2.249
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $\% H_2O = 5.91$	Mf	.941
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	30.36
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) $Ps = .52$	Ps	29.29
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .16$ $Cp = .84$	Vs	1781
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.27
$\frac{1{,}039\ (490 + 460)(2.249)}{(1781)(6)(29.29)(.941)(.27^2)}$	% I	103.4

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 29

Test No. ESP-0-3-4
Date 10-31-80
Time
Location ESP-outlet

Final Weights
By JP Date 11-7-80
Location DM SITE LAB

Tare Weights
By JP Date 10-21-80
Location DM SITE LAB

PRES. 499.48 482.43 17.05

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	29-0	464.59	462.89	1.70			
1	29-1	453.67	452.70	0.97			
2	29-2	450.30	445.18	5.12			
3	29-3	461.11	454.20	6.91			
4	29-4	466.47	459.80	6.67			
5	29-5	449.82	444.40	5.42			
6	29-6	447.72	445.84	1.88			
7	29-7	455.90	454.83	1.07			
F	29-F	554.81	552.72	2.09			
			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.

SAMPLE HANDLING LOG

Project Number 4891-L93

Source Identification ESP-Outlet

Test Run Number ESP-O-3-4

Pollutant(s) in Sample Particulate Sizing

Task	Date	Time	Personnel	Remarks
Sampling	10-31-80	1047-1053		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-31-80	1053-1105	Vogel, Raja	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J. Pawlowski	ON SITE LAB
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-4-1

MRI Project Number 4891-L93
Field Dates
Plant PFIZER
Sampling Location ESP-outlet
Sampling Date 10-30-80

FIELD CREW

Crew Chief G Cobb

Testing Engineer 1 Daniel Wolf
2
3

Engr. Technician 1
2
3

Lab Technician 1 T Robinson
2 Walker
3

Process Engineer 1
2

Other 1
2

ANDERSEN SAMPLING CALCULATIONS

Plant PFIZER
Sampling Location ESP-OUTLET
Test No. ESP-0-4-1

Date 10/30/80
Initial N. Cooper

Velocity head at sampling location, in. H_2O	ΔPs	.13
Stack temperature at sample point, °F	Ts	510
Barometric pressure, in. Hg	Pb	29.55
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.58
Percent moisture in gas stream by volume	% H_2O	6.3
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	Mf	.937
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	33.33
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1540
Calculated nozzle diameter, in. .72 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	~~.293~~ .293
Actual nozzle diameter, in.	D_{n_a}	.330
Assumed meter temperature, °F	Tm	40
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.914
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)$ (Mf)	Fm	~~.442~~ .442

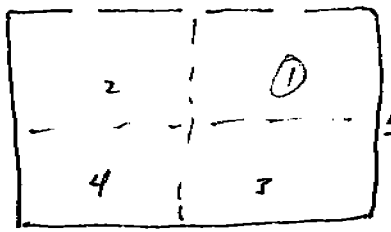
97C

.884 @ 2 [redacted]
.110 @ 15 [redacted]

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10/24/80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP Q#4-1
OPERATOR Mr. Cassel
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.55
STATIC PRESSURE, (P_s) +5.2
Filter Set 22

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired)	.442
Probe Tip Diameter	.330
CO_2	17.7
O_2	13.7
CO	0
N_2	68.7
% H_2O	6.3%

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	0911	247.800										
QUAD	2	0913	248.68	248.68	.13	.60	.61	510	40	38	3.5	NA	NA
1	4	0915	249.57	249.55			.62	510	40	40	3.5	NA	NA
	6	0917	250.452	250.425			.62	510	42	40	3.5	NA	NA
			V_m =	2.625		$\Delta H_@$	.617		T_m =	40			
					ΔP = .13			T_s = 510					

COMMENTS:

EPA (Dur) 235
4 72

C-4-2-75

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 10-30-80
Initial AC

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	510
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .617, Pb = 29.55, Vm = 2.625, Tm+460 = 500	Vm_{std}	2.741
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ %H_2O = 5.95	Mf	.941
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	31.391
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.60 ~~30.48~~
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) P_s = +.52	Ps	29.59
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ ΔP .13, C_p = .84	Vs	1608
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.33
$\frac{1{,}039\ (510 + 460)(2.741)}{(1608)(6)(29.59)(.941)(.33^2)}$	% I	109.2

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 22

Test No. ESP-0-4-1
Date 10-30-80
Time
Location ESP Outlet

Final Weights
By Boomer Date 11-5-80
Location On Site Lab

Tare Weights
By JP Date 10-20-80
Location On-Site Lab

PRES 569.24 504.98 64.26

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	22-0	428.29	424.77	3.52			
1	22-1	423.92	417.89	6.03			
2	22-2	432.80	415.48	17.32			
3	22-3	438.61	425.77	12.84			
4	22-4	438.90	426.51	12.39			
5	22-5	425.26	419.90	5.36			
6	22-6	427.76	426.41	1.35			
7	22-7	454.26	453.09	1.17			
F	22-F	523.40	521.17	2.23			
			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-4-1

Pollutant(s) in Sample Part. matter

Task	Date	Time	Personnel	Remarks
Sampling	10-30-80	0911-0917		
Probe Technician				
Meter Technician			Vogel	
Other				
Transport of Train to Cleanup Site	10-30-80	0920-0935	Vogel, Rogers	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J. PAVELONIS	ON SITE LAB
Write Up				

78

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-0-4-2

MRI Project Number 4891-(93)
Field Dates
Plant PFIZER
Sampling Location ESP outlet
Sampling Date 10/29/80

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 Daniel Vogel
2
3

Engr. Technician 1
2
3

Lab Technician 1 F. Johnson
2 Walker
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-0-4-2

Date 10/29/80
Initial D. Vozel

Velocity head at sampling location, in. H_2O	ΔPs	.1
Stack temperature at sample point, °F	Ts	500
Barometric pressure, in. Hg	Pb	29.81
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.54
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	30.56
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	~~1404.9~~ 1405
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.304
Actual nozzle diameter, in.	D_{n_a}	.333
Assumed meter temperature, °F	Tm	47
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.849
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.417

507

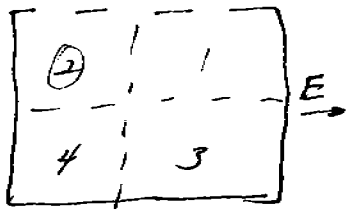
.417 @ 7 min 2 834

.164 @ 15 sec.

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 10/29/80
SAMPLING LOCATION ESP-outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP-0-4-2
OPERATOR Dr. Vogel
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 29.61
STATIC PRESSURE, (P_s) ~~29.51~~ +.52
Filter Set 21

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



SCHEMATIC OF TRAVERSE POINT LAYOUT
with Dimensions

Calculated ACFM (desired)	.417
Probe Tip Diameter	.333
CO_2	17.7
O_2	13.7
CO	0
N_2	68.7
% 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
QUAD	0	1753	242.801										
2	2	1755	243.635	243.635	.10	.52	.53	500	52	52	3	NA	NA
	4	1757	244.469	244.45			.54	500	52	51	3	NA	NA
	6	1759	245.303	245.287			.54	500	51	50	3	NA	NA
									T_m = 51.3				
						ΔH =	.536						
	6 min		2.486										
			Vm		ΔP = .10								

COMMENTS.

C-4-2-81

EPA (Dun 235
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant PFIZER
Sampling Location ESP-OUTLET
Test Number ESP-0-9-2

Date 10/29/80
Initial MR. D. Dagel

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	500
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.51. ΔH = .10 Tm = 51.3 Vm = 2.486	Vm_{std}	2.532 ~~2.533~~
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ 6.3% from mass	Mf	.937 ~~.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	30.53 ~~30.56~~
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) +0.52	Ps	29.55 ~~29.59~~
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = .10	Vs	1405
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.333
$\frac{1{,}039\ (500 + 460)(2.532)}{(1{,}405)(6)(29.55)(.937)(.333^2)}$	% I	97.57

ANDERSEN PARTICLE SIZE ANALYSIS
Filter Set # 21

Test No. ESP-0-4-2
Date 10-29-80
Time 1753-1759
Location ESP Outlet

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

Tare Weights _____
By J.D. Date 10-30-80
Location On-Site Lab

Pres 523.37 509.01 14.36

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	21-0	424.33	422.56	1.77			
1	21-1	420.78	417.98	2.80			
2	21-2	451.87	441.44	10.43			
3	21-3	423.26	414.49	8.77			
4	21-4	430.34	422.79	7.55			
5	21-5	421.55	416.75	4.80			
6	21-6	434.68	433.44	1.24			
7	21-7	473.80	472.61	1.19			
F	21-F	487.84	485.74	2.10			
			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 9891-L93

Source Identification SSP-OOT/ET

Test Run Number ESP-0-4-2

Pollutant(s) in Sample PARTICULATE

Task	Date	Time	Personnel	Remarks
Sampling	10/29/80	1753-1759	VOGEL	
Probe Technician	10/29/80		VOGEL	
Meter Technician	10/29/80		VOGEL	
Other				
Transport of Train to Cleanup Site	10/29/80	1810-1815	VOGEL	
Train Disassembly	10-29/80			
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J. PAVLIONIS	ON SITE LAB
Write Up				

115

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ESP-D-4-3

MRI Project Number 4891-L93
Field Dates
Plant RL-2 a
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

MRI - Form PO (10/72)

C-4-2-85

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location ESP-Outlet
Test No. ESP-0-4-3

Date 11-4-80
Initial CC.

Velocity head at sampling location, in. H_2O	ΔPs	.13
Stack temperature at sample point, °F	Ts	505
Barometric pressure, in. Hg	Pb	29.06
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.1
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	30.35 ~~28.36~~
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	1624
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}	.283
Actual nozzle diameter, in.	D_{n_a}	.270
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	.645
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.321

FIELD DATA - ANDERSEN

PLANT PR-2w
DATE 11-4-80
SAMPLING LOCATION ESP. Outlet
SAMPLE TYPE Part: calcite
RUN NUMBER ESP-c-4-3
OPERATOR Cobb
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 29.06
STATIC PRESSURE, (P_s) +.52
Filter Set 32

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

Calculated ACFM (desired) .321 (.080)
Probe Tip Diameter .270
CO_2 17
O_2 11.8
CO 0
N_2 71.2
% H_2O 6

SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

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	1150	286.75										
Run 3	2	1152	287.39	287.38	.13	.31	.31	505	53	53	N/A	N/A	N/A
	4	1154	288.03	288.02		.31	.31		53	53			
	6	1156	288.66	288.66		.31	.31		53	53			
			Vm =	1.91		ΔH =	.31		Tm =	53			
					ΔP = .13			Ts = 505					

COMMENTS:

EPA (Dur) 235
4 72

C-4-2-87

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 11-4-80
Initial AC.

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	505
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .31$ $Pb = 29.06$ $Vm = 1.91$ $Tm+460 = 513$	Vm_{std}	1.91
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ $H_2O = 6\%$ (Assumed)	Mf	0.94
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
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.35
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O) $P_s = +.52$	Ps	29.1
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .13$ $Cp = .84$	Vs	1624
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	.27
$\frac{1{,}039\ (505 + 460)(1.91)}{(1624)(6)(29.1)(.94)(.27^2)}$	% I	99.56

ANDERSEN PARTICLE SIZE ANALYSIS
Filter Set # 32

Test No. ESP-0-4-3
Date 11-4-80
Time
Location ESP-outlet

Final Weights
By Boomer Date 11-5-80
Location On Site LAB

Tare Weights
By JP. Date 10-21-80
Location On Site LAB

PRES. 569.28 501.90 67.38

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0	32-0	479.32	478.56	0.76			
1	32-1	441.73	440.68	1.05			
2	32-2	460.43	455.60	4.83			
3	32-3	464.45	459.39	5.06			
4	32-4	470.71	465.61	5.10			
5	32-5	424.97	421.06	3.91			
6	32-6	449.18	448.30	0.88			
7	32-7	437.05	436.51	0.54			
F	32-F	446.81	444.85	1.96			
			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 4891-193

Source Identification ESP-Outlet

Test Run Number ESP-0-4-3

Pollutant(s) in Sample Particulate sizing

Task	Date	Time	Personnel	Remarks
Sampling	11-4-80	1150-1156		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	11-4-80	1200-1215	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis			J Powerhouse	On Site Lab
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN ~~Bag~~ ESP-04-4(2)

MRI Project Number 4891-L93
Field Dates
Plant Pfizer
Sampling Location ESP Outlet
Sampling Date 12-8-80

FIELD CREW

Crew Chief D. Cobb

Testing Engineer 1 Olson
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)

Date 12-8-80
Initial E. Olson

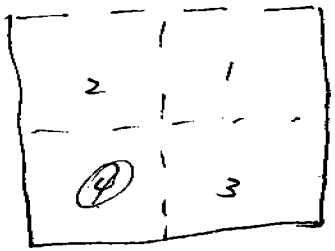
Velocity head at sampling location, in. H_2O	ΔPs	.27
Stack temperature at sample point, °F	Ts	490
Barometric pressure, in. Hg	Pb	29.10
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.06
Percent moisture in gas stream by volume	% H_2O	5%
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	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	30.998
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.348
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$ 881.9	Vs	2,323 ~~2,411~~
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}	0.237
Actual nozzle diameter, in. nozzel # 61-6	D_{n_a}	0.233
Assumed meter temperature, °F	Tm	55
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.71
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	0.365

FIELD DATA - ANDERSEN

0.091 @ 15 sec.

PLANT Pfizer
DATE 12-8-80
SAMPLING LOCATION ESP Outlet
SAMPLE TYPE Particulate
RUN NUMBER ESP 0-4-4 (2)
OPERATOR E. Olson
AMBIENT TEMPERATURE 60 °F
BAROMETRIC PRESSURE 29.
STATIC PRESSURE, (P_s) -.52
Filter Set 55

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



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired)	0.365
Probe Tip Diameter	0.233
CO_2	16.2
O_2	10.7
CO	0
N_2	73.1
% H_2O	5% ~~6.1-6~~

Nozzel # 6.1-6

TRAVERSE POINT NUMBER Quadr. #4	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 173,600 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	1519											
	2	1521	174.33	174.28	0.27	.35	.39	490	56	56	3	NA	NA
	4	1523	175.06	174.98			.40		56	57	3	↓	↓
	6	1525	175.79	175.689			.41		56	57	4	↓	↓
			V_m = 2.089			ΔH_{Ave} = .40			$T_{m_{Ave}}$ = 56.3				

COMMENTS:

EPA (Dur) 235

C-4-2-93

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location ESP Outlet
Test Number ESP-0-4-4-(2)

Date 12-8-80
Initial 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}	490
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $V_m = 2.089$, $P_b = 29.10$, $\Delta H_A = 0.40$, $T_m = 56.3$	Vm_{std}	2.079
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	30.998
Molecular wt. stack gas, lb/lb-mole (Md) (Mf) + 18(1 - Mf)	Ms	30.348
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.06
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P_s = 0.27$, $C_p = 0.84$, $T_s = 490$, $P_s = 29.06$, $M_s = 30.348$	Vs	2,323
Total sample time, minutes	θ	6
Nozzle diameter, inches	Dn	0.233
$\frac{1{,}039\ (490 + 460)(2.079)}{(2{,}323)(6)(29.06)(.95)(0.233^2)}$	% I	98.23

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 55

Test No. ESP-O-4-4(2)
Date 12-8-80
Time
Location ESP-Outlet

Final Weights
By JP Date 12-10-80
Location JOB SITE LAB

Tare Weights
By [illegible] Date 12-3-80
Location JOB SITE LAB

Pres 495.15 474.77 20.38

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0	55-0	441.77	440.52	1.25			
1	55-1	431.06	429.86	1.20			
2	55-2	471.18	466.81	4.37			
3	55-3	461.84	456.31	5.53			
4	55-4	452.60	444.93	7.67			
5	55-5	458.21	452.33	5.88			
6	55-6	484.15	481.93	2.22			
7	55-7	458.15	457.18	0.97			
F	55-F	538.56	537.92	0.64			
			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-4-4-(2)

Pollutant(s) in Sample Anderson - Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-8-80	1519-1525	Ed Olson	
Probe Technician				
Meter Technician			Ed Olson	
Other				
Transport of Train to Cleanup Site	12-8-80	1529	Ed Whited	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site			J. Pa	
Lab Analysis			J. PAVELONIS	
Write Up				

C-5 Dust Collector:

C-5-1 Mass

MIDWEST RESEARCH INSTITUTE

RUN Dust-1-1

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

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Cobb
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 12-3-80

SAMPLING LOCATION Dust Collector

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	50
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.77
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	29.2
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	35
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.25
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	~
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	3/16 (.187	
ACTUAL NOZZLE DIAMETER, in.	.183	
REFERENCE Δp, in. H_2O	1.35	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 12-3-80
Initial EC

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

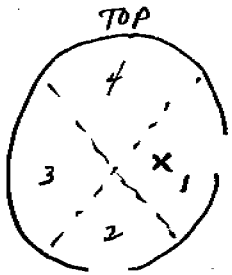
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	50
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	5
Mole fraction dry gas	Mf	.99
Nozzle diameter, inches	Dn	.183
Barometric pressure, inches Hg	Pb	29.77
$\frac{5.168\ (50 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.77}}$	K	67.27

FIELD DATA

PLANT Pfizer
DATE 12-3-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Mass
RUN NUMBER Dust-1-1
OPERATOR Cold-Stultz
AMBIENT TEMPERATURE 36
BAROMETRIC PRESSURE 29.77
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 64



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 3' SS
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR 1.01
PROBE HEATER SETTING None
HEATER BOX SETTING None
REFERENCE Δp 1.32

Leak CK: Initial at 15" Hg, CFM .002
5" Hg Final at Hg, CFM .013

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 67.27 \times \frac{\sqrt{\Delta Ps}}{\sqrt{Ts + 460}}$

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 / 1740	58.765										
	5 / 1745	61.71	61.74	.94	1.3	1.3	32	37	37	5	N/H	NA
	10 / 1750	64.64	64.66	.93	1.25	1.25	30	45	38	5		
	15 / 1755	67.56	67.58	.93	1.25	1.25	32	52	39	5		
	20 / 1800	70.53	70.55	.95	1.3	1.3	27	60	41	5		
	25 / 1805	73.50	73.53	.96	1.32	1.3	33	64	44	5		
	30 / 1810	76.45	76.50	.94	1.3	1.3	29	67	46	5		
	35 / 1815	79.38	79.5	.93	1.25	1.25	29	70	48	5		
	40 / 1820	82.31	82.31	.93	1.25	1.2	31	70	50	5		
	45 / 1825	85.71	85.29	.92	1.25	1.25	29	71	52	5		
	50 / 1830	88.61	88.3	.91	1.2	1.25	29	71	53	5		
	55 / 1835	91.56	91.38	.92	1.25	1.25	30	73	55	5		
	60 / 1840	94.48	94.30	.92	1.25	1.25	29	74	56	5		
			9430	~~.92~~ AVE			Ts =					
								Tm =	54.7			
						AVE 30						
		Vm = 35.535		.93								
				Δp AVE								
					ΔH =	1.263						

COMMENTS.

EPA-Dust 235

C-5-1-4

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 12-3-80
Initial EC

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.263, Pb = 29.77, Vm = 35.535, Tm+460 = 514.7	Vm_{std}	36.37
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	29.2
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = .93, Cp = .84	Vs	3175
Total sample time, minutes	θ	60
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (30 + 460)(36.37)}{(3175)(60)(29.2)(.99)(.183^2)}$	% I	100.4

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location Dust Collector
Sample Box No. 8
Sample Type Mass

Run No. Dust-1-1
Sample Date 12-3-80
Recovery Date
Cleanup Person

Filter No. 64
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

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

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

SILICA GEL

N/A

Silica Gel
Color

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

RECOVERED SAMPLE

Probe Rinse: Sample No. 127
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. Dust-1-1 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					
127		5	84.47233	82.30530	200		
	64	6	1.17161	0.78193			
		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-L93

Source Identification Dust Collector

Test Run Number Dust-1-1

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	12-3-80	1740-1840		
Probe Technician			Cobb/Stultz	
Meter Technician				
Other				
Transport of Train to Cleanup Site	12-3-80	1840-1855	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-15-80		PAVELCIVIS	
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN Dust - 1 - 2

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)

NOMOGRAPH DATA

PLANT Pfizer

DATE 12-2-80

SAMPLING LOCATION Dust Collector

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	70 ~~50~~
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	28.88
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.31
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	50
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.26
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.05	
CALCULATED NOZZLE DIAMETER, in.	3/16 (.1875	
ACTUAL NOZZLE DIAMETER, in.	3/16 (.1830)	
REFERENCE Δp, in. H_2O	1.32	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number Dust-1-2

Date 12-2-80
Initial RC

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	.99 ~~28.84~~
Nozzle diameter, inches	Dn	.183
Barometric pressure, inches Hg	Pb	28.88
$\frac{5.168\ (70 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{28.88}}$	K	70.97

FIELD DATA

PLANT Arizona
DATE 12-2-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Mass
RUN NUMBER Dust-1-2
OPERATOR Cobb
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 28.88
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 86

SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 2' SS
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR 1.05
PROBE HEATER SETTING N/A
HEATER BOX SETTING Max
REFERENCE Δp 1.32

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 5 Hg, CFM 0.0

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 20.97 \times \sqrt{\frac{Ps}{Ts + 460}}$

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	1340	862.0										
Dust-2	5	1345	865.63	865.94	1.3	1.8	1.8	32	47	42	5	270	
	10	1350	869.16	868.65	1.2	1.7	.98	31	47	42	3		
	15	1355	872.80	872.22	1.3	1.8	1.9	35	58	44	5		
	20	1400	876.30	875.85	1.2	1.7	1.9	34	66	47	5	255	
	25	1405	879.8	879.58	1.2	1.7	1.9	33	68	48	5		
	30	1410	883.3	883.43	1.2	1.7	1.9	32	68	50	5		
	35	1415	886.96	887.31	1.3	1.8	1.9	30	70	52	5		
	40	1420	890.48	891.85	1.2	1.7	1.9	28	72	52	5		
	45	1425	893.99	894.67	1.2	1.7	1.9	30	70	54	5		
	50	1430	897.63	898.51	1.3	1.8	1.8	35	72	55	5	253	
	55	1435	900.99	901.83	1.1	1.5	1.5	31	72	55	5		
	60	1440	904.35	905.43	1.1	1.5	1.4	30	74	55	5		
	65	1445	907.90	908.17	.95	1.3	1.2	30	76	55	5		
	70	1450 910	~~910.64~~	911.17	.95	1.3	1.2	30	68	55	5		
	75	1455	913.72	913.96	.95	1.3	1.1	30	68	55	5		
	80	1500	916.87	916.84	.97	1.35	1.2	32	68	55	4	240	
	85	1505	920.01	919.83	.96	1.3	1.2	30	67	55	4		
	90	1510	923.16	922.51	.97	1.35	1.2	32	67	55	5		
	95	1515	926.29	925.94	.95	1.3	1.3	27	68	55	5		
	100	1520	929.41	929.13	.95	1.3	1.3	32	67	55	5		
	105	1525	932.54	932.47	.95	1.3	1.4	28	68	55	5		
	110	1530	935.71	935.93	.97	1.35	1.4	27	69	55	5		
	115	1535	938.86	934.02	.97	1.35	1.4	32	69	55	5	235	

COMMENTS.

EPA Form 235

C-5-1-12

70.97

TRAVERSE POINT NUMBER	SAMPLING TIME min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m) ft^3 Desired 936.86	GAS METER READING (V_m) ft^3 Actual 939.02	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 ~~1530~~ ~~1140~~ 1535											
	120 1545 ~~125~~	942.03	942.10	.97	1.35	1.3	27	68	55	5		
	125 1550 ~~125~~	945.20	945.295	.97	1.35	1.3	25	61	53	5		
	~~130~~											
	~~135~~											
	~~140~~											
	~~145~~											
		V_m =	83.395	ΔP = 1.08	ΔH =	~~1.38~~ 1.49	T_s = 30.5	T_m =	52.8			

Run Number Dust-1-2 Date 12-2-80 Sampling Location Dust Collector

Comments:

EPA (Dun 236
4 72

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Dust-Collector
Test Number Dust-1-2

Date 12-2-80
Initial ee

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	30.5
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 28.88, ΔH = 1.49, Vm = 83.395, Tm+460 = 519.8	Vm_{std}	82.04
Mole fraction dry gas, $\frac{100-\%\ H_2O}{100}$ 1%	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	28.88
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 = -7.65	Ps	28.31
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = 1.08, Cp = .84	Vs	3477
Total sample time, minutes	θ	125
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (30.5 + 460)(82.04)}{(3477)(125)(28.31)(.99)(.183^2)}$	% I	102.4

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: PP-2a
Sample Location: Dust Collector
Sample Box No.:
Sample Type: Mass

Run No.: Dust-1-2
Sample Date: 12-2-80
Recovery Date:
Cleanup Person:

Filter No.: 86
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/	90	104	0		
Initial Volume (wt) b/	100	100	0		
Net Volume (wt) b/	-10	4	0		
Sample No.(s)					

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

SILICA GEL

636.5	
619.5	
1.0	

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. 118; Liquid Level Marked; Sealed
Impinger Rinse: Sample No.; Liquid Level Marked; Sealed
Water Blank: Sample No.; Liquid Level Marked
Dry Catch: Sample No.; Description; Sealed
Acetone Blank: Sample No. 121; Liquid Level Marked; Sealed
Filter Blank: Sample No.; Sealed

Sample Disposition:
Carrier: Date Shipped:
Remarks:

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

MIDWEST RESEARCH INSTITUTE

Run No. Dust 1-2 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					
118		5	91.10877	87.64374	134		
	86	6	0.38493	0.30706			
		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 4891-293

Source Identification Dust Collector

Test Run Number Dust-1-2

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	12-2-80	1340-1545		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	12-2-80	1600-1615	Cobb - Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-15-80		PAVELCINIS	
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN Dust 1-3

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

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Cobb
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 12-3-80

SAMPLING LOCATION Dust Collector (1-3)

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	1
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.8
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O) -7.65	P_s	29.23
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	35
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.08
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	3/16 (.187)	
ACTUAL NOZZLE DIAMETER, in.	.183	
REFERENCE Δp, in. H_2O	1.35	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pizza
Sampling Location Dust Collector
Test Number Dust-1-3

Date 12-3-80
Initial CC

Isokinetic sampling equation:

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

Where:

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

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

K = Constant of fixed and assumed parameters, dimensionless

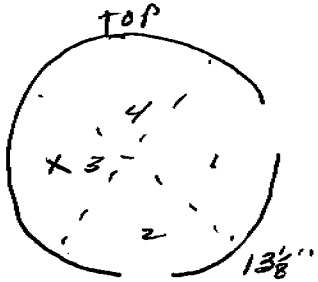
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	45
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	29.8
$\frac{5.168\ (45 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.8}}$	K	66.6

FIELD DATA

PLANT Pfizer
DATE 12-3-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE 1216 = 5
RUN NUMBER Dust-1-3
OPERATOR Cobb
AMBIENT TEMPERATURE 35
BAROMETRIC PRESSURE 29.8
STATIC PRESSURE, (P_s) -2.65
FILTER NUMBER (s) 61



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 2' SS
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR 1.0
PROBE HEATER SETTING N/A
HEATER BOX SETTING
REFERENCE Δp 1.35

Leak CK: Initial at 15" Hg, CFM 0.0
Σ "Hg Final at Hg, CFM .001

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 66.6 \times \sqrt{\frac{Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)		GAS METER READING (V_m), ft^3 945.00 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	1020											
	5	1025	949.18	947.07	1.4	1.9	1.9	24	35	33	5	200	
	10	1030	952.78	952.68	1.4	1.9	1.9	20	43	34	6		
	15	1035	956.49	956.44	1.5	2.1	2.1	24	46	36	6	210	48
	20	1040	960.43	960.47	1.7	2.4	2.4	25	60	38	8	230	
	25	1045	964.39	964.51	1.7	2.4	2.4	20	65	40	8	235	
	30	1050	968.47	—	1.8	2.5	2.5	20	70	42	8	245	
	35	1055	972.42	972.65	1.7	2.4	2.4	24	72	46	8	250	
	40	1100	976.38	976.68	1.7	2.4	2.3	20	74	48	8	250	60
	45	1105	980.45	980.59	1.8	2.5	2.3	23	74	49	8	254	
	50	1110	984.41	984.58	1.7	2.4	2.3	20	75	51	8	255	
	55	1115	988.51	988.58	1.8	2.5	2.3	15	77	53	8	255	
	60	1120	992.35	992.46	1.6	2.2	2.2	21	77	54	7		70
	65	1125	996.30	—	1.7	2.4	2.3	25	78	55	7		
	70	1130	1000.25	1000.52	1.7	2.4	2.3	23	78	55	7	280	
	75	1135	4.17	4.54	1.7	2.4	2.3	30 ✓	78	56 ✓	7		
	80	1140	8.12	8.51	1.7	2.4	2.2	25 ✓	78	56	7	275	
	85	1145	12.02	12.49	1.7	2.4	2.2	36	78	56	7	283	
	90	1150	16.04	16.238	1.8	2.5	2.0	35	78	57	7		
	~~95~~												
	~~100~~												
	~~105~~		Vm = 70.638		ΔP = 1.67	ΔH = 2.24							
	~~110~~							T_s = 23.89	Tm = 58.19				
	~~115~~												

COMMENTS

EPA (Dur) 235

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 12-3-80
Initial C.C.

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	23.89
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 2.24$, $P_b = 29.8$, $V_m = 70.638$, $T_m + 460 = 519.2$	Vm_{std}	71.91
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	29.23
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $C_p = .84$, $\Delta p = 1.67$	Vs	4226
Total sample time, minutes	θ	90
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (23.89 + 460)(71.91)}{(4226)(90)(29.23)(.99)(.183^2)}$	% I	98.1

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location Dust Collector
Sample Box No. 8
Sample Type Mass

Run No. Dust-1-3
Sample Date 12-3-80
Recovery Date
Cleanup Person

Filter No. 61
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/					
Initial Volume (wt) b/			N/A		
Net Volume (wt) b/					
Sample No.(s)					

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

SILICA GEL

N/A

Silica Gel
Color

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

RECOVERED SAMPLE

Probe Rinse: Sample No. 112
Liquid Level Marked
Sealed

Impinger Rinse: Sample No.
Liquid Level Marked
Sealed

Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed

Acetone Blank: Sample No. 121
Liquid Level Marked
Sealed

Filter Blank: Sample No.
Sealed

Sample Disposition
Carrier Date Shipped:
Remarks:

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

MIDWEST RESEARCH INSTITUTE

Run No. Dust-1-3 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					
112		5	93.76161	92.59032	140		
	61	6	1.38725	0.77269			
		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-L93

Source Identification Dust Collector

Test Run Number Dust-1-3

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	12-3-80	1020-1150		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	12-3-80	1150-1200	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-15-80		DAVE LONIS	
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN DC-1-4

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 1-9-81

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

NOMOGRAPH DATA

PLANT Pfizer

DATE 1-9-81

SAMPLING LOCATION Dust Collector DC-1-4

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	40
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.37
STATIC PRESSURE IN STACK, in. Hg -7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.80
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	48
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.92
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.97	
CALCULATED NOZZLE DIAMETER, in.	.209	
ACTUAL NOZZLE DIAMETER, in.	.183	
REFERENCE Δp, in. H_2O	1.50	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 1-9-81
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

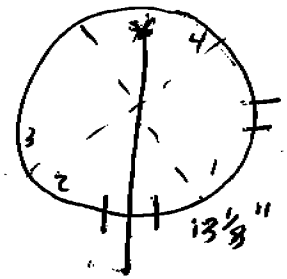
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	40
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.99
Nozzle diameter, inches	Dn	.183
Barometric pressure, inches Hg	Pb	29.37
$\frac{5.168\ (40 + 460)\ (.84)\ (3)\ (.99)\ (.183^2)}{\sqrt{29.37}}$	K	39.84

Top

FIELD DATA

PLANT Pfizer
DATE 1-9-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER DC-1-4
OPERATOR M. Hansen
AMBIENT TEMPERATURE 10°F
BAROMETRIC PRESSURE 29.37
STATIC PRESSURE, (Ps) -7.65
FILTER NUMBER (s) 745



PROBE LENGTH AND TYPE 2', SS
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER ΔH@ 1.84
C FACTOR .97
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp 1.50

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 5.5 Hg, CFM 0.0

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 39.84 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m, ft³) 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	1506	373.00										
DC-1-4	3	1509	375.00	374.40	1.25	1.55	1.60	34	~~41~~ 51	42	5.5	NA	NA
	6	1512	377.00	376.90	1.25	1.55	1.65	37	52	41	5.5		
a	9	Stop 1515	378.98	378.93	1.25	1.55	1.70	46	54	42	—		
	~~12~~	~~1518~~											
	~~15~~												
	Start	(1519)			~~1.25~~	~~1.55~~		~~42~~					
a	12	Stop 1522	380.97	380.91	1.25	1.55	1.65	42	54	41	—		
		Leak	checked -	OK.									
	Start	(1529)	381.03		~~1.25~~	~~1.55~~							
	15	1532	383.08	383.00	1.25	1.55	1.65	42	52	~~2~~ 40	a		
	18	1535	384.97	385.02	1.20	1.50	1.65	42	57	41	a		
	21	1538	386.90	387.05	1.20	1.50	1.65	49	61	41	a		
	24	1541	388.83	389.04	1.20	1.50	1.60	49	64	42	a		
	27	1544	390.72	390.94	1.15	1.45	1.50	53	67	43	a		
	30	1547	392.65	392.90	1.20	1.50	1.40	50	69	43	a		
	V_m -	380.97	392.90	11.87		ΔH =	1.605						
		-373.00	-381.03	+7.97				T_s = 44.4					
		7.97	11.87	19.78					T_m =	49.85			
		V_m = 19.78			Δp = 1.22								

COMMENTS Kiln No. 7 is down.

a/ vacuum problem, may not working. Leak checked OK.

EPA-Dur-235

C-5-1-29

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 1-9-81
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}	44.4
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.605, Pb = 29.37, Vm = 19.84, Tm = 49.85	Vm_{std}	20.24
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) -7.65	Ps	28.80
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = 1.22	Vs	3,715
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (44.4 + 460)(20.24)}{(3{,}715)(30)(28.80)(.99)(.183^2)}$	% I	99.68

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location Dust Collector
Sample Box No. 8
Sample Type MASS

Run No. DC-1-4
Sample Date 1-9-81
Recovery Date
Cleanup Person

Filter No. 145
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

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

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

SILICA GEL

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. #177
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 #181
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. DC-1-4

PARTICULATE CLEAN-UP AND ANALYSIS

Date 1-9-81

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					
177		5	91.32853	90.90760	192		
	145	6	1.31633	0.49701			
		6					
		6					
		7					
		8					
		9					
181		10	84.7408	84.73838	150		

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-LC9

Source Identification Dust Collector

Test Run Number DC-1-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-9-81	1506-1547	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	1-9-81	1506-1547	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-9-81	1555	J. Johnson	
Train Disassembly	1-9-81	1610	R. Stultz	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN Dust-2-1

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-5-80

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

Lab Technician 1 T. Walker, J. Pavelonis
2 A. Small
3 B. Dent

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE ~~10~~ 12-5-80

SAMPLING LOCATION Dust Collector
Dust - 2-1

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	~~59~~ 55
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.41
STATIC PRESSURE IN STACK, in. Hg -7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.84
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	47
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.21
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.00	
CALCULATED NOZZLE DIAMETER, in.	.193	
ACTUAL NOZZLE DIAMETER, in.	.183	
REFERENCE Δp, in. H_2O	1.50	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer

Sampling Location Dust Collector

Test Number Dust -2-1

Date 12-5-80

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

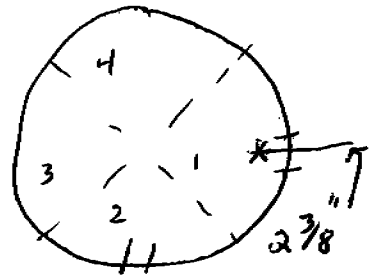
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	~~59~~ 55
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	29.41
$\frac{5.168\ (55 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.41}}$	K	68.34

FIELD DATA

PLANT Pfizer
DATE 12-5-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER Dust-2-1
OPERATOR M. Hansen
AMBIENT TEMPERATURE 45°F
BAROMETRIC PRESSURE 29.41
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 93



PROBE LENGTH AND TYPE 2', S.S.
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR 1.00
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp 1.50

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 5" Hg, CFM 0.0

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 68.34 \times \sqrt{\frac{Ps}{Ts + 460}}$

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	1600	183.87										
Dust-2-1	5	1605	187.19	187.04	1.20	1.50	1.50	48	48	46	5.0	NA	NA
	10	1610	190.44	190.26	1.15	1.45	1.50	47	55	47	5.0		
	15	1615	193.67	193.59	1.15	1.45	1.60	55	62	48	5.0		
	20	1620	196.92	196.94	1.15	1.45	1.60	50	66	50	5.0		
	25	1625	200.16	200.24	1.15	1.45	1.55	53	70	53	5.0		
	30	1630	203.41	203.44	1.15	1.45	1.45	49	72	54	5.0		
			V_m = 19.57		Δp_s = 1.16			T_s = 50.3					
						ΔH = 1.53			T_m =	55.9			

COMMENTS

EPA-Dur-235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number Dust -2-1

Date 12-5-80
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}	50.3
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.41 Tm = 55.9 ΔH = 1.53 Vm = 19.57	Vm_{std}	19.75
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) -7.65	Ps	28.84
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP_s = 1.16	Vs	3,641
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (50.3 + 460)(19.75)}{(3{,}641)(30)(28.84)(.99)(.183^2)}$	% I	100.26

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location Dust Collector
Sample Box No. 8
Sample Type MASS

Run No. Dust-2-1
Sample Date 12-5-80
Recovery Date 12-5-80
Cleanup Person A. Small

Filter No. 93
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

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

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

SILICA GEL

Silica Gel
Color

Description of Impinger Solution
Total Moisture, gm Assumed 1%

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

RECOVERED SAMPLE

Probe Rinse: Sample No. 132
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. 129
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. Dust-2-1 PARTICULATE CLEAN-UP AND ANALYSIS

Date 12-5-80 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					
132		5	91.47188	90.00671	165		
	93	6	0.75575	0.49436			
		6					
		6					
		7					
		8					
		9					
129		10	87.62170	81.62620	154		

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 Dust Collector

Test Run Number Dust-2-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-5-80	1600-1630	M. Hansen	
Probe Technician	–	–	–	
Meter Technician	12-5-80	1600-1630	M. Hansen	
Other				
Transport of Train to Cleanup Site	12-5-80	1635	G. Cobb	
Train Disassembly	12-5-80	1645	A. Small	
Train Cleanout	12-5-80	1650	A. Small	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-15-80		J. Pavelonis	
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN Dust-2-2

MRI Project Number 4891 L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-5-80

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

Lab Technician 1 T. Walker
2 A. Small
3 J. Pavelonis, B. Dent

Process Engineer 1
2

Other 1
2

NOMOGRAPH DATA

PLANT Pfizer

DATE 12-5-80

SAMPLING LOCATION Dust Collector

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	60
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.48
STATIC PRESSURE IN STACK, in. Hg — 7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.91
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	40
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.08
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.02	
CALCULATED NOZZLE DIAMETER, in.	.198	
ACTUAL NOZZLE DIAMETER, in.	.183	
REFERENCE Δp, in. H_2O	1.45	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer

Sampling Location Dust Collector

Test Number Dust-2-2

Date 19-5-80

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}	60
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	~~45~~ 5
Mole fraction dry gas	Mf	~~28.84~~ .99
Nozzle diameter, inches	Dn	.183
Barometric pressure, inches Hg	Pb	29.48
$\frac{5.168\ (60 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.48}}$	K	68.92

ISOKINETIC PERFORMANCE WORKSHEET

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

Date: 12-5-80
Initial: RCS

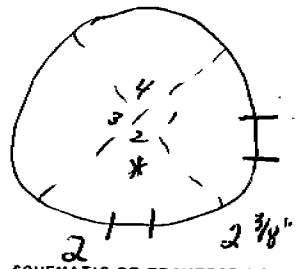
Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	48.3
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.33, Pb = 29.48, Vm = 27.56, Tm = 57	Vm_{std}	27.81
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	28.92
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ Cp = 1.00	Vs	3370
Total sample time, minutes	θ	45
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (48.3 + 460)(27.81)}{(3370)(45)(28.92)(.99)(.183^2)}$	% I	101.0

FIELD DATA

PLANT Pfizer
DATE 12-5-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER Dust-2-2
OPERATOR M. Hansen
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.48
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 69



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 2', S.S.
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR 1.02
PROBE HEATER SETTING N/A
HEATER BOX SETTING NA
REFERENCE Δp 1.45

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 6" Hg, CFM a/ 0.

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 68.92 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	0845	125.20										
Dust-2	5 stop	0850	128.17	127.98	.94	1.20	1.20	45	45	44	5.0	NA	NA
	10 start	0900	~~131.24~~	~~131.12~~	~~1.0~~	~~1.30~~	~~1.35~~	~~45~~	~~50~~	~~45~~	~~5.5~~		
10	15	0905	131.24	131.12	1.0	1.30	1.35	45	50	45	5.5		
15	20	0910	134.29	134.21	1.0	1.30	1.35	50	58	46	5.5		
20	25	0915	137.42	137.30	1.05	1.35	1.35	48	63	48	5.5		
25	30	0920	140.52	140.46	1.02	1.30	1.40	45	66	50	6.0		
30	35	0925	143.65	143.65	1.05	1.35	1.45	49	70	52	6.0		
35	40	0930	146.69	146.67	.99	1.25	1.25	50	72	54	5.5		
40	45	0935	149.72	149.71	.99	1.25	1.30	53	74	56	5.5		
45		0940	152.74	152.76	.98	1.25	1.30	50	75	58	5.5		

a/ Final leak check not accomplished. A "U" tube was broken as probe removed from stack. (MDH)

V_m = 27.56 Δp = 1.00 ΔH = 1.33 T_m = 57
T_s = 48.3

COMMENTS

EPA-Dur-235

C-5-1-46

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pizer
Sample Location: bag Dust Collector
Sample Box No.:
Sample Type: Mass

Run No.: DusA-2-2
Sample Date: 12-5-80
Recovery Date:
Cleanup Person:

Filter No.: 69
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/					
Initial Volume (wt) b/		N/A			
Net Volume (wt) b/					
Sample No.(s)					

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

SILICA GEL

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. 133
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. 129
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. Dust-2-2 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					
133		5	86.31839	84.83310	205		
	69	6	1.00544	0.78248			
		6					
		6					
		7					
		8					
		9					
129		10	87.62170	87.62620	154		

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 4841-L(93)

Source Identification Dust Collector

Test Run Number Dust-2-2

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	12-5-80	0845-0940		
Probe Technician			Cobb	
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	12-5-80	0950	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-15-80		J. PAVELONIS	
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN Dust-2-3

MRI Project Number 4891-h(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-5-80

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

Lab Technician 1 T. Walker, J. Pavelonis
2 A. Small
3 B. Dent

Process Engineer 1
2

Other 1
2

NOMOGRAPH DATA

PLANT Pfizer

DATE 12-5-80

SAMPLING LOCATION Dust Collector
Dust-2-3

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	58
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.49
STATIC PRESSURE IN STACK, in. Hg -7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.92
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	50
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.00
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.02	
CALCULATED NOZZLE DIAMETER, in.	.202	
ACTUAL NOZZLE DIAMETER, in.	.183	
REFERENCE Δp, in. H_2O	1.40	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 12-5-80
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

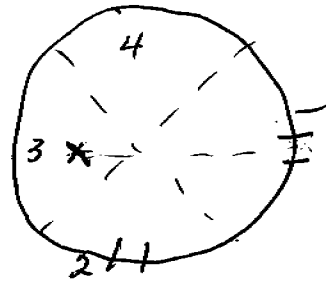
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	58
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	29.49
$\frac{5.168\ (58 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.49}}$	K	68.64

FIELD DATA

PLANT Pfizer
DATE 12-5-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER Dust 2-3
OPERATOR M. Hansen
AMBIENT TEMPERATURE 45°F
BAROMETRIC PRESSURE 29.49
STATIC PRESSURE, (P_s) -7.65"
FILTER NUMBER (s) 71



PROBE LENGTH AND TYPE 2' S.S.
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR ~~1.45~~ 1.02
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp 1.40

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

$VM = 68.64 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³ Desired	GAS METER READING (V_m), ft³ Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1125	153.594										
Dust-2-3	5	1130	157.02	156.96	1.25	1.70	1.70	42	47	46	6.0	NA	NA
	10	1135	160.37	160.32	1.20	1.60	1.65	45	56	46	6.0		
	15	1140	163.69	163.73	1.20	1.60	1.70	52	62	48	6.0		
	20	1145	167.03	167.12	1.20	1.60	1.65	47	66	50	6.0		
	25	1150	170.36	170.47	1.20	1.60	1.60	50	70	52	6.0		
	30	1155	173.70	173.75	1.20	1.60	1.55	46	72	54	6.0		
	35	1200	177.05	177.05	1.20	1.60	1.55	44	73	56	6.0		
	40	1205	180.38	180.40	1.20	1.60	1.60	50	75	58	6.0		
	45	1210	183.72	183.76	1.20	1.60	1.60	47	76	58	6.0		
			V_m = 30.166		Δp = 1.21		ΔH = 1.62		T_m = 59.17				
								T_s = 47					

COMMENTS

EPA-Dur-235

C-5-1-53

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 12-5-80
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}	47
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1.21$ $Vm = 30.166$ $T_m = 59.17$ $Pb = 29.49$	Vm_{std}	30.32
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	28.92
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P_s = 1.21$	Vs	3,702
Total sample time, minutes	θ	45
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (47 + 460)(30.32)}{(3{,}702)(45)(28.92)(.99)(.183^2)}$	% I	99.992658

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer
Sample Location: Dust Collector
Sample Box No.: 8
Sample Type: MASS

Run No.: Dust - 2-3
Sample Date: 12-5-80
Recovery Date:
Cleanup Person:

Filter No.: 71
Sample No.:
Sample Material Description:

MOISTURE AND/OR SAMPLE

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

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

SILICA GEL

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.: 131
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.: 129
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. Dust-2-3

PARTICULATE CLEAN-UP AND ANALYSIS

Date 12-5-80

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					
131		5	91.46059	89.80842	148		
	71	6	1.14710	0.77024			
		6					
		6					
		7					
		8					
		9					
129		10	87.62170	87.62620	154		

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-LC93)

Source Identification Dust Collector

Test Run Number Dust-2-3

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-5-80	1125-1210	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	12-5-80	1125-1210	M. Hansen	
Other				
Transport of Train to Cleanup Site	12-5-80	1212	G. Cobb	
Train Disassembly	12-5-80	1220	A. Small	
Train Cleanout	12-5-80	1230	A. Small	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-15-80		J. PAVELONIS	
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN Dust-2-4

MRI Project Number 4891-193
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)

NOMOGRAPH DATA

PLANT Pfizer

DATE 12-4-80

SAMPLING LOCATION Dust Collector

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	60
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.5
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.93
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	35
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.3
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.0	
CALCULATED NOZZLE DIAMETER, in.	3/16 (.187)	
ACTUAL NOZZLE DIAMETER, in.	.183	
REFERENCE Δp, in. H_2O	1.35	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number Dust-2-4

Date 12-4-80
Initial AC

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

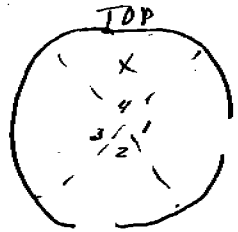
ΔPs = Velocity head of S pitot, inches H_2O

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	29.5
$\frac{5.168\ (60 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.5}}$	K	68.9

FIELD DATA

PLANT Pfizer
DATE 12-4-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Mass
RUN NUMBER Dust-2-4
OPERATOR Cobb
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.5
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 67



PROBE LENGTH AND TYPE 8' SS
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR .84
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp 1.35

Leak CK: Initial at 15" Hg, CFM .001
6" Hg Final at Hg, CFM .012

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

$$VM = 68.9 \times \sqrt{\frac{Ps}{Ts + 460}}$$

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3 94.5 Desired	GAS METER READING Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH) 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 / 1630											
	5 / 1635	97.82	97.93	1.2	1.6	1.7	55	44	42	5	N/A	NR
	10 / 1640	101.18	101.19	1.2	1.6	1.6	47	52	43	5		
	15 / 1645	104.59	104.58	1.25	1.7	1.7	51	60	45	5		
	20 / 1650	107.94	107.93	1.2	1.6	1.6	48	66	47	5		
	25 / 1655	111.38	111.33	1.25	1.7	1.7	40	70	49	5		
	30 / 1700	114.74	114.69	1.2	1.6	1.6	45	72	52	5		
	35 / 1705	118.12	118.08	1.2	1.6	1.6	40	75	54	5		
	40 / 1710	121.48	121.49	1.2	1.6	1.6	43	76	56	5		
	45 / 1715	124.86	124.948	1.2	1.6	1.6	40	77	58	5		
				ΔP=1.21			T_s=45.44					
		V_m =	30.448		ΔH =	1.63		Tm =	57.67			

COMMENTS

EPA (Dur) 235

C-5-1-61

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number Dust-2-4

Date 12-4-80
Initial GG

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	45.44
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.63, Pb = 29.5, Vm = 30.448, Tm+460 = 517.7	Vm_{std}	30.73
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 $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ ΔP = 1.21, Cp = .84	Vs	3696
Total sample time, minutes	θ	45
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (45.44 + 460)(30.73)}{(3696)(45)(28.93)(.99)(.1832)}$	% I	101.2

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location ~~Baghouse Outlet~~ Dust Coll.
Sample Box No.
Sample Type ~~Mass~~ Mass

Run No. Dust-2-4
Sample Date 12-4-80
Recovery Date
Cleanup Person

Filter No. 67
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

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

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

SILICA GEL

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. 142
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. Dust-2-4 PARTICULATE CLEAN-UP AND ANALYSIS

Date _____ FIELD ANALYSIS Performed by _____

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

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

** Indicate value and units (ml or gm)

MRI LAB ANALYSIS

Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
142		5	88.25232	87.30724	223		
	~~69~~	6		~~0.78248~~			
	67	6	1.49215	0.78305			
		6					
		7					
		8					
		9					
126		10	~~95.82292~~	~~95.80776~~	~~125~~		
					142		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-293

Source Identification Dust Collector

Test Run Number Dust-2-4

Pollutant(s) in Sample M055

Task	Date	Time	Personnel	Remarks
Sampling	12-4-80	1630-1715		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	12-4-80	1715-1730	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-15-80		J. Pavelonis	
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN Dust-3-1

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-10-80

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. Paulonis
3 A. Small

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

NOMOGRAPH DATA

PLANT Pfizer

DATE 12-6-80

SAMPLING LOCATION Dust Collector
Dust - 3-1

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	70
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.42
STATIC PRESSURE IN STACK, in. Hg -7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.85
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	75
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.10
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.05	
CALCULATED NOZZLE DIAMETER, in.	.198	
ACTUAL NOZZLE DIAMETER, in.	.183	
REFERENCE Δp, in. H_2O	1.50	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 12-6-80
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

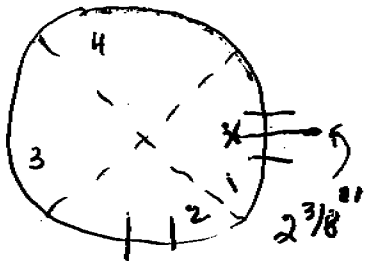
ΔPs = Velocity head of S pitot, inches H_2O

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	.99
Nozzle diameter, inches	Dn	.183
Barometric pressure, inches Hg	Pb	29.42
$\frac{5.168\ (70 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.42}}$	K	70.32

FIELD DATA

PLANT Pfizer
DATE 12-6-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER Dust-3-1
OPERATOR M. Hansen
AMBIENT TEMPERATURE 50°F
BAROMETRIC PRESSURE 29.42
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (S) 95



PROBE LENGTH AND TYPE 2', S.S.
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR 1.05
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp 1.50

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

$VM = 70.32 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1045	223.30										
Dust-3-1	5	1050	226.04	225.93	0.80	.97	.99	68	62	60	5.0	NA	NA
	10	1055	228.88	228.79	.87	1.10	1.15	72	70	61	5.5		
	15	1100	231.45	231.83	.87	1.10	1.20	68	77	62	5.5		
	20	1105	234.58	234.83	.87	1.10	1.10	70	82	66	6.0		
	25	1110	237.40	237.49	.85	1.05	0.95	70	84	66	5.5		
	30	1115	240.23	240.23	.85	1.05	0.99	66	86	67	5.5		
			V_m=16.93		AP=0.85								
									T_{m_a}=	70.25			
						AH=	1.06						
								Ts=69					

COMMENTS

EPA-Dur-235

C-5-1-69

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 12-6-80
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}	69
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.42 ΔH = 1.06 Tm = 70.25 Vm = 16.93	Vm_{std}	16.61
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) −7.65	Ps	28.85
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔPs = 0.85	Vs	3,173
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (69 + 460)(16.61)}{(3{,}173)(30)(28.85)(.99)(.183^2)}$	% I	100.27

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location Dust Collector
Sample Box No. 8
Sample Type MASS

Run No. Dust-3-1
Sample Date 12-6-80
Recovery Date 12-6-80
Cleanup Person A. Small

Filter No. 95
Sample No. Dust-3-1
Sample Material Description

MOISTURE AND/OR SAMPLE

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

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

SILICA GEL

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. 150
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. 137
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. Dust-3-1 PARTICULATE CLEAN-UP AND ANALYSIS

Date 12-6-80 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					
150		5	94.62213	93.12412	220		
	95	6	.75347	0.49496			
		6					
		6					
		7					
		8					
		9					
137		10	84.87858	84.87922	146		

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 Dust Collector

Test Run Number Dust-3-1

Pollutant(s) in Sample Particulates

Task	Date	Time	Personnel	Remarks
Sampling	12-6-80	1045-1115	M. Hansen	
Probe Technician	–	–	–	
Meter Technician	12-6-80	1045-1115	M. Hansen	
Other	–	–	–	
Transport of Train to Cleanup Site	12-6-80	1120	M. Hansen	
Train Disassembly	12-6-80	1125.	A. Small	
Train Cleanout	12-6-80	1130	A. Small	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-15-80		J. Pavelonis	
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN Dust-3-2

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

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	$T_{m_{avg.}}$	35
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	$T_{s_{avg.}}$	40
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.20
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.96	
CALCULATED NOZZLE DIAMETER, in.	.195	
ACTUAL NOZZLE DIAMETER, in.	.183	Nozzle No.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

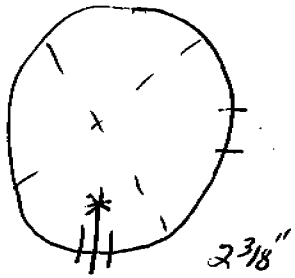
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	35
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
$\frac{5.168\ (35 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.03}}$	K	66.11

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) 106



PROBE LENGTH AND TYPE 2', SS.
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER ~~8~~ 12
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .96
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp 1.50

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 4.0 Hg, CFM ~~4~~ 0.0

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 66.11 \times \frac{\sqrt{\Delta Ps}}{Ts + 460}$

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
Dust-3-2	0	1615	214.70										
	5	1620	217.75	217.81	1.05	1.30	1.30	32	42	40	4.0	NA	NA
	10	1625	220.73	220.82	1.00	1.25	1.20	33	49	40	4.0		
	15	1630	223.59	223.77	.92	1.15	1.10	33	54	40	4.0		
	20	1635	226.53	226.73	1.00	1.25	1.15	28	58	42	4.0		
	25	1640	229.49	229.67	.95	1.20	1.10	32	60	43	4.0		
	30	1645	232.44	232.61	.98	1.20	1.05	31	61	44	4.0		
				ΔP=	.983				T_m=	47.75			
						ΔH=	1.15						
								T_s=31.5					
			V_m=17.91										

COMMENTS

It's snowing.
No. 7 Kiln is down

EPA-Dur-235

C-5-1-77

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 1-6-81
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}	31.5
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.15, Pb = 29.03, Vm = 17.91, Tm = 47.75	Vm_{std}	18.12
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) -7.65	Ps	28.46
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP_s = .983	Vs	3,312
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (31.5 + 460)(18.12)}{(3312)(30)(28.46)(.99)(.183^2)}$	% I	98.70

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location Dust Collector
Sample Box No. T2
Sample Type MASS

Run No. Dust -3-2
Sample Date 1-6-81
Recovery Date 1-6-81
Cleanup Person

Filter No. 106
Sample No.
Sample Material Description

MOISTURE AND/OR SAMPLE

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

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

SILICA GEL

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 #167
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 #159
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. Dust-3-2 PARTICULATE CLEAN-UP AND ANALYSIS

Date 1-6-81 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					
167		5	92.7532	92.2141	240		
	106	6	1.07193	0.49290			
		6					
		6					
		7					
		8					
		9					
159		10	93.06291	93.06296	120		

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 Dust Collector

Test Run Number Dust-3-2

Pollutant(s) in Sample MASS-Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-6-81	1615-1645	M. Hansen	
Probe Technician	1-6-81	–	–	
Meter Technician	1-6-81	1615-1645	M. Hansen	
Other	–	–	–	
Transport of Train to Cleanup Site	1-6-81	1650	E. Olson	
Train Disassembly	1-6-81	1715	J. Johnson	
Train Cleanout	1-6-81	1718	J. Johnson	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN Dust-3-3

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-6-80

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 A. Small

Process Engineer 1
2

Other 1
2

NOMOGRAPH DATA

PLANT Pfizer

DATE 12-6-80

SAMPLING LOCATION Dust Collector
Dust -3-3

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	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.38
STATIC PRESSURE IN STACK, in. Hg -7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.81
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	~~50~~ 75
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.15
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	1.05	
CALCULATED NOZZLE DIAMETER, in.	.195	
ACTUAL NOZZLE DIAMETER, in.	.183	
REFERENCE Δp, in. H_2O	~~1.5~~ 1.45	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 12-6-80
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

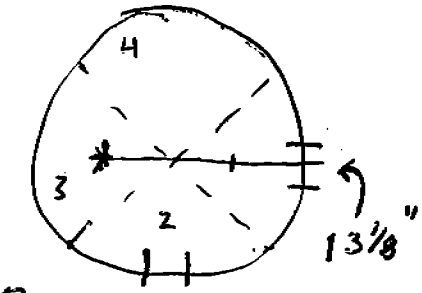
ΔPs = Velocity head of S pitot, inches H_2O

Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	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	29.38
$\frac{5.168\ (60 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.38}}$	K	~~67.71~~ 69.04

FIELD DATA

PLANT Pfizer
DATE 12-6-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER Dust-3-3
OPERATOR M. Hansen
AMBIENT TEMPERATURE 45°F
BAROMETRIC PRESSURE 29.38
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 94



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 2', S.S.
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR 1.05
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp ~~1.5~~ 1.45

$VM = \frac{\cancel{67.74}\ 69.04}{} \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 6" 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^3 204.25		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
	0	0900	Desired	Actual		DESIRED	ACTUAL		INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F			
Dust-3-3	5	0905	207.44	207.46	1.15	1.50	1.55	78	58	56	6.0	NA	NA
	10	0910	210.59	210.69	1.10	1.40	1.45	67	69	57	6.0		
	15	0915	213.73	213.87	1.10	1.40	1.40	73	75	58	6.0		
	20	0920	216.85	216.97	1.10	1.40	1.35	77	81	60	5.5		
	25	0925	219.99	220.03	1.10	1.40	1.30	73	84	62	5.5		
	30	0930	223.11	223.15	1.10	1.40	1.35	77	86	64	5.5		
			V_m = 18.90		Δp = 1.11				T_m =	67.5			
						ΔH =	1.40						
								T_s = 74.17					

COMMENTS

EPA-Dur 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer

Sampling Location Dust Collector

Test Number Dust-3-3

Date 12-6-80

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}	74.17
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.38 ΔH = 1.40 Vm = 18.90 Tm = 67.5	Vm_{std}	18.63
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ 1.0%	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) −7.65	Ps	28.81
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔPs = 1.11	Vs	3,646
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (74.17 + 460)(18.63)}{(3{,}646)(30)(28.81)(.99)(.183^2)}$	% I	98.97

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer
Sample Location: Dust Collector
Sample Box No.: 8
Sample Type: MASS

Run No.: Dust-3-3
Sample Date: 12-6-80
Recovery Date: 12-6-80
Cleanup Person: J. Puvelonis

Filter No.: 94
Sample No.:
Sample Material Description:

MOISTURE AND/OR SAMPLE

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

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

SILICA GEL

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. 136
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. 137
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. Dust-3-3 PARTICULATE CLEAN-UP AND ANALYSIS

Date 12-6-80 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					
138		5	87.25376	85.43126	156		
	94	6	0.85670	0.49601			
		6					
		6					
		7					
		8					
		9					
137		10	84.81858	84.81922	146		

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 Dust Collector

Test Run Number Dust-3-3

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-6-80	0900-0930	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	12-6-80	0900-0930	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	12-6-80	0940	M. Hansen	
Train Disassembly	12-6-80	0945	T. Walker, A. Small	
Train Cleanout	12-6-80	1005	T. Walker, R. Stultz	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-15-80		I. Paulionis	
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN Dust -3-4

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

NOMOGRAPH DATA

PLANT Pfizer

DATE 1-7-81

SAMPLING LOCATION Dust Collector
Dust - 3-4

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	25
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.12
STATIC PRESSURE IN STACK, in. Hg -7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.55
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	25
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.95
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.95	
CALCULATED NOZZLE DIAMETER, in.	.205	
ACTUAL NOZZLE DIAMETER, in.	.183 (Nozzle No. 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 -3-4

Date 1-7-81

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

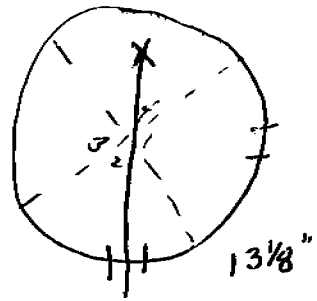
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	25
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	29.12
$\frac{5.168\ (25 + 460)\ (.84)\ (5)\ (.99)\ (.183^2)}{\sqrt{29.12}}$	K	64.68

Top

FIELD DATA

PLANT Pfizer
DATE 1-7-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER Dust-3-4
OPERATOR M. Hansen
AMBIENT TEMPERATURE 15°F
BAROMETRIC PRESSURE 29.12
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 122



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 3', SS
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER 8
METER BOX NUMBER 9
METER $\Delta H_@$ 1.84
C FACTOR .95
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp 1.50

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 5.0 Hg, CFM 0.0

READ AND RECORD ALL DATA EVERY 5 MINUTES

$VM = 64.68 \times \frac{\sqrt{\Delta Ps}}{Ts + 460}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
Dust-3-4	0	0855	234.77										
	5	0900	237.75	237.86	1.05	1.30	1.30	33	26	21	4.5	NA	NA
	10	0910	240.69	240.86	1.02	1.30	1.20	33	34	22	4.0		
	15	0915	243.62	243.32	1.02	1.30	1.15	37	39	24	4.0		
	20	0920	246.60	246.72	1.05	1.30	1.10	35	44	26	4.0		
	25	0920	249.64	249.64	1.10	1.35	1.10	37	47	28	4.0		
	30	0925	252.52	251.	1.00	1.25	—	44	49	30	4.0		
			*	252.11									
									T_m =	32.5			
			V_m = 4.	17.34									
					ΔP = 1.04		ΔH = 1.17						
								T_s = 36.5					

COMMENTS Kiln No. 7 is down.
* The last 45 sec. the ΔH was at 0.0

EPA Dun 235

C-5-1-93

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 1-7-81
Initial MOH

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	36.5
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1.17$, $Pb = 29.12$, $Tm = 32.5$, $Vm = 17.34$	Vm_{std}	18.14
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	28.94
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	28.55
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = 1.04$	Vs	3,418
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (36.5 + 460)(18.14)}{(3{,}418)(30)(28.55)(.99)(.183^2)}$	% I	96.4

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer
Sample Location: Dust Collector
Sample Box No.: 8
Sample Type: MASS

Run No.: Dust-3-4
Sample Date: 1-7-81
Recovery Date: 1-7-81
Cleanup Person: J. Johnson

Filter No.: 122
Sample No.:
Sample Material Description:

MOISTURE AND/OR SAMPLE

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

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

SILICA GEL

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 #170
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 # 164
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. Dust-3-4 PARTICULATE CLEAN-UP AND ANALYSIS

Date 1-7-81 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~~ Bottle No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By	Date
		1					
		2					
		3					
		4					
170		5	93.35476	92.84473	180		
	122	6	1.14186	0.49640			
		6					
		6					
		7					
		8					
		9					
161		10	93.60801	93.60724	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 Dust Collector

Test Run Number DC-3-4

Pollutant(s) in Sample Particulate-Mass

Task	Date	Time	Personnel	Remarks
Sampling	1-7-81	0855-0925	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	1-7-81	0855-0925	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-7-81	0935	M. Hansen	
Train Disassembly	1-7-81	0955	J. Johnson	
Train Cleanout	1-7-81	1000	J. Johnson	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN DC-4-1

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 1-9-81

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

NOMOGRAPH DATA

PLANT Pfizer

DATE 1-9-81

SAMPLING LOCATION Dust Collector DC-4-1

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	~~35~~ 45
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.41
STATIC PRESSURE IN STACK, in. Hg -7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.84
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	35
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.10
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR		~~.96~~ 1.0
CALCULATED NOZZLE DIAMETER, in.		~~.200~~ .197
ACTUAL NOZZLE DIAMETER, in.		.183 (Nozzle No. 7)
REFERENCE Δp, in. H_2O		~~1.55~~ 1.50

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 1-9-81
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

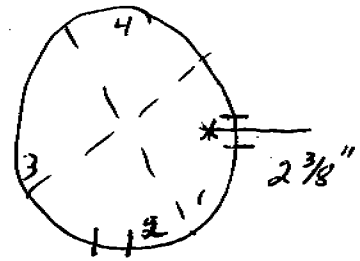
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	~~35~~ 45
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.99
Nozzle diameter, inches	Dn	.183
Barometric pressure, inches Hg	Pb	29.41
$\frac{5.168\ (\underline{35}^{45} + 460)\ (\underline{.84})\ (\underline{3})\ (\underline{.99})\ (\underline{.183}^2)}{\sqrt{\underline{29.41}}}$	K	~~39.41~~ 40.21

Top

FIELD DATA

PLANT Pfizer
DATE 1-9-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER DC-4-1
OPERATOR M. Hansen
AMBIENT TEMPERATURE -4°F
BAROMETRIC PRESSURE 29.41
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 142



PROBE LENGTH AND TYPE 2', SS
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR ~~.46~~ 1.00
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp ~~1.55~~ 1.50

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 5 Hg, CFM 0.0

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

$VM = \frac{\cancel{34.47}\ 40.21}{} \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	0933	351.35										
DC-4-1	3	0936	353.12	353.05	.95	1.20	1.25	30	35	29	5.0	NA	NA
	6	0939	354.87	354.84	.95	1.20	1.30	41	~~38~~	~~28~~	5.0		
	9	0942	356.56	356.54	.90	1.10	1.20	52	41	28	5.0		
	12	0945	358.27	358.27	.92	1.10	1.20	46	45	28	5.0		
	15	0948	359.90	359.99	.83	1.05	1.20	44	48	29	5.0		
	18	0951	361.64	361.72	.95	1.20	1.25	46	50	29	5.0		
	21	0954	363.38	363.46	.45	1.20	1.25	50	52	30	5.0		
	24	0957	365.12	365.21	.95	1.20	1.25	47	54	31	5.0		
	27	1000	366.81	366.94	.91	1.10	1.20	55	55	31	5.0		
	30	1003	368.49	368.65	.90	1.10	1.20	57	57	32	5.0		
			V_m=17.315										
					ΔP=.921			T_s=46.8					
						ΔH=	1.23		T_m=	38.5			

COMMENTS Kiln No. 7 is down.

EPA-Dur 235

C-5-1-101

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 1-9-81
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}	46.8
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.23, Pb = 29.41, Vm = 17.315, Tm = 38.5	Vm_{std}	18.075
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	28.84
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = .921	Vs	3,234
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (46.8 + 460)(18.075)}{(3{,}234)(30)(28.84)(.99)(.183^2)}$	% I	102.60

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer
Sample Location: Dust Collector
Sample Box No.: 8
Sample Type: MASS

Run No.: DC-4-1
Sample Date: 1-9-81
Recovery Date:
Cleanup Person:

Filter No.: 142
Sample No.: 1
Sample Material Description:

MOISTURE AND/OR SAMPLE

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

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

SILICA GEL

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 173
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 181
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. DC-4-1 PARTICULATE CLEAN-UP AND ANALYSIS

Date 1-9-81 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					
173		5	89.98051	89.12995	126		
	142	6	0.62272	0.48503			
		6					
		6					
		7					
		8					
		9					
181		10	84.7408	84.73838	150		

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 Dust Collector

Test Run Number DC-4-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-9-81	0933-1003	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	1-9-81	0933-1003	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-9-81	1015	M. Hansen	
Train Disassembly	1-9-81	1045	J. Johnson	
Train Cleanout	1-9-81		J. Johnson	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN DC-4-2

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

NOMOGRAPH DATA

PLANT Pfizer

DATE 1-7-81

SAMPLING LOCATION Dust Collector DC-4-2

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_{@}$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	30
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.31
STATIC PRESSURE IN STACK, in. Hg -7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.74
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	10
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.85
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.95	
CALCULATED NOZZLE DIAMETER, in.	.210	
ACTUAL NOZZLE DIAMETER, in.	.183	
REFERENCE Δp, in. H_2O	1.40	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number DC-4-2

Date 1-7-81
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

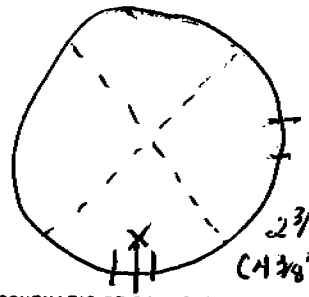
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	30
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.91
Nozzle diameter, inches	Dn	.183
Barometric pressure, inches Hg	Pb	29.31
$\frac{5.168\ (30 + 460)\ (.84)\ (3)\ (.99)\ (.183^2)}{\sqrt{29.31}}$	K	39.08

Tap

FIELD DATA

PLANT Pfizer
DATE 1-7-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER DC-4-2
OPERATOR M. Hansen
AMBIENT TEMPERATURE 10°F
BAROMETRIC PRESSURE 29.31
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) ~~129~~ 126



2 3/8" (4 3/8" in stack)

PROBE LENGTH AND TYPE 3', SS
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR .95
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp 1.40

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

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 34.08 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1733	278.33										
DC-4-2	3	1736	279.85	279.90	.75	.98	1.00	45 35	34	30	4.0	NA	NA
	6	1739	281.45	281.59	.83	1.10	1.15	45 35	38	30	4.5		
	9	1742	283.07	283.24	.85	1.10	1.10	34	42	31	4.5		
	12	1745	284.66	284.82	.82	1.10	.99	33	45	31	4.5		
	15	1748	286.23	286.39	.80	1.05	.97	37	48	32	4.5		
	18	1751	287.80	287.94	.80	1.05	.94	37	50	33	4.5		
	21	1754	289.40	289.51	.83	1.10	.97	37	52	34	4.5		
	24	1757	290.98	291.08	.81	1.05	.96	34	53	35	4.5		
	27	1800	292.57	292.66	.82	1.10	.97	38	54	36	4.5		
	30	1803	294.16	294.354	.82	1.10	.95	38	55	36	4.5		
		1803+15 sec.											
			Vm = 16.024						Tm = 39.95				
					Ap = .81		ΔH = 1.00						
								Ts = 35.8					

COMMENTS

EPA-Dur-235

ISOKINETIC PERFORMANCE WORKSHEET

Plant: Pfizer
Sampling Location: Dust Collector
Test Number: DC-4-2

Date: 1-7-81
Initial: BC

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	35.8
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1$ $Pb = 29.31$ $Vm = 16.024$ $Tm+460 = 499.95$	Vm_{std}	16.61
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	28.74
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .81$ $C_p = .84$	Vs	3005
Total sample time, minutes	θ	30.25
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (35.8 + 460)(16.61)}{(3005)(30.25)(28.74)(.99)(.183^2)}$	% I	98.8

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: DC-4-2 Pfizer
Sample Location: Dust Collector
Sample Box No.: 8
Sample Type: Mass

Run No.: DC-4-2
Sample Date: 1-7-81
Recovery Date:
Cleanup Person:

Filter No.: 126
Sample No.:
Sample Material Description:

MOISTURE AND/OR SAMPLE

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

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

SILICA GEL

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 #166
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 #164
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. DC-4-2 PARTICULATE CLEAN-UP AND ANALYSIS

Date 1-7-81 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					
166		5	94.58191	94.21365	190		
	126	6	1.18912	0.49506			
		6					
		6					
		7					
		8					
		9					
164		10	93.60801	93.60724	130		

Comments:

Codes:

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

MRI-Form P10 (10/72)

SAMPLE HANDLING LOG

Project Number 4891-293

Source Identification ~~Bonner~~ Dust Collector

Test Run Number DC-4-2

Pollutant(s) in Sample Mass

Task	Date	Time	Personnel	Remarks
Sampling	1-7-81	1733-1803		
Probe Technician				
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	1-7-81	1803-1815	Hansen	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN DC-43

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

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

NOMOGRAPH DATA

PLANT Pfizer

DATE 1-8-81

SAMPLING LOCATION Dust Collector DC-4-3

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	40
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.46
STATIC PRESSURE IN STACK, in. Hg -7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.89
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	30
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.15
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.95	
CALCULATED NOZZLE DIAMETER, in.	.196	
ACTUAL NOZZLE DIAMETER, in.	.183 (Nozzle No. 7)	
REFERENCE Δp, in. H_2O	1.50	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

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

Date 1-8-81
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

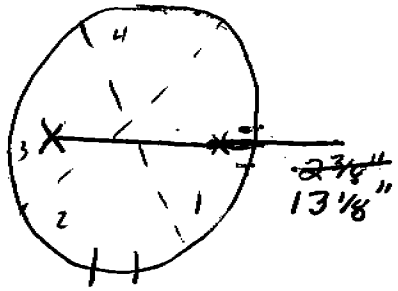
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	40
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.99
Nozzle diameter, inches	Dn	.183
Barometric pressure, inches Hg	Pb	29.46
$\frac{5.168\ (40 + 460)\ (.84)\ (3)\ (.99)\ (.183^2)}{\sqrt{29.46}}$	K	39.78

Top

FIELD DATA

PLANT Pfizer
DATE 1-8-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER DC-43
OPERATOR M. Hansen
AMBIENT TEMPERATURE 10°F
BAROMETRIC PRESSURE 29.46
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 130



PROBE LENGTH AND TYPE 4', SS
NOZZLE I.D. .183
ASSUMED MOISTURE, % 1.0
SAMPLE BOX NUMBER 8
METER BOX NUMBER 2
METER $\Delta H_@$ 1.84
C FACTOR .95
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp 1.50

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 6.0 Hg, CFM 0.0

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 39.78 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 324.33 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	1426											
DC-43	3	1429	326.20	326.10	1.10	1.35	1.35	37	40	36	5.0	NA	NA
	6	1432	328.03	327.95	1.05	1.30	1.40	38	42	36	5.0		
	9	1435	329.89	329.84	1.10	1.35	1.45	42	46	36	5.5		
	12	1438	331.75	331.71	1.10	1.35	1.45	43	49	36	5.5		
	15	1441	333.57	333.55	1.05	1.30	1.35	43	51	36	5.0		
	18	1444	335.43	335.43	1.10	1.35	1.40	43	54	36	5.5		
	21	1447	337.29	337.30	1.10	1.35	1.40	44	56	36	5.5		
	24	1450	339.15	339.18	1.10	1.35	1.45	42	58	37	5.5		
	27	1453	341.01	341.07	1.10	1.35	1.45	42	60	38	5.5		
	30	1456	342.87	342.95	1.10	1.35	1.40	42	60	38	5.5		
			V_m=18.62		ΔP=1.09				T_m=	44.05			
						ΔH=1.41							
								Ts=41.6					

COMMENTS No. 7 Kiln is down.

EPA-Dur-235

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 1-8-81
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}	41.6
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1.41$, $Pb = 29.46$, $Vm = 18.62$, $T_m = 44.05$	Vm_{std}	19.26
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	28.89
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = 1.09$	Vs	3,497
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\,(41.6 + 460)(19.26)}{(3{,}497)(30)(28.89)(.99)(.183^2)}$	% I	99.89

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant: Pfizer
Sample Location: Dust Collector
Sample Box No.: 8
Sample Type: MASS

Run No.: DC-4-3
Sample Date: 1-8-81
Recovery Date:
Cleanup Person:

Filter No.: 130
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/					
Initial Volume (wt) b/					
Net Volume (wt) b/					
Sample No.(s)					

NA

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

SILICA GEL

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 #162
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 #165
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. DC-43 PARTICULATE CLEAN-UP AND ANALYSIS

Date 1-8-81 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					
162		5	94.52245	94.14056	165		
	130	6	0.54200	0.49432			
		6					
		6					
		7					
		8					
		9					
165		10	94.58375	94.58366	170		

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 4841-L(93)

Source Identification Dust Collector

Test Run Number DC-43

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-8-81	1426-1456	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	1-8-81	1426-1456	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-8-81	1500	G. Cobb	
Train Disassembly	1-8-81	1520	A. Small	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

MIDWEST RESEARCH INSTITUTE

RUN DC-4-4

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

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

NOMOGRAPH DATA

PLANT Pfizer

DATE 1-8-81

SAMPLING LOCATION Dust Collector DC-4-4

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	25
PERCENT MOISTURE IN GAS STREAM BY VOLUME	% H_2O	1.0
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.45
STATIC PRESSURE IN STACK, in. Hg -7.65 ($P_m \pm 0.074$ STACK GAUGE PRESSURE in in. H_2O)	P_s	28.88
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	.98
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	30
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.95
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	—
C FACTOR	.95	
CALCULATED NOZZLE DIAMETER, in.	.205	
ACTUAL NOZZLE DIAMETER, in.	.183	(Nozzle No. 7)
REFERENCE Δp, in. H_2O	1.50	

EPA (Dur) 234
4 72

ISOKINETIC SAMPLING WORKSHEET

Plant Pfizer

Sampling Location Dust Collector

Test Number DC-4-4

Date 1-8-81

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

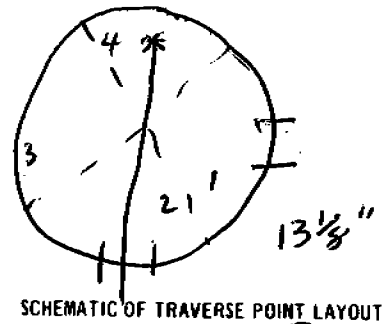
Ts = Stack temperature, °F

Assumed average meter temperature, °F	Tm_{avg}	25
Pitot coefficient	Cp	.84
Sampling time interval, minutes	θi	3
Mole fraction dry gas	Mf	.99
Nozzle diameter, inches	Dn	.183
Barometric pressure, inches Hg	Pb	29.45
$\frac{5.168\ (25 + 460)\ (.84)\ (3)\ (.99)\ (.183^2)}{\sqrt{29.45}}$	K	38.59

Top

FIELD DATA

PLANT Pfizer
DATE 1-8-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER DC-4-4
OPERATOR M. Hansen
AMBIENT TEMPERATURE -5°F
BAROMETRIC PRESSURE 29.45
STATIC PRESSURE, (P_s) -7.65
FILTER NUMBER (s) 128



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 2
METER $\Delta H_@$ 1.84
C FACTOR .95
PROBE HEATER SETTING NA
HEATER BOX SETTING NA
REFERENCE Δp 1.50

Leak CK: Initial at 15" Hg, CFM 0.0
Final at 5.5 Hg, CFM 0.005

READ AND RECORD ALL DATA EVERY 3 MINUTES

$VM = 38.59 \times \sqrt{\frac{\Delta Ps}{Ts + 460}}$

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 Desired	GAS METER READING (V_m), ft^3 Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O Desired	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O Actual	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	0920	300.25										
DC-4-4	3	0925	302.17	302.08	1.20	1.50	1.50	27	36	25	5.0	NA	NA
	6	0928	304.05	303.96	1.15	1.45	1.55	27	38	25	5.0		
	9	0931	305.88	305.91	1.10	1.40	1.55	30	40	25	5.0		
	12	0934	307.70	307.77	1.10	1.40	1.40	33	42	26	5.0		
	15	0937	309.53	309.60	1.10	1.40	1.35	31	44	26	5.0		
	18	0940	311.40	311.43	1.15	1.45	1.40	30	46	27	5.0		
	21	0943	313.32	313.33	1.20	1.50	1.50	27	47	27	5.0		
	24	0946	315.23	315.28	1.20	1.50	1.55	28	49	28	5.5		
	27	0949	317.18	317.24	1.25	1.60	1.55	28	50	28	5.5		
	30	0952	319.13	319.217	1.25	1.60	1.50	30	51	30	5.5		
			Vm=18.967						Tm=	35.5			
					Δp=1.17		ΔH=1.485						
								Ts=29.1					

COMMENTS Kiln No. 7 is down

EPA Dur 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Duct Collector
Test Number DC-4-4

Date 1-8-81
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}	29.1
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = 1.485, Pb = 29.45, Vm = 19.967, Tm = 35.5	Vm_{std}	19.959
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	28.88
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = 1.17	Vs	3,578
Total sample time, minutes	θ	30
Nozzle diameter, inches	Dn	.183
$\frac{1{,}039\ (29.1 + 460)(19.959)}{(3{,}578)(30)(28.88)(.99)(.183^2)}$	% I	98.69

PARTICULATE SAMPLE RECOVERY AND INTEGRITY

Plant Pfizer
Sample Location Dust Collector
Sample Box No. 8
Sample Type MASS

Run No. DC-4-4
Sample Date 1/8/81
Recovery Date
Cleanup Person

Filter No. 128
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/					
Initial Volume (wt) b/					
Net Volume (wt) b/					
Sample No.(s)					

N/A

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

SILICA GEL

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 #169
Liquid Level Marked
Sealed

Impinger Rinse: Sample No. ~~[illegible]~~
Liquid Level Marked
Sealed

Water Blank: Sample No.
Liquid Level Marked

Dry Catch: Sample No.
Description
Sealed

Acetone Blank: Sample No. BEAKER #169
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. DC-4-4 PARTICULATE CLEAN-UP AND ANALYSIS

Date 1/8/81 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					
169		5	92.53114	91.88191	220		
	128	6	0.79836	0.49722			
		6					
		6					
		7					
		8					
		9					
165		10	94.58375	94.58366	170		

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 Dust Collector

Test Run Number DC-4-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-8-81	0922-0952	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	1-8-81	0922-0952	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-8-81	1000	M. Hansen	
Train Disassembly	1-8-81	1015	J. Johnson	
Train Cleanout	1-8-81	1030	J. Johnson	
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

C-5-2 Particle Sizing

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust-1-1

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

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Cobb
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walker
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

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

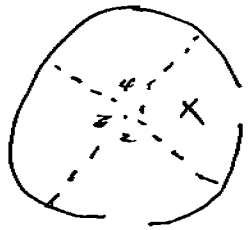
Date 12-3-80
Initial PC

Velocity head at sampling location, in. H_2O	ΔPs	2.93
Stack temperature at sample point, °F	Ts	30
Barometric pressure, in. Hg	Pb	29.8
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	29.23
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	3173
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}	.104
Actual nozzle diameter, in.	D_{n_a}	.113
Assumed meter temperature, °F	Tm	30
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	.185

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 12-3-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Anderson Particulate
RUN NUMBER Dust - 1-1
OPERATOR Cebb
AMBIENT TEMPERATURE 30
BAROMETRIC PRESSURE 28.8
STATIC PRESSURE, (P_s)
Filter Set # 41

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) .185 (.555)
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 (312.15)	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 / 1908											
	3 / 1911	312.71	312.73	.93	1.0	1.0	30	30	30	N/A	N/A	N/A
	6 / 1914	313.26	313.29			1.0		30	30			
	9 / 1917	313.82	313.85			.09		31	30			
	12 / 1920	314.37	314.49			.09		33	31			
	Add 30 sec											
		V_m =	2.34		ΔH =	.095		T_m =	30.63			
				ΔP = .93			T_s = 30					

COMMENTS:

EPA (Dur) 235
4 72

C-5-2-3

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 12-3-80
Initial E.C.

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .095, Pb = 29.8, Vm = 2.34, Tm + 460 = 490.6	Vm_{std}	2.508
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	29.23
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ ΔP = .93, C_p = .84	Vs	3174
Total sample time, minutes	θ	12.33
Nozzle diameter, inches	Dn	.113
$\frac{1{,}039\ (30 + 460)(2.508)}{(3174)(12.33)(29.23)(.99)(.113^2)}$	% I	88.3

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET #41

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

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

Tare Weights
By J.P. Date 10-22-80
Location On Site Lab

PRES. 676.96 517.34

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	41-0	429.98	429.57				
1	41-1	447.74	447.53				
2	41-2	467.30	466.86				
3	41-3	456.58	455.11				
4	41-4	455.69	452.73				
5	41-5	433.39	427.78				
6	41-6	428.48	424.53				
7	41-7	440.61	439.27				
F	41-F	463.03	462.62				

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 4891-193

Source Identification Dust Collector

Test Run Number Dust-1-1

Pollutant(s) in Sample Anderson-Pentachlorophenol

Task	Date	Time	Personnel	Remarks
Sampling	12-3-80	1908-1920		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	12-3-80	1920-1930	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-6-80	1255	I. PAVELONIS	
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust-1-2

MRI Project Number 4691-293
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-3-80

FIELD CREW

Crew Chief Cobb

Testing Engineer 1 Cobb
2
3

Engr. Technician 1
2
3

Lab Technician 1 Walter
2
3

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant PS. 2 [illegible]
Sampling Location Dust Collector
Test No. Dust - 1 - 2

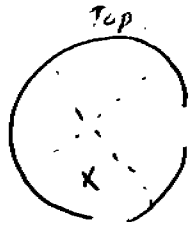
Date 12 - 3 - 80
Initial E.C.

Velocity head at sampling location, in. H_2O	ΔPs	1.08
Stack temperature at sample point, °F	Ts	25
Barometric pressure, in. Hg	Pb	29.78
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O) Ps = -7.65	Ps	29.21
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 Cp = .84 $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	3404
Calculated nozzle diameter, in. Fs = .19 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	Dn_c	.101
Actual nozzle diameter, in.	Dn_a	.113
Assumed meter temperature, °F	Tm	40
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	.190

FIELD DATA - ANDERSEN

PLANT Pf. 2 cu
DATE 12-3-82
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Andersen - Particulate
RUN NUMBER Dust - 1-2
OPERATOR cobb
AMBIENT TEMPERATURE 25
BAROMETRIC PRESSURE 29.78
STATIC PRESSURE, (P_s) -7.65
Filter Set 37

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) .19 (.57/3 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	951	305.2										
Dust-2	3	954	305.77	305.8	1.08	1.1	.101	25	32	32	N/A	N/A	N/A
	6	957	306.34	306.35			.100		32	32			
	9	960	306.91	306.91			.100		32	32			
	12	963	307.48	307.495			.095		34	32			
			V_m = 2.295			ΔH = .101							
					ΔP = 1.08			T_s = 25	T_m = 32.3				

COMMENTS.

EPA (Dur) 235
1 72

C-5-2-9

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number Dust-1-2

Date 12-3-80
Initial P.C.

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	25
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .101, Pb = 29.78, Vm = 2.295, Tm+460 = 492.3	Vm_{std}	2.45
Mole fraction dry gas, $\frac{100-\% H_2O}{100}$ % H_2O = 1	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
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	29.21
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps x Ms}}$ Cp = .84, Δp = 1.08	Vs	3403
Total sample time, minutes	θ	12
Nozzle diameter, inches	Dn	.113
$\frac{1{,}039\ (25 + 460)(2.45)}{(3403)(12)(29.21)(.99)(.113^2)}$	% I	81.9

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 37

Test No. Dust-1-2
Date
Time
Location

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 624.58 520.13

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	37-0	450.31	449.55				
1	37-1	444.93	445.43				
2	37-2	440.88	440.02				
3	37-3	441.01	443.12				
4	37-4	444.29	457.89				
5	37-5	463.17	458.47				
6	37-6	457.78	454.69				
7	37-7	458.21	457.24				
F	37-F	497.22	496.96				
			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 4891-293

Source Identification Dust Collector

Test Run Number Dust-1-2

Pollutant(s) in Sample Arsenic-Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-3-80	851-903		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	12-3-80	910-915	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-6-80	1250	J. PAVELONIS	
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust-1-3

MRI Project Number 4891-L93
Field Dates
Plant Pitz
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 1-3

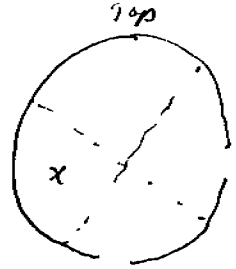
Date 12-2-80
Initial PC

Velocity head at sampling location, in. H_2O	ΔPs	.95
Stack temperature at sample point, °F	Ts	350
Barometric pressure, in. Hg	Pb	28.88
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O) $S_p = -7.65$	Ps	28.31
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 $C_p = .84$ $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	~~3325~~ 3276
Calculated nozzle diameter, in. $Fs = .210$ $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.108
Actual nozzle diameter, in.	D_{n_a}	.113
Assumed meter temperature, °F	Tm	~~70~~ 50
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.210 (.231)
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.210 ~~.214~~ ~~.209~~

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 12-3-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Anderson
RUN NUMBER Dust-1-3
OPERATOR Cobb
AMBIENT TEMPERATURE ~~50~~ 35
BAROMETRIC PRESSURE 28.88
STATIC PRESSURE, (P_s) -7.65
Filter Set 3b

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) .210 (1.05/5 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 (301.5)	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											
	5 / 1625	302.55	302.43	.95	1.4	1.3	~~50~~ 35	34	34	NA	NA	NA
	10 / 1630	303.6	303.6			1.5		35	35			
	15 / 1635	304.65	304.775			1.4		38	36			
		Vm = 3.275					Ts = 35					
				ΔP = .95	ΔH =	1.4		Tm =	35.3			

COMMENTS:

EPA (Dur) 235
4 77

ISOKINETIC PERFORMANCE WORKSHEET

Plant PPi-2 Date 12-2-80
Sampling Location Dust Collector Initial GC
Test Number Dust-1-3

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = 1.4$, $Pb = 28.88$, $Vm = 3.275$, $Tm+460 = 495.3$	Vm_{std}	3.38
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	28.31
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .95$, $C_p = .84$	Vs	3276
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.113
$\frac{1{,}039\,(35 + 460)(3.38)}{(3276)(15)(28.31)(.99)(.113^2)}$	% I	98.8

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 36

Test No. Dust-1-3
Date 12-2-80
Time
Location Dust-Collector

Final Weights
By DENT Date 12-3-80
Location On Site LAB

Tare Weights
By JP Date 10-21-80
Location On Site LAB

PRES 568.37 526.32

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	36-0	439.84	439.50				
1	36-1	430.06	429.73				
2	36-2	473.98	473.38				
3	36-3	432.17	430.83				
4	36-4	443.71	440.74				
5	36-5	432.65	427.91				
6	36-6	442.69	440.34				
7	36-7	442.87	442.16				
F	36-8	441.00	440.82				
		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 4891-293

Source Identification Dust Collector

Test Run Number Dust-1-3

Pollutant(s) in Sample Anderson-Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-2-80	1620-1635		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	12-2-80	1635-1645	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-6-80	1132	J. PAVELONIS	
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN DC-1-4-X

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 1-9-81

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

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Dust Collector
Test No. DC-1-4-81

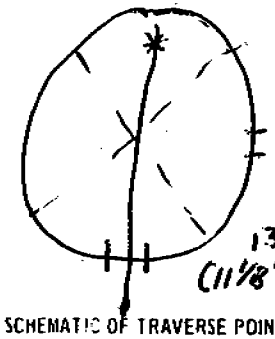
Date 1-9-81
Initial MDH

Velocity head at sampling location, in. H_2O	ΔPs	1.22
Stack temperature at sample point, °F	Ts	45
Barometric pressure, in. Hg	Pb	29.38
Static pressure in stack, in. Hg -7.65 (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	28.81
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 $\Delta P = 1.22$ $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	3,717
Calculated nozzle diameter, in. Fs = .26 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.113
Actual nozzle diameter, in.	D_{n_a}	.115
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	.26
Calculated meter flow rate, ft^3/min Fs = .26 $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.252

[redacted] Top [redacted] .756 cu ft/min [redacted]

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 1-9-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Particle size
RUN NUMBER DC-1-4
OPERATOR M. Hansen
AMBIENT TEMPERATURE 50°F
BAROMETRIC PRESSURE 29.38
STATIC PRESSURE, (P_s) -7.65
Filter Set 72



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) .252 (.063/15 sec)
Probe Tip Diameter .115
CO_2 0
O_2 21
CO 0
N_2 79
% H_2O 1.0, assumed

Console No. 2

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

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	1651	394.90										
DC-1-4	3	1654	395.66	395.70	1.22	.23	.24	45	44	39	a	NA	NA
	6	1657	396.41	396.51			.24		46	39			
	9	1700	397.17	397.33			.24		47	39			
	12	1703	397.93	398.14			.24		48	40			
	15	1706	398.68	398.987			.24		49	40			
			V_m = 4.087			ΔH =	.24		T_m =	43.1			

COMMENTS: Kiln No. 7 is down.
a/ vacuum gage not working. Meter runs ok.

EPA (Dun 235

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer

Sampling Location Dust Collector

Test Number DC-1-4

Date 1-9-81

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}	45
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .24, Pb = 29.38, Vm = 4.087, Tm = 43.1	Vm_{std}	4.213
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) −7.65	Ps	28.81
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ ΔP = 1.22	Vs	3,717
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (45 + 460)(4.213)}{(3{,}717)(15)(28.81)(.99)(.115^2)}$	% I	105.11

ANDERSEN PARTICLE SIZE ANALYSIS

Test No. DC-1-4
Date 1-9-81
Time
Location

Final Weights
By Small Date 1/10-1/11/81
Location

Tare Weights
By Small Date 1-8-81
Location ON SITE

PRES 687.49 459.79

Stage No.	72 Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0		403.82	401.68				
1		405.60	404.73				
2		424.93	422.19				
3		414.53	410.14				
4		421.04	415.75				
5		420.29	415.91				
6		420.73	419.08				
7		414.20	414.27				
F		460.03	460.82				
		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-1-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-9-81	1651-1706	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	1-9-81	1651-1706	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-9-81	1715	M. Hansen	
Train Disassembly	1-9-81	1722	J. Johnson	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust-2-1

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-5-80

FIELD CREW

Crew Chief B. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

Lab Technician 1 T. Walker, J. Pavelonis
2 A. Small
3 B. Dent

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Dust Collector
Test No. Dust - 2-1

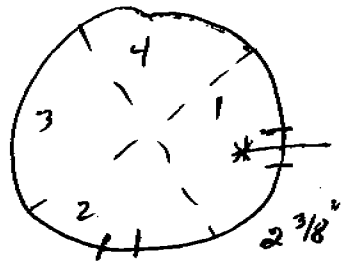
Date 12-5-80
Initial MDH

Velocity head at sampling location, in. H_2O	ΔPs	1.16
Stack temperature at sample point, °F	Ts	~~50~~ 50
Barometric pressure, in. Hg	Pb	29.41
Static pressure in stack, in. Hg -7.65 (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	28.84
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	3,640
Calculated nozzle diameter, in. Fs = .23 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.108
Actual nozzle diameter, in.	D_{n_a}	.115
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	.23
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.223

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 12-5-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Particulate
RUN NUMBER Dust-2-1
OPERATOR M. Hansen
AMBIENT TEMPERATURE 45°F
BAROMETRIC PRESSURE 29.41
STATIC PRESSURE, (P_s) -7.65
Filter Set 50

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



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) .223(.055/15sec.)
Probe Tip Diameter .115
CO_2 0%
O_2 21%
CO 0%
N_2 79%
% H_2O 1.0 assumed

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 / 1710	326.20										
Dust-2-1	3 / 1713	326.87	326.74	1.16	.13	.13	50	47	47	NA	NA	NA
	6 / 1716	327.54	327.43			.15		47	47			
	9 / 1719	328.21	328.17			.17		48	47			
	12 / 1722	328.88	328.91			.17		50	48			
		V_m = 2.71			ΔH =	.155		T_m = 47.6				

COMMENTS:

EPA-Dun 235

C-5-2-27

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number Dust -2-1

Date 12-5-80
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}	50
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.41 ΔH = .155 Tm = 47.6 Vm = 2.71	Vm_{std}	2.77
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) -7.65	Ps	28.84
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$	Vs	3,640 ~~2,856~~
Total sample time, minutes	θ	12
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (50 + 460)(2.77)}{(\cancel{2{,}856})(12)(28.84)(.99)(.115^2)}$	% I	~~113.42~~

3,640

89.00

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET #5D

Test No. Dust-2-1
Date 12-5-80
Time 1710-1722
Location Dust Collector

Final Weights _____
By JP Date 12-8-80
Location On Site Lab

Tare Weights _____
By Dent Date 12-2-80
Location On Site Lab

Pres. 703.93 510.56

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0	50-0	461.95	460.76				
1	50-1	455.47	455.13				
2	50-2	463.57	462.63				
3	50-3	464.88	462.91				
4	50-4	465.62	460.22				
5	50-5	468.46	459.90				
6	50-6	460.25	455.71				
7	50-7	448.63	447.43				
F	50-F	571.99	571.70				
			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 Dust-2-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-5-80	1710-1722	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	12-5-80	1710-1722	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	12-5-80	1725	M. Hansen	
Train Disassembly	12-5-80	1730	M. Hansen	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust-2-2

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-5-80

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

Lab Technician 1 T. Walker, J. Pavelonis
2 A. Small
3 B. Dent

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Dust Collector
Test No. Dust-2-2

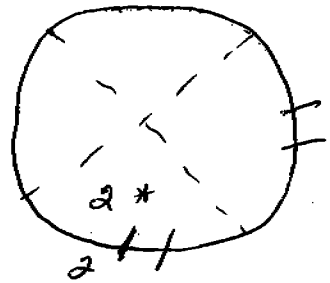
Date 12-5-80
Initial MDH

Velocity head at sampling location, in. H_2O	ΔPs	1.00
Stack temperature at sample point, °F	Ts	49
Barometric pressure, in. Hg	Pb	29.50
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O) −7.65	Ps	28.93
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	3,371.
Calculated nozzle diameter, in. Fs = .21 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.107
Actual nozzle diameter, in.	D_{n_a}	.115
Assumed meter temperature, °F	Tm	47
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	
Calculated meter flow rate, ft^3/min Fs = .21 $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.203

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 12-5-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Particulate
RUN NUMBER Dust-2-2
OPERATOR M. Hansen
AMBIENT TEMPERATURE 45°F
BAROMETRIC PRESSURE 29.50
STATIC PRESSURE, (P_s) -7.65
Filter Set 47

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



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) 0.203
Probe Tip Diameter .113
CO_2 0
O_2 21
CO 0
N_2 79
% H_2O 1.0

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)		GAS METER READING (V_m), ft^3 319.75 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	1030											
Dust 2-2	3	1033	320.36	320.40	1.0	.10	.13	49	41	41	NA	NA	NA
	6	1036	320.97	321.01			.12		42	41			
	9	1039	321.58	321.68			.13		43	41			
	12	1042	322.19	322.30			.11		44	41			
	15	1045	322.80	322.93			.11		45	42			
			V_m = 3.18			ΔH =	.12		T_m =	42.1			

COMMENTS:

EPA (Dur) 235

C-5-2-33

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 12-5-80
Initial AC

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	49
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .12, Pb = 29.5, Vm = 3.18, Tm+460 = 500.1	Vm_{std}	3.297
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 $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ ΔP = 1, C_p = .84	Vs	3371
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (49 + 460)(3.297)}{(3371)(15)(28.93)(.99)(.115^2)}$	% I	91.04

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 47

Test No. Dust 2-2
Date 12-5-80
Time
Location Dust Collector

Final Weights
By DENT Date 12-5-80
Location ON SITE LAB

Tare Weights
By I.P. Date 10-24-80
Location ON SITE LAB

PRES. 591.06 510.12

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0	47-0	446.46	455.56				
1	47-1	445.73	445.10				
2	47-2	434.60	433.87				
3	47-3	426.28	425.12				
4	47-4	439.39	438.05				
5	47-5	427.95	425.24				
6	47-6	435.85	434.04				
7	47-7	430.20	428.20				
F	47-F	545.17	544.86				

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 4891-293

Source Identification Dust Collector

Test Run Number Dust -2-2

Pollutant(s) in Sample Andersen-Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-5-80	1030-1045		
Probe Technician				
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	12-5-80	10-45-1100	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-6-80		J. Paulionis	
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust-2-3

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-5-80

FIELD CREW

Crew Chief G. Cobb

Testing Engineer 1 M. Hansen
2
3

Engr. Technician 1
2
3

Lab Technician 1 T. Walker J. Pavelonis
2 A. Small
3 B. Dent

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Dust Collector
Test No. Dust-2-3

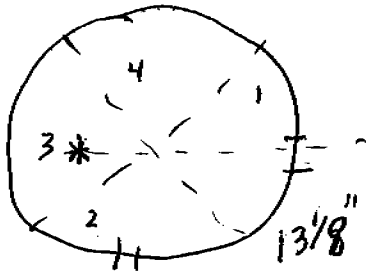
Date 12-5-80
Initial MDH

Velocity head at sampling location, in. H_2O	ΔPs	1.21
Stack temperature at sample point, °F	Ts	47
Barometric pressure, in. Hg	Pb	29.43
Static pressure in stack, in. Hg -7.65 (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	28.86
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 $5{,}128.8\ (Cp)\ (\sqrt{\Delta Ps})\ \sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	3,706
Calculated nozzle diameter, in. Fs = .22 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.104
Actual nozzle diameter, in.	D_{n_a}	.115
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	
Calculated meter flow rate, ft^3/min Fs = .22 $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	0.215

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 12-5-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Particulate
RUN NUMBER Dust-2-3
OPERATOR M. Hansen
AMBIENT TEMPERATURE 45°F
BAROMETRIC PRESSURE 29.43
STATIC PRESSURE, (P_s) -7.65
Filter Set ~~48~~ 49

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



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) 0.215 (.054/15 sec)
Probe Tip Diameter .115
CO_2 0
O_2 21
CO 0
N_2 79
% H_2O 1.0 assumed
Meter Box No. 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	1500	323.40										
Dust 2-3	3	1503	324.05	324.00	1.21	.11	.11	47	45	45	NA	NA	NA
	6	1506	324.70	324.64			.12		46	45			
	9	1509	325.35	325.31			.14		47	45			
	12	1512	326.00	326.03			.14		48	46			
			V_m =	2.63		ΔH =	.128		T_m =	45.88			
					ΔP = 1.21			T_s = 47					

COMMENTS.

EPA Form 235

C-5-2-39

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 12-5-80
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}	47
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .128, Pb = 29.43, Vm = 2.63, Tm + 460 = 505.9	Vm_{std}	2.70
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	28.86
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = 1.21, Cp = .84	Vs	3706
Total sample time, minutes	θ	12
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (47 + 460)(2.7)}{(3706)(12)(28.86)(.99)(.115^2)}$	% I	84.64

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 49

Test No. Dust-2-P
Date 12-5-80
Time
Location Dust Collector

Final Weights
By JP Date 12-5-80
Location On Site Lab

Tare Weights
By DENT Date 12-2-80
Location On Site Lab

PRES 646.74 507.23

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0	49-0	451.85	451.54				
1	49-1	440.81	440.57				
2	49-2	451.98	451.01				
3	49-3	443.08	440.89				
4	49-4	460.01	454.90				
5	49-5	459.99	450.61				
6	49-6	454.58	449.70				
7	49-7	464.84	463.56				
F	49-F	554.91	554.35				
			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 4891-293

Source Identification Dust Collector

Test Run Number Dust-2-3

Pollutant(s) in Sample Anderson-Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-5-80	1500-1512		
Probe Technician				
Meter Technician			Hansen	
Other				
Transport of Train to Cleanup Site	12-5-80	1512-1530	Hansen	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust-2-4

MRI Project Number 4891-L93
Field Dates
Plant PSI-EU
Sampling Location ~~12-4-80~~ 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-2-4

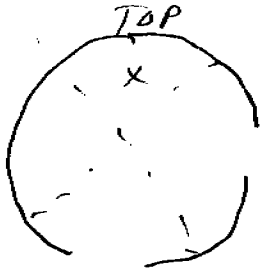
Date 12-4-80
Initial R.C.

Velocity head at sampling location, in. H_2O	ΔPs	1.21
Stack temperature at sample point, °F	Ts	45
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	3693
Calculated nozzle diameter, in. .21 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.101
Actual nozzle diameter, in.	D_{n_a}	.113
Assumed meter temperature, °F	Tm	40
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.21
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)$ (Mf)	Fm	.202

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 12-4-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Andersen
RUN NUMBER Dust-2-4
OPERATOR Cobb
AMBIENT TEMPERATURE 40
BAROMETRIC PRESSURE 29.5
STATIC PRESSURE, (P_s) -7.65
Filter Set 45

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)	.202 (.606)
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 / 1755	316.94										
	3 / 1800	317.55	317.55	1.21	.1	.095	45	38	39	N/A	N/A	N/A
	6 / 1805	318.15	318.12			.1		39	39			
	9 / 1810	318.76	318.73			.1		40	39			
	12 / 1815	319.36	319.36			.1		42	40			
		V_m =	2.422		ΔH =	.099		T_m =	39.5			
				ΔP = 1.21			T_s = 45					

COMMENTS:

EPA (Dun) 235
4 72

C-5-2-45

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number Dust-2-4

Date 12-4-80
Initial AG

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	45
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .099$, $Pb = 29.5$, $Vm = 2.422$, $Tm+460 = 499.5$	Vm_{std}	2.524
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 $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P = 1.21$, $C_p = .84$	Vs	36.94
Total sample time, minutes	θ	12
Nozzle diameter, inches	Dn	.113
$\frac{1{,}039\ (45 + 460)(2.524)}{(36.94)(12)(28.93)(.99)(.113^2)}$	% I	81.7

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET #45

Test No. Dust-2-4
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. 499.12 486.13

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0	45-0	452.64	452.51				
1	45-1	454.94	454.96				
2	45-2	468.99	469.02				
3	45-3	470.75	470.79				
4	45-4	464.78	464.80				
5	45-5	444.10	444.05				
6	45-6	436.21	436.13				
7	45-7	456.56	456.47				
F	45-F	447.03	446.88				
			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 4891-193

Source Identification Dust Collector

Test Run Number Dust-2-4

Pollutant(s) in Sample Anderson-Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-4-80	1755-1815		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	12-4-80	1815-1830	Cobb	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust-3-1

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 12-6-80

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. Paulonis
3 A. Small

Process Engineer 1
2

Other 1
2

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

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

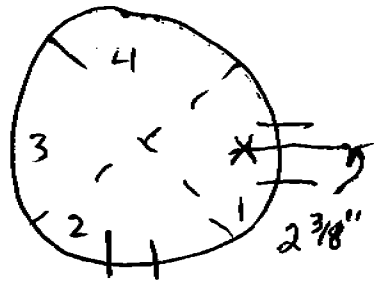
Date 12-6-80
Initial MDH

Velocity head at sampling location, in. H_2O	ΔPs	.85
Stack temperature at sample point, °F	Ts	69
Barometric pressure, in. Hg	Pb	29.40
Static pressure in stack, in. Hg -7.65 (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	28.83
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 $\Delta P = .85$ $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	3,174
Calculated nozzle diameter, in. Fs = .23 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.115
Actual nozzle diameter, in.	D_{n_a}	.115
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	.23
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)$ (Mf)	Fm	.222

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 12-6-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Particulate
RUN NUMBER Dust-3-1
OPERATOR M. Hansen
AMBIENT TEMPERATURE 50°F
BAROMETRIC PRESSURE ~~29.40~~ 29.40
STATIC PRESSURE, (P_s) -7.65
Filter Set 54

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



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) .222 (.056/15sec.)
Probe Tip Diameter .115
CO_2 0
O_2 21%
CO 0
N_2 79%
% H_2O 1.0% Assumed.

Console No. 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	1410	333.38										
Dust-3-1	3	1413	334.05	333.94	.85	.11	.10	69	60	60	NA	NA	NA
	6	1416	334.72	334.60			.13		60	60			
	9	1419	335.39	335.31			.15		62	60			
	12	1422	336.06	336.02			.15		64	60			
	15	1425	336.73	336.75			.15		66	61			
	~~18~~	~~1428~~	~~337.40~~										
			V_m = 3.37			ΔH = .136			T_m =	61.3			

COMMENTS:

C-5-2-51

EPA (Dun) 235
1 72

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 12-6-80
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}	69
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Pb = 29.40 ΔH = .136 Vm = 3.37 Tm = 61.3	Vm_{std}	3.35
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
Static pressure in stack, absolute, in. Hg -7.65 (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	28.83
Stack velocity, fpm ΔP = .85 $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$	Vs	3,174
Total sample time, minutes	θ	~~18~~ 15
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (69 + 460)(3.35)}{(3{,}174)(15)(28.83)(.99)(.115^2)}$	% I	102.46

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET #54

Test No. Dust-3-1
Date 12-6-80
Time
Location Dust Collector

Final Weights
By JP Date 12-9-80
Location JOB SITE LAB

Tare Weights
By DENT Date 12-3-80
Location JOB SITE LAB

PRES. 682.88 481.16

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0	54-0	447.88	446.38				
1	54-1	435.11	434.82				
2	54-2	443.71	442.72				
3	54-3	452.37	449.81				
4	54-4	435.92	431.23				
5	54-5	454.03	445.03				
6	54-6	452.03	447.33				
7	54-7	422.22	420.96				
F	54-F	535.02	533.62				
		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 Dust-3-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-6-80	1410-1425	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	12-6-80	1410-1425	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	12-6-80	1428	M. Hansen	
Train Disassembly	12-6-80		T. Walker	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust-3-2

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

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Dust Collector
Test No. DC - 3-2

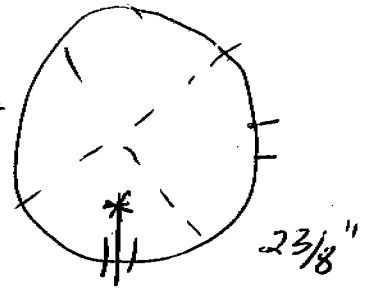
Date 1-6-81
Initial RCS

Velocity head at sampling location, in. H_2O	ΔPs	1.0 ~~1.24~~
Stack temperature at sample point, °F	Ts	40 ~~37.8~~
Barometric pressure, in. Hg	Pb	28.92
Static pressure in stack, in. Hg (Pb) ± (0.074 x gage pressure, in. H_2O) -7.65" H_2O	Ps	28.35
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	3375 ~~3750~~
Calculated nozzle diameter, in. $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min Fs = .204 ~~0.190~~	D_{n_c}	0.106
Actual nozzle diameter, in.	D_{n_a}	.115 # 60-3
Assumed meter temperature, °F	Tm	37 #
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.204
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	0.197

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 1-6-81
SAMPLING LOCATION Dust Collector
Particulate SAMPLE TYPE ~~DC DUST 3-2~~
RUN NUMBER DUST-3-2
OPERATOR M. HANSEN
AMBIENT TEMPERATURE 25°F
BAROMETRIC PRESSURE 28.42
STATIC PRESSURE, (P_s) -7.65"
Filter Set 59

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) .197 (.049/15 sec)
Probe Tip Diameter .115
CO_2 0
O_2 21
CO 0
N_2 79
% H_2O 1 %

Console #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 / 1745	252.85										
	3 / 1748	253.44	253.43	1.0	.15	.15	40	27	25	2.0	NA	NA.
	6 / 1751	254.03	254.06			.14		28	27	2.0	↓	↓
	9 / 1754	254.62	254.68			.13		30	28	2.0		
	12 / 1757	255.21	255.30			.13		32	28	2.0		
	15 / 1800	255.80	255.89			.12		34	29	2.0		
	18 / 1803	256.39	256.475			.12		36	30	2.0		
		V_m=	3.625 ft³		ΔH_{Ave}	.132		$T_{m\,Ave}$	29.5			

COMMENTS:

EPA (Dur) 235

C-5-2-57

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location DUST - COLLECTOR
Test Number DUST - 3-2

Date 1-6-81
Initial 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}	40
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ Vm = 3.625 Cf, Pb = 28.92, ΔH_{AVE} = .132, Tm = 29.5	Vm_{std}	~~3.90~~ 3.78
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
Static pressure in stack, absolute, in. Hg (Pb) ± (0.074 x stack gage pressure, in H_2O)	Ps	28.35
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ (Cp = .84)	Vs	3375
Total sample time, minutes	θ	18
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (40 + 460)(3.78)}{(3375)(18)(28.35)(.99)(.115^2)}$	% I	87.09 ~~89.85~~

ANDERSEN PARTICLE SIZE ANALYSIS

Test No. Dust-3-2
Date 1-6-81
Time
Location Dust Collector

Final Weights
By DWAS Date 1-7-81, 1/10/81
Location

Tare Weights
By DENT Date 12-3-80
Location

PRES 649.03 489.25

Stage No.	59 Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0		540.22	438.13				
1		425.70	423.65				
2		442.99	439.54				
3		422.45	418.43				
4		446.13	439.61				
5		424.93	418.44				
6		438.59	433.98				
7		426.08	424.51				
F		542.42	541.43				

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 Dust-3-2

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-6-81	1745-1803	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	1-6-81	1745-1803	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-6-81	1807	E. Olson	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN Dust 3-3

MRI Project Number 4891-L93
Field Dates
Plant Pizer
Sampling Location Dust Collector
Sampling Date 12-6-80

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)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Dust Collector
Test No. Dust 3-3

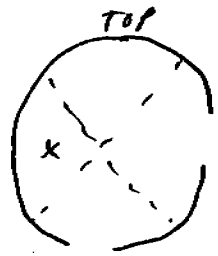
Date 12-6-80
Initial GC.

Velocity head at sampling location, in. H_2O	ΔPs	1.11
Stack temperature at sample point, °F	Ts	74.17
Barometric pressure, in. Hg	Pb	29.41
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	28.84
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	3644
Calculated nozzle diameter, in. $Fs = .29$ $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.121
Actual nozzle diameter, in.	D_{n_a}	.115
Assumed meter temperature, °F	Tm	68
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.29
Calculated meter flow rate, ft^3/min $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.274

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 12-6-80
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Anderson Particulate
RUN NUMBER Dust-8-3
OPERATOR Cobb
AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE 29.41
STATIC PRESSURE, (P_s) -7.65
Filter Set 53

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) .274 (.822/3min) (.069/15sec)
Probe Tip Diameter .115
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 330.1	GAS METER READING Actual	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL 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	1125											
	3	1128	330.92	330.83	1.11	1.6	1.5	74	60	57	N/A	N/A	N/A
	6	1131	331.74	331.62			1.7		60	57			
	9	1134	332.57	332.42			1.7		62	58			
	12	1137	333.89	333.235			1.8		64	58			
			Vm =	3.135		ΔH=	1.675		Tm =	59.5			
					ΔP = 1.11			Ts = 74					

COMMENTS:

EPA (Dur) 235
4 77

C-5-2-63

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 12-6-80
Initial EC.

Isokinetic equation:

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

Average stack temperature, °F	Ts_{avg}	74
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\left(\frac{\Delta H_{avg}}{13.6}\right)\right)}{(Tm+460)}$ $\Delta H = 1.625$, $Pb = 29.41$, $Vm = 3.135$, $Tm+460 = 519.5$	Vm_{std}	3.144
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	28.84
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = 1.11$, $Cp = .84$	Vs	3644
Total sample time, minutes	θ	12
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (74 + 460)(3.144)}{(3644)(12)(28.84)(.99)(.115^2)}$	% I	105.6

ANDERSEN PARTICLE SIZE ANALYSIS
FILTER SET # 53

Test No. Dust 3-3
Date 12-6-80
Time
Location Dust Collector

Final Weights
By JP Date 12-8-80
Location On Site Lab

Tare Weights
By Dent Date 12-2-80
Location On Site Lab

PRES. 600.97 474.07

Stage No.	Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0	53-0	450.98	450.72				
1	53-1	427.35	426.96				
2	53-2	468.31	467.51				
3	53-3	456.51	453.66				
4	53-4	464.85	460.04				
5	53-5	433.61	425.08				
6	53-6	440.89	436.93				
7	53-7	446.97	445.82				
F	53-F	532.21	531.74				
			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 4891-193

Source Identification Dust Collector

Test Run Number Dust 3-3

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	12-6-80	1125-1137		
Probe Technician				
Meter Technician			Cobb	
Other				
Transport of Train to Cleanup Site	12-6-80	1137-1145	Cobb/Stultz	
Train Disassembly				
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis	12-6-80	1301	J. PAVELONIS	
Write Up				

C-5-2-66

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN DC-3-4-(2)

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

MRI - Form PO (10/72)

C-5-2-67

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Dust Collector
Test No. DC-3-4-2

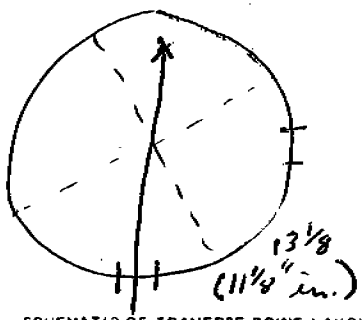
Date 1-7-81
Initial MDH

Velocity head at sampling location, in. H_2O	ΔPs	1.04
Stack temperature at sample point, °F	Ts	35
Barometric pressure, in. Hg	Pb	29.24
Static pressure in stack, in. Hg (Pb) $\pm$ (0.074 x gage pressure, in. H_2O)	Ps	28.67
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	3,406
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	30
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 $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.183

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 1-7-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Andersen - Particulate
RUN NUMBER DC-3-4-2
OPERATOR M. Hansen
AMBIENT TEMPERATURE 15°F
BAROMETRIC PRESSURE 29.24
STATIC PRESSURE, (P_s) -7.65
Filter Set 63

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) .183 (.046/15 sec)
Probe Tip Diameter .115
CO_2 0
O_2 21
CO 0
N_2 79
% H_2O 1.0, assumed

Console No. 2

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 261.40 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	1413											
DC-3-4	3	1416	261.95	261.96	1.04	.10	.11	35	25	24	2.0	NA	NA
	6	1419	262.50	262.53			.11		27	24	2.0		
	9	1422	263.05	263.14			.12		28	25	2.0		
	12	1425	263.60	263.74			.13		30	25	2.0		
	15	1428	264.15	264.37			.13		33	26	2.0		
	18	1431	264.69	264.99			.13		35	27	2.0		
			V_m = 3.59			ΔH = .122			T_m =	27.42			

COMMENTS: Kiln No. 7 is down.

EPA (Dur) 235

C-5-2-69

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number DC-3-4-2

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), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .122$, $Pb = 29.24$, $Vm = 3.59$, $Tm = 27.42$	Vm_{std}	3,800
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	28.67
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = 1.04$	Vs	3,406
Total sample time, minutes	θ	18
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\,(35 + 460)(3.800)}{(3{,}406)(18)(28.67)(.99)(.115^2)}$	% I	84.92

ANDERSEN PARTICLE SIZE ANALYSIS

Test No. DC-3-4-2
Date 1-7-81
Time
Location Dust Collector

Final Weights
By Date
Location

Tare Weights
By JP Date 12-8-80
Location

PES 699.23 480.69

Stage No.	63 Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0		413.11	411.57				
1		414.30	413.09				
2		416.13	413.83				
3		426.63	423.63				
4		414.76	409.57				
5		397.69	390.96				
6		416.29	412.98				
7		394.09	392.87				
F		483.35	483.37				
		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-3-4-2

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-7-81	1413-1431	M. Hansen	
Probe Technician	–	–	–	
Meter Technician	1-7-81	1413-1431	M. Hansen	
Other	–	–	–	
Transport of Train to Cleanup Site	1-7-81	1435	M. Hansen	
Train Disassembly	1-7-81	1445	J. Johnson	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN DC-4-1

MRI Project Number 4891-L(93)
Field Dates
Plant Pfizer
Sampling Location Dust Collector
Sampling Date 1-9-81

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

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

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

Date 1-9-81
Initial MDH

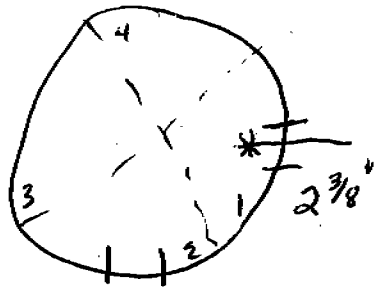
Velocity head at sampling location, in. H_2O	ΔPs	.92
Stack temperature at sample point, °F	Ts	~~33~~47
Barometric pressure, in. Hg	Pb	29.43
Static pressure in stack, in. Hg -7.65 (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	28.86
Percent moisture in gas stream by volume	% H_2O	1.0
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	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	~~28.85~~ 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	3,231
Calculated nozzle diameter, in. Fs = .21 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.109
Actual nozzle diameter, in.	D_{n_a}	.115
Assumed meter temperature, °F	Tm	33
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.21
Calculated meter flow rate, ft^3/min Fs = .21 $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.198

[redacted] .59 cu ft/min [redacted]

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 1-9-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Particulate
RUN NUMBER DC-4-1
OPERATOR M. Hansen
AMBIENT TEMPERATURE 5°F
BAROMETRIC PRESSURE 29.43
STATIC PRESSURE, (P_s) -7.65
Filter Set 70

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) .198 (.0495/15sec.)
Probe Tip Diameter .115
CO_2 0
O_2 21
CO 0
N_2 79
% H_2O 1.0, assumed

Console No. 2

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 1126	369.55										
DC-4-1	3 @ STOP 1129	370.14	370.14	.92	.13	.14	47	41	36	1.0	NA	NA
	~~6~~	~~370.74~~										
	~~9~~	~~371.33~~										
	~~12~~	~~371.93~~										
	~~15~~	~~372.52~~										
	Start 1132											
	6 1135	370.74	370.70			.15		40	35	0.5		
	9 1138	371.33	371.39			.17		40	35	0.5		
	12 1141	371.93	372.09			.17		41	35	0.5		
	15 1144	372.52	372.877			.18		42	35	0.5		
		V_m = 3.327			ΔH =	.162		T_m =	38.0			

COMMENTS: Kiln No. 7 is down. @ vacuum problem.

EPA (Dun 235

C-5-2-75

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 1-9-81
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}	47
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .162$ $Pb = 29.43$ $Vm = 3.327$ $Tm+460 = 498$	Vm_{std}	3.47
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 -7.65 $(Pb) \pm (0.074 \times$ stack gage pressure, in $H_2O)$	Ps	28.86
Stack velocity, fpm $5{,}128.8\,(Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ $\Delta P = .92$ $C_p = .84$	Vs	3231
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\,(47 + 460)(3.47)}{(3231)(15)(28.86)(.99)(.115^2)}$	% I	99.8

ANDERSEN PARTICLE SIZE ANALYSIS

Test No. DC-4-1
Date 1-9-81
Time
Location Dust Collector

Final Weights
By Small Date 1/11/81
Location

Tare Weights
By SMALL Date 1-8-81
Location

PBS 653.03 476.46

Stage No.	70 Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0		431.82	428.81				
1		412.14	410.53				
2		428.99	426.04				
3		413.59	409.66				
4		425.81	420.18				
5		404.11	397.61				
6		431.26	427.31				
7		406.28	404.32				
F		466.82	465.27				

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-4-1

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-9-81	1132-1144	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	1-9-81		M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-9-81	1144-1200	~~M~~	
Train Disassembly	1-9-81			
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN DC-4-2

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

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

Plant Pfizer
Sampling Location Dust Collector
Test No. DC-4-2

Date 1-7-81
Initial MDH

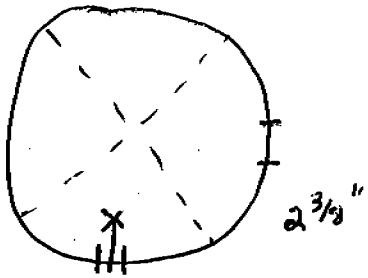
Velocity head at sampling location, in. H_2O	ΔPs	.81
Stack temperature at sample point, °F	Ts	35
Barometric pressure, in. Hg	Pb	29.31
Static pressure in stack, in. Hg -7.65 (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	28.74
Percent moisture in gas stream by volume	% H_2O	1.00
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	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	3,002
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}	.108
Actual nozzle diameter, in.	D_{n_a}	.115
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	~~.108~~ .19
Calculated meter flow rate, ft^3/min Fs = .19 $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.184

FIELD DATA - ANDERSEN

.552 cu ft/3 min

PLANT Pfizer
DATE 1-7-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE MASS
RUN NUMBER DC-4-2
OPERATOR M. Hansen
AMBIENT TEMPERATURE 10°F
BAROMETRIC PRESSURE 29.31
STATIC PRESSURE, (P_s) -7.65
Filter Set 65

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) .184 (.046/15 sec.)
Probe Tip Diameter .115
CO_2 0
O_2 21
CO 0
N_2 79
% H_2O 1.0

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	~~1902~~	~~294.90~~ 295.15										
DC-4-2	3	~~1905~~	~~295.45~~		.81	~~.11~~		~~35~~				NA	NA
	6		~~296.00~~										
	9		~~296.56~~										
	12		~~297.11~~										
	15		~~297.66~~										
	0	1907			.81								
	3	1910	295.70	295.68		.11	.13	35	30	30	2.5	NA	NA
	6	1913	296.25	296.37			.17		32	30	2.5		
	9	1916	296.81	297.06			.15		33	30	2.5		
	12	1919	297.36	297.71			.14		35	30	2.5		
	15	1922	297.91	298.46			.14		36	30	2.5		
				3									
			Vm =	3.31		ΔH =	.146		Tm =	31.6			
					ΔP = .81			T_s = 35					

COMMENTS:

EPA (Dun 235

C-5-2-81

ISOKINETIC PERFORMANCE WORKSHEET

Plant Pfizer
Sampling Location Dust Collector
Test Number DC-4-2

Date 1-7-81
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}	35
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .146$, $Pb = 29.31$, $Vm = 3.21$, $Tm+460 = 491.6$	Vm_{std}	3.38
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	28.74
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P = .81$, $C_p = .84$	Vs	3002
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (35 + 460)(3.38)}{(3002)(15)(28.74)(.99)(.115^2)}$	% I	102.6

ANDERSEN PARTICLE SIZE ANALYSIS

Test No. DC-4-2
Date 1-7-81
Time
Location Dust Collector

Final Weights
By [illegible] Date 1/10/81
Location

Tare Weights
By JP Date 12-8-80
Location

PES 648.23 485.00

Stage No.	65 Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0		411.24	411.18				
1		419.96	420.55				
2		410.65	410.99				
3		411.97	411.72				
4		430.66	428.71				
5		442.47	439.52				
6		435.97	435.24				
7		422.85	423.73				
F		463.38	464.69				

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-4-2

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-7-81	1907-1922	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	1-7-81	1907-1922	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-7-81	1925	G. Cobb	
Train Disassembly	1-7-81		J. Johnson	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN DC-43

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

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

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

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

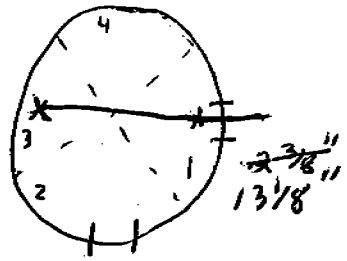
Date 1-8-81
Initial MDH

Velocity head at sampling location, in. H_2O	ΔPs	1.10
Stack temperature at sample point, °F	Ts	40
Barometric pressure, in. Hg	Pb	29.44
Static pressure in stack, in. Hg -7.65 (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	28.87
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 $\Delta P = 1.10$ $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	3,508
Calculated nozzle diameter, in. Fs = .20 $24\sqrt{\frac{Fs/Vs}{\pi}}$, where Fs = 0.5 to 0.75 ft^3/min	D_{n_c}	.102
Actual nozzle diameter, in.	D_{n_a}	.115
Assumed meter temperature, °F	Tm	40
Isokinetic sample rate, stack conditions, ft^3/min $Vs\ (0.00694)\ (\pi)\left(\frac{Dn_a}{2}\right)^2$	Fs	.20
Calculated meter flow rate, ft^3/min Fs = .20 $Fs\left(\frac{Tm+460}{Ts+460}\right)\left(\frac{Ps}{Pb}\right)(Mf)$	Fm	.194

[redacted] FIELD DATA - ANDERSEN [redacted] .502 cu ft/3 [redacted]

PLANT Pfizer
DATE 1-8-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Particle size
RUN NUMBER DC-43
OPERATOR M. Hansen
AMBIENT TEMPERATURE 10°F
BAROMETRIC PRESSURE 29.44
STATIC PRESSURE, (P_s) -7.65
Filter Set 62

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



SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired) .194 (.0485/15sec.)
Probe Tip Diameter .115
CO_2 0
O_2 21
CO 0
N_2 79
% H_2O 1.0, Assumed

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	1656	343.60										
DC-43	3	1659	344.18	344.17	1.10	.13	.14	40	46	40	2.5	NA	NA
	6	1702	344.76	344.84			.15		46	39	2.5		
	9	1705	345.35	345.50			.15		46	39	2.5		
	12	1708	345.93	346.20			.17		47	39	2.5		
	15	1711	346.51	346.92			.17		48	40	2.5		
			V_m = 3.32			ΔH =	.156		T_m =	43.0			

COMMENTS: No. 7 Kiln is down.

EPA (Dur) 235

C-5-2-87

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 1-8-81
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}	40
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ $\Delta H = .156$, $Pb = 29.44$, $Vm = 3.32$, $Tm = 43.0$	Vm_{std}	3.43
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	28.87
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{PsxMs}}$ $\Delta P = 1.10$	Vs	3,508
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (40 + 460)(3.43)}{(3508)(15)(28.87)(.99)(.115^2)}$	% I	89.59

ANDERSEN PARTICLE SIZE ANALYSIS

Test No. DC-43
Date 1-8-81
Time
Location Dust Collector

Final Weights
By SMALL Date 1-11-81
Location

Tare Weights
By DENT Date 12-4-80
Location

PRES 637.30 507.51

Stage No.	62 Filter No.	Final wt (mg)	Tare wt (mg)	Sample wt (mg)a/	% of total wtc/	Cumulative % of total wtc/	Dp μ
0		452.18	450.02				
1		436.49	435.18				
2		451.63	449.85				
3		440.08	437.39				
4		452.07	447.64				
5		438.95	432.50				
6		454.20	449.77				
7		453.12	450.99				
F		490.99	570.99				
		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-43

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-8-81	1656-1711	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	1-8-81	1656-1711	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-8-81	1715	G. Cobb	
Train Disassembly	1-8-81	1735	J. Johnson	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

MIDWEST RESEARCH INSTITUTE

Particle Sizing - Andersen

RUN DC-4-4

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

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

MRI - Form PO (10/72)

ANDERSEN SAMPLING CALCULATIONS

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

Date 1-8-81
Initial MDH

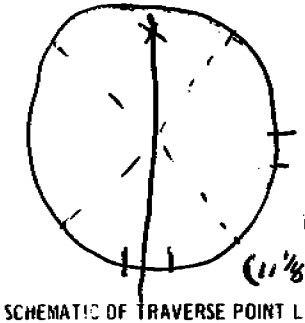
Velocity head at sampling location, in. H_2O	ΔPs	1.17
Stack temperature at sample point, °F	Ts	29
Barometric pressure, in. Hg	Pb	29.49
Static pressure in stack, in. Hg -7.65 (Pb) ± (0.074 x gage pressure, in. H_2O)	Ps	28.92
Percent moisture in gas stream by volume	% H_2O	1.0
Mole fraction, dry gas $\frac{100 - \% H_2O}{100}$	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 $\Delta P = 1.17$ $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps}\right)\sqrt{\frac{Ts + 460}{Ps \times Ms}}$	Vs	3,575
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}	.099
Actual nozzle diameter, in.	D_{n_a}	.115
Assumed meter temperature, °F	Tm	30
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	~~.184~~ .185

.555 cu.ft/3 min.

FIELD DATA - ANDERSEN

PLANT Pfizer
DATE 1-8-81
SAMPLING LOCATION Dust Collector
SAMPLE TYPE Particulate
RUN NUMBER DC-4-4
OPERATOR M. Hansen
AMBIENT TEMPERATURE -5°F
BAROMETRIC PRESSURE 29.49
STATIC PRESSURE, (P_s) -7.65
Filter Set 67

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



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

SCHEMATIC OF TRAVERSE POINT LAYOUT with Dimensions

Calculated ACFM (desired)	.185 (.0046/1 sec.)
Probe Tip Diameter	.115
CO_2	0
O_2	21
CO	0
N_2	79
% H_2O	1.0 assumed

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3 319.60 Desired	Actual	VELOCITY HEAD (ΔP_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
DC-4-4	0	1121											
	3	1124	320.16	320.18	1.17	.12	.13	29	38	32	3.0	NA	NA
	6	1127	320.71	320.82			.14		37	32	3.0		
	9	1130	321.27	321.45			.14		37	31	3.0		
	12	1133	321.82	322.08			.13		37	31	3.0		
	15	1136	322.38	322.71			.13		37	31	3.0		
			V_m=3.11										
						ΔH=	.134		T_m=	34.3			

COMMENTS:

EPA (Dun 235

C-5-2-93

ISOKINETIC PERFORMANCE WORKSHEET

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

Date 1-8-81
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}	29
Meter volume (std), $\frac{17.64(Vm)\left(Pb+\frac{\Delta H_{avg}}{13.6}\right)}{Tm+460}$ ΔH = .134, Pb = 29.49, Vm = 3.11, Tm = 34.3	Vm_{std}	3.27
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	28.92
Stack velocity, fpm $5{,}128.8\ (Cp)\left(\sqrt{\Delta Ps_{avg}}\right)\sqrt{\frac{Ts+460}{Ps \times Ms}}$ ΔP = 1.17	Vs	3,575
Total sample time, minutes	θ	15
Nozzle diameter, inches	Dn	.115
$\frac{1{,}039\ (29 + 460)(3.27)}{(3{,}575)(15)(.99)(.99)(.115^2)}$	% I	81.82

28.92

ANDERSEN PARTICLE SIZE ANALYSIS

Test No. DC-4-4
Date 1-8-81
Time
Location Dust Collector

Final Weights
By SMALL Date 1-10-81
Location

Tare Weights
By DW Date 1-6-81
Location

PRES 642.18 502.76

Stage No.	Filter No. 67	Final wt (mg)	Tare wt (mg)	Sample wt (mg) a/	% of total wt c/	Cumulative % of total wt c/	Dp μ
0		429.50	425.48				
1		414.79	413.64				
2		427.47	425.82				
3		407.12	405.29				
4		420.51	417.44				
5		412.01	407.41				
6		423.12	420.11				
7		404.63	403.41				
F		470.72	471.60				

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 Collecter

Test Run Number DC-4-4

Pollutant(s) in Sample Particulate

Task	Date	Time	Personnel	Remarks
Sampling	1-8-81	1121-1136	M. Hansen	
Probe Technician	—	—	—	
Meter Technician	+ 1-8-81	1121-1136	M. Hansen	
Other	—	—	—	
Transport of Train to Cleanup Site	1-8-81	1140	M. Hansen	
Train Disassembly	1-8-81		J. Johnson	
Train Cleanout				
Packing and Storage				
Shipment to Analysis Site				
Lab Analysis				ON SITE
Write Up				

C-6 Product Loading