AP-42 Section Number: 9.9.4

Reference Number: 12

Title: Stack Particulate Samples Collected at Verhoff Alfalfa, Hoytville, OH

Affiliated Environmental Systems, Inc.

Affiliated Environmental Systems, Inc.

September 1992

AP-42 Section 9.9.4
Reference 12
Report Sect.
Reference

affiliated Environmental services, inc.

Verhoff Alfalfa
Attn: Mr. Don Verhoff
P.O. Box 87
Ottawa, OH 45875

REPORT TO VERHOFF ALFALFA

ON

STACK PARTICULATE SAMPLES
COLLECTED AT
HOYTVILLE, OH

SUBMITTED BY

AFFILIATED ENVIRONMENTAL SERVICES, INC.
3606 VENICE RD.
SANDUSKY, OH 44870

DATE OF TESTING: 9-18-92

DATE OF REPORT: 9-25-92

Joe Gillingham
FIELD TEST SUPERVISOR

Don Dauch
MANAGER, AIR SAMPLING DIVISION

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Don Verhoff - office
(419) 523-4767

INTRODUCTION

This report contains the results of stack particulate and NO_x emission testing performed by Affiliated Environmental Services, Inc. for Verhoff Alfalfa Mills, Inc. Hoytville, OH. Testing was performed on 9/8-18-92 on the outlet stack. Hay from hoppers, is fed into a drum and is dried. The air from the drum is then drawn through a cyclone and exhausted out a 42" inch diameter stack.

Waste wood

Fuel ?

Single-pass dryer ? yes

DESCRIPTION OF TEST

All tests were performed in accordance with EPA methods 1,2,3,4, and 5 as described in the federal register. A 20 point sampling set was selected due to the port locations. Each point was sampled for 3 minutes for a total time of a 60 minute test. The equipment used for testing consisted of a Fyrite Gas Analyzer and a RAC Stack Train Sampler (EPA type). A RAC type "S" pitot and heated stainless steel sampling probe was used with the sampling train. All equipment was calibrated in the lab prior to the test. The calculations for the stack sampling parameters were performed on a computer. A description of the method 1-5 test follows on the next few pages. NO_x samples were collected and analyzed per EPA Method 7.

METHOD 1

Sample and Velocity Traverses for Stationary Sources.

The location of the sampling site and traverse points are determined based on stack diameters and length of the stack.

METHOD 2

Determination of Stack Gas Velocity and Volumetric Flow Rate.

Velocities are measured with a type "S" pitot tube. Temperatures are measured with thermocouples.

METHOD 3

Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight.

A gas sample is extracted by using a bag simultaneously with the particulate tests. Analyses are performed using an Orsat and/or Fyrite Analyzer.

METHOD 4

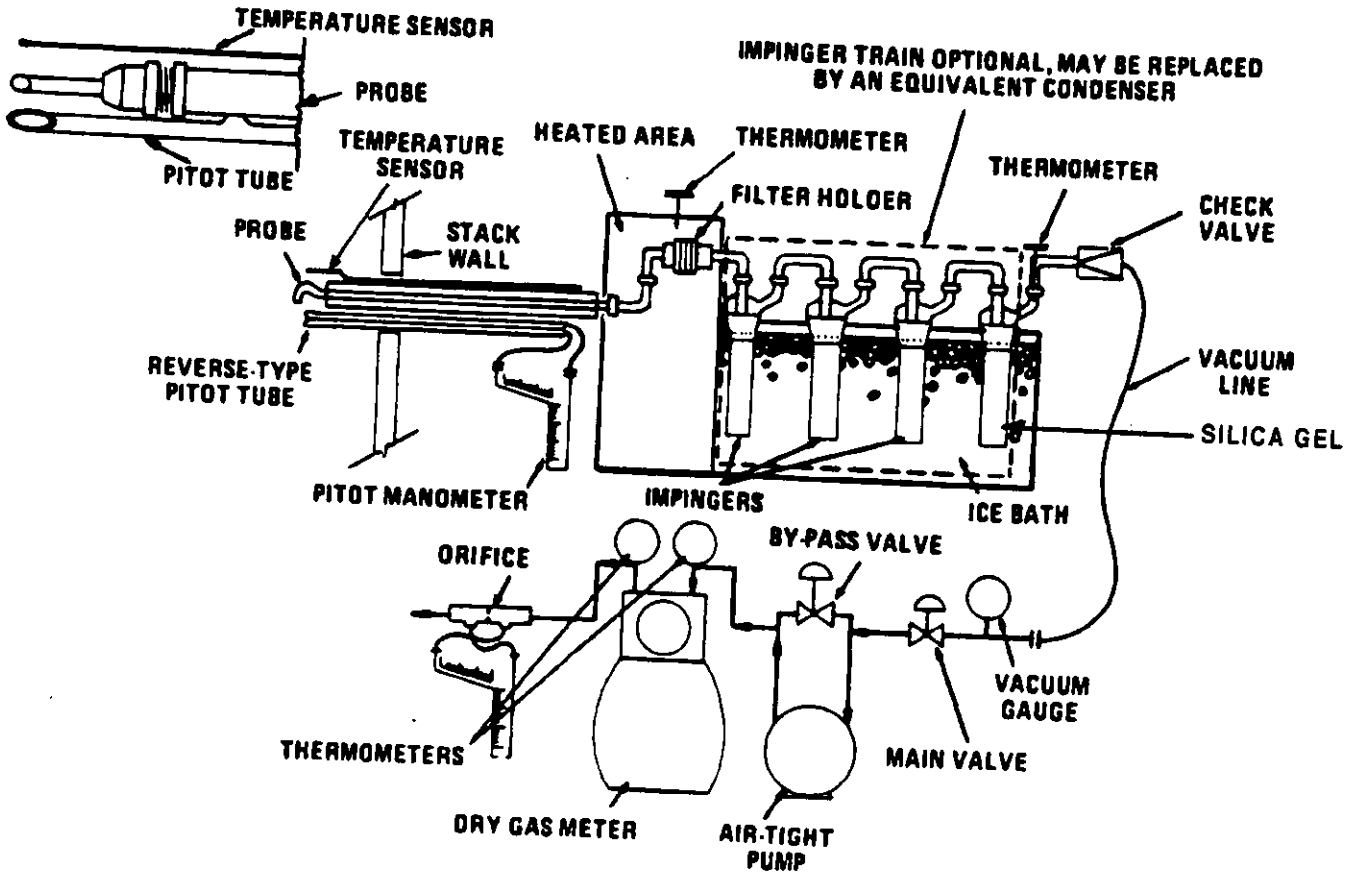
Determination of Moisture Content.

A gas sample is extracted at a constant rate from the source. Moisture is deter - mined either volumetrically or gravimetrically.

METHOD 5

Determination of Particulate Emissions from Stationary Sources.

Particulate matter is withdrawn isokinetically from the source and collected on a glass fiber filter maintained at 248 ± 25° F. A schematic of the sampling train is shown in Figure 1.



Particulate-sampling train.

Figure # 1

STACK PARTICULATE DATA AND NO_X DATA SUMMARY

Test No.	gr/dscf(A)	x1-$^{-6}$ lbs/dscf(B)	lbs/hr	NO_x lbs/hr
1	0.0568	8.1368	14.66	<0.29
2	0.0667	9.5456	17.23	<0.27
3	0.0813	11.6454	21.04	<0.27

(A) = Grains per dry standard cubic feet at 68°F and 29.92 inches Hg

(B) = Pounds per dry standard cubic feet at 68°F and 29.92 inches Hg

STACK GAS DATA SUMMARY

Test No.	Flow Rate(A)	Temp. °F	Moisture %	CO_2 %	O_2 %	CO ppm
1	30,022	194	11.7	0.0	21.0	182
2	30,084	195	11.4	0.0	21.0	176
3	30,112	195	11.3	0.0	21.0	215

(A) = Dry standard cubic feet per minute at 68°F and 29.92 inches Hg

Test No.	CO lb/hr
1	23.4
2	22.7
3	27.8

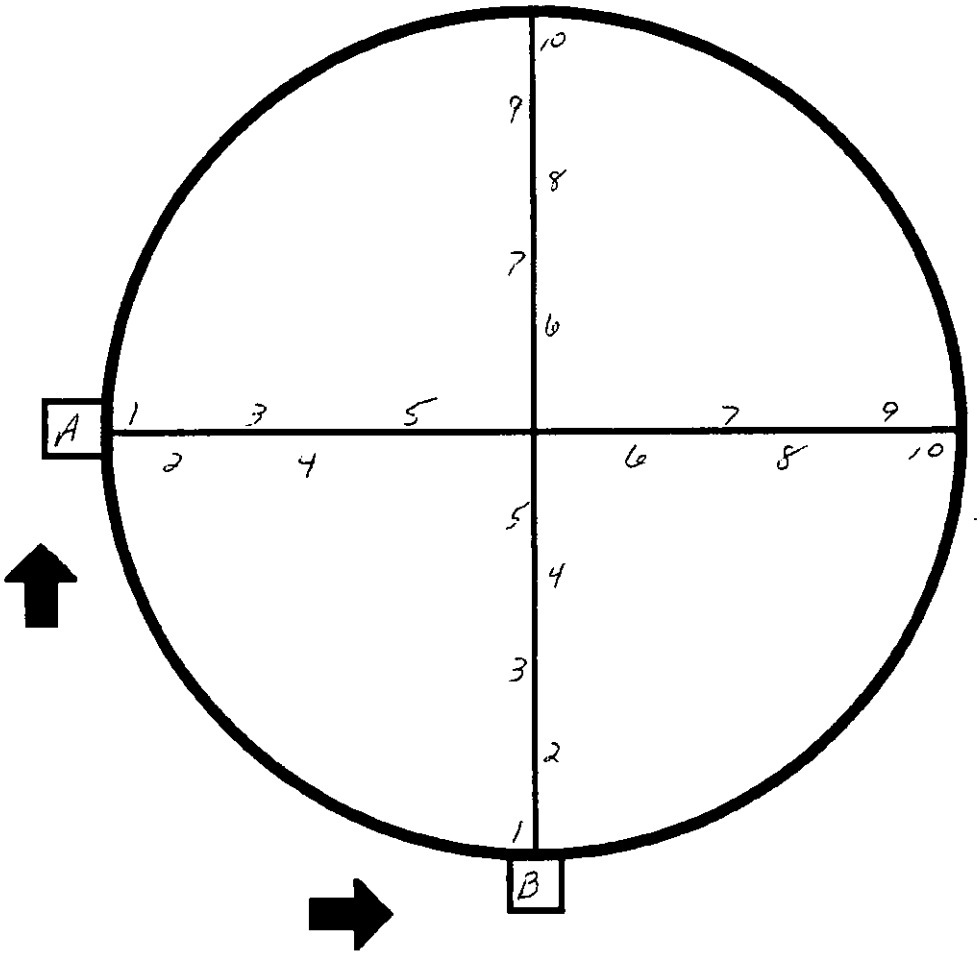
81,536 PER YEAR 52 WK

LOCATION OF SAMPLING POINTS DURING PARTICULATE EMISSIONS TESTING

Distance A= 3 diameters

42" diameter stack

Distance B= 3 diameters



Sample Point #	Distance from Inside of Stack Wall (inches)	Sample Point #	Distance from Inside of Stack Wall (inches)
1	1.1"	6	27.6"
2	3.4"	7	32.5"
3	6.1"	8	35.9"
4	9.5"	9	38.6"
5	14.4"	10	41.0"

QUALITY CONTROL/QUALITY ASSURANCE

All equipment was fully calibrated at our laboratory prior to the test. The sampling nozzles were measured using a vernier caliper. The pitots were measured for proper alignment and dimensions. All thermometers and thermocouples were calibrated against ASTM glass thermometers. The RAC base units are checked in the field by comparison of a 10 minute run at 0.75 cfm (ΔH) to dry gas meter integration and single point check against critical orifice. Blank solutions (acetone, distilled water) are taken and analyzed at the laboratory to see if they are within specifications. A chain of custody was maintained by the field supervisor from the start of the test program to its completion. When the samples were returned to the laboratory they were placed under the control of the laboratory supervisor until analysis is completed.

FORMULAS USED IN CALCULATIONS

Gas Volume Sampled - Standard cubic feet = Vmc

$$17.64 \times (Vm) \times (Y) \times \left(\frac{Pbar + \frac{\Delta H}{13.6}}{Tm} \right)$$

Volume of Water Vapor - Standard cubic feet =Vwc

$$Vlc \times \left(\frac{PH20}{MH20} \right) \times \left(\frac{RTstd}{Pstd} \right) = (0.0471\ ft/ml) \times Vlc$$

Stack Moisture Content - Bws

$$Bws = \frac{Vwc}{Vwc + Vmc}$$

Dry Molecular Weight - Md

$$Md = 0.44 \times (\%CO2) + 0.32 \times (\%02) + 0.28 \times (\%CO+N2)$$

Stack Gas Molecular Weight - Ms

$$Ms = 18 \times (Bws) + Md \times (1-Bws)$$

Average Stack Velocity - Vs

$$Vs = 85.48 \times (Cp) \times (\sqrt{\Delta P}) \times \sqrt{\frac{Ts + 460}{Ps \times Ms}}$$

Stack Gas Volumetric Flow Rate - SCFH

$$3600 \times (1-Bws) \times Vs \times A \times \left(\frac{Tstd}{Ts} \right) \times \left(\frac{Ps}{Pstd} \right)$$

Isokinicity %

$$\frac{TS \times (1.667) \times (Vwc + Vmc)}{(min.) \times (17.64) \times Ps \times Vs \times Atip}$$

Stack Particulate Concentration - Pounds/hour

$$2.205 \times 10^{-6} \left(\frac{Mn}{Vm\ std} \right) \times SCFH$$

Grains/standard cu ft

$$0.0154 \left(\frac{Mn}{Vm\ std} \right)$$

Y = Calibration factor of sampling train

Pbar = Barometric pressure

R Tstd = 460 + 68 = 528

Pstd = 29.92 in Hg

Cp = Pitot tube coefficient

Ps = Stack static pressure + Pbar

A = Area of stack - sq ft

min = Minutes of test

Atip = Area of sampling nozzle sq ft

Mn = Weight gain of filter + probe wash

Vlc = Volume of liquid and silica collected

PLANT NAME: VERHOFF ALFALFA

SOURCE I.D.: outlet (Hoytville) DATE: 9-18-92

STACK PARTICULATE SAMPLE LABORATORY DATA SHEET

Run # 1 Lab Analysis by: Joe Dillinghorn

Date: 9-23-92

	FINAL WEIGHT mg	INITIAL WEIGHT mg	NET WEIGHT GAIN mg
Filter	727.3	635.4	91.9
Probe wash	106801.3	106762.2	39.1
Impingers	105543.8	105478.4	65.4

SILICA	IMPINGER
Final Weight = 555	Final Volume = 295
Initial Weight = 550	Initial Volume = 200
Total Gain +5	Total Gain +95

Total gain mg	196.4
Filter & Wash mg	131.0
- Acetone blank mg	- .15
Net Particulate Weight mg	130.85

Net particulate weight refers to the filter and wash minus the acetone blank.

PLANT NAME: Verhoff Alfalfa

SOURCE I.D.: outlet (Hoytville) DATE: 9-18-92

STACK PARTICULATE SAMPLE LABORATORY DATA SHEET

Run # 2 Lab Analysis by: Joe Gillingham

Date: 9-23-92

	FINAL WEIGHT mg	INITIAL WEIGHT mg	NET WEIGHT GAIN mg
Filter	738.6	632.2	106.4
Probe wash	104500.5	104452.6	47.9
Impingers	101703.5	101583.9	119.6

SILICA	IMPINGER
Final Weight = 555	Final Volume = 292
Initial Weight = 550	Initial Volume = 200
Total Gain +5	Total Gain +92

Total gain mg	273.9
Filter & Wash mg	154.3
- Acetone blank mg	-.15
Net Particulate Weight mg	154.15

Net particulate weight refers to the filter and wash minus the acetone blank.

PLANT NAME: VERHOLT ALFALFA

SOURCE I.D.: outlet (Hoytville) DATE: 9-18-92

STACK PARTICULATE SAMPLE LABORATORY DATA SHEET

Run # 3 Lab Analysis by: Joe Gillingham

Date: 9-23-92

	FINAL WEIGHT mg	INITIAL WEIGHT mg	NET WEIGHT GAIN mg
Filter	728.8	633.4	95.4
Probe wash	107943.0	107851.3	91.7
Impingers	107963.1	107838.6	124.5

SILICA	IMPINGER
Final Weight = 555	Final Volume = 291
Initial Weight = 550	Initial Volume = 200
Total Gain +5	Total Gain +91

Total gain mg	311.6
Filter & Wash mg	187.1
- Acetone blank mg	- .15
Net Particulate Weight mg	186.95

Net particulate weight refers to the filter and wash minus the acetone blank.

AFFILIATED ENVIRONMENTAL SERVICES, INC.
3606 VENICE RD.
SANDUSKY, OHIO 44870

PLANT NAME: Verhoff Alfalfa

DATE OF TEST: 9-18-92

STACK SAMPLING PARAMETERS

TEST RUN NUMBER 1

MINUTES OF TEST	60
VOLUME OF GAS COLLECTED cubic feet	37.988
METER CALIBRATION FACTOR Y	.99
BAROMETRIC PRESSURE	29.95
PRESSURE DIFFERENTIAL ACROSS ORIFICE DELTA H	1.21
METER TEMPERATURE (+460)	562
STACK STATIC PRESSURE (HG)	.0294
STACK TEMPERATURE (+460)	654
AVERAGE SQUARE ROOT OF VELOCITY HEAD	1.14
VOLUME OF IMPINGER WATER COLLECTED ml	95
WEIGHT OF SILICA COLLECTED gms	5
AREA OF SAMPLING NOZZLE square feet	.0001917
PITOT TUBE COEFFICIENT	.84
AREA OF STACK square feet	9.621
CARBON DIOXIDE (DRY FRACTION)	0
CARBON MONOXIDE (DRY FRACTION)	0
OXYGEN (DRY FRACTION)	21
NITROGEN (DRY FRACTION)	79

STACK PARTICULATE DATA

GAS VOLUME STANDARD CONDITIONS DSCF	35.459
VOLUME OF WATER VAPOR cubic feet	4.71
PERCENT MOISTURE IN STACK GAS	11.7
DRY GAS MOLECULAR WEIGHT	28.84
STACK GAS MOLECULAR WEIGHT	27.572
VELOCITY OF STACK GAS feet per second	72.81
FLOW RATE OF STACK GAS DSCFH	1801325
FLOW RATE OF STACK GAS DSCFM	30022
ISOKINICITY %	98.9
WEIGHT GAIN OF IMPINGERS mg	65.4
WEIGHT GAIN OF FILTER mg	91.9
WEIGHT GAIN OF PROBE WASH mg	39.1
PARTICULATES COLLECTED POUNDS/HOUR	14.66
PARTICULATES COLLECTED GRAINS/DSCF	.0568
PARTICULATES COLLECTED POUNDS/DSCF	8.1368E-06

AFFILIATED ENVIRONMENTAL SERVICES, INC.
3606 VENICE RD.
SANDUSKY, OHIO 44870

PLANT NAME: Verhoff Alfalfa

DATE OF TEST: 9-18-92

STACK SAMPLING PARAMETERS

TEST RUN NUMBER 2

MINUTES OF TEST	60
VOLUME OF GAS COLLECTED cubic feet	38.555
METER CALIBRATION FACTOR Y	.99
BAROMETRIC PRESSURE	29.95
PRESSURE DIFFERENTIAL ACROSS ORIFICE DELTA H	1.21
METER TEMPERATURE (+460)	568
STACK STATIC PRESSURE (HG)	.0294
STACK TEMPERATURE (+460)	655
AVERAGE SQUARE ROOT OF VELOCITY HEAD	1.14
VOLUME OF IMPINGER WATER COLLECTED ml	92
WEIGHT OF SILICA COLLECTED gms	5
AREA OF SAMPLING NOZZLE square feet	.0001907
PITOT TUBE COEFFICIENT	.84
AREA OF STACK square feet	9.621
CARBON DIOXIDE (DRY FRACTION)	0
CARBON MONOXIDE (DRY FRACTION)	0
OXYGEN (DRY FRACTION)	21
NITROGEN (DRY FRACTION)	79

STACK PARTICULATE DATA

GAS VOLUME STANDARD CONDITIONS DSCF	35.608
VOLUME OF WATER VAPOR cubic feet	4.569
PERCENT MOISTURE IN STACK GAS	11.4
DRY GAS MOLECULAR WEIGHT	28.84
STACK GAS MOLECULAR WEIGHT	27.604
VELOCITY OF STACK GAS feet per second	72.824
FLOW RATE OF STACK GAS DSCFH	1805032
FLOW RATE OF STACK GAS DSCFM	30084
ISOKINICITY %	99.6
WEIGHT GAIN OF IMPINGERS mg	119.6
WEIGHT GAIN OF FILTER mg	106.4
WEIGHT GAIN OF PROBE WASH mg	47.9
PARTICULATES COLLECTED POUNDS/HOUR	17.23
PARTICULATES COLLECTED GRAINS/DSCF	.0667
PARTICULATES COLLECTED POUNDS/DSCF	9.5456E-06

AFFILIATED ENVIRONMENTAL SERVICES, INC.
3606 VENICE RD.
SANDUSKY, OHIO 44870

PLANT NAME: Verhoff Alfalfa

DATE OF TEST: 9-18-92

STACK SAMPLING PARAMETERS

TEST RUN NUMBER 3

MINUTES OF TEST	60
VOLUME OF GAS COLLECTED cubic feet	38.531
METER CALIBRATION FACTOR Y	.99
BAROMETRIC PRESSURE	29.95
PRESSURE DIFFERENTIAL ACROSS ORIFICE DELTA H	1.2
METER TEMPERATURE (+460)	571
STACK STATIC PRESSURE (HG)	.0294
STACK TEMPERATURE (+460)	655
AVERAGE SQUARE ROOT OF VELOCITY HEAD	1.14
VOLUME OF IMPINGER WATER COLLECTED ml	91
WEIGHT OF SILICA COLLECTED gms	5
AREA OF SAMPLING NOZZLE square feet	.0001907
PITOT TUBE COEFFICIENT	.84
AREA OF STACK square feet	9.621
CARBON DIOXIDE (DRY FRACTION)	0
CARBON MONOXIDE (DRY FRACTION)	0
OXYGEN (DRY FRACTION)	21
NITROGEN (DRY FRACTION)	79

STACK PARTICULATE DATA

GAS VOLUME STANDARD CONDITIONS DSCF	35.398
VOLUME OF WATER VAPOR cubic feet	4.522
PERCENT MOISTURE IN STACK GAS	11.3
DRY GAS MOLECULAR WEIGHT	28.84
STACK GAS MOLECULAR WEIGHT	27.615
VELOCITY OF STACK GAS feet per second	72.809
FLOW RATE OF STACK GAS DSCFH	1806697
FLOW RATE OF STACK GAS DSCFM	30112
ISOKINICITY %	98.9
WEIGHT GAIN OF IMPINGERS mg	124.5
WEIGHT GAIN OF FILTER mg	95.4
WEIGHT GAIN OF PROBE WASH mg	91.7
PARTICULATES COLLECTED POUNDS/HOUR	21.04
PARTICULATES COLLECTED GRAINS/DSCF	.0813
PARTICULATES COLLECTED POUNDS/DSCF	1.16454E-05

A.E. SERVICES, INC.

PARTICULATE SAMPLE DATA SHEET
(Me 1 5)

Location: VERHOFT ALFALFA
Stack: outlet
Operator: JOE Gillingham
Date: 9-18-92
Run Number: 1
Pitot Tube Coeff.: .84 I#
Area of Stack: 42" AREA = 9.621

Ambient Temp.: 63°
Barometric Pres.: 29.95
Assumed Moisture %: 15%
Heater Box Setting: 248
Probe Length & No.: 5'SS I#
Nozzle Diameter & No.: 3/16 .1875 I# AREA .0009817
Probe Heater Setting: 248

Avg. Fyrite Analysis: 0.0 % CO_2 = 0 % O_2

Additional Information:

START: A 9:43 - 10:13

STOP: B 10:16 - 10:46

Base Unit # 2 Y = .99

STATIC PRESSURE "H2O (Ps) +.40 = "Hg. .0294

LEAK CHECK "Hg Initial .006 At 8" Final .004 At 2"

PITOT LEAK CHECK Initial OK Final OK

10 MIN. CHECK Final Initial

Witnessed by

Pt. #	Time Min.	Stack temp f	ΔP	√ΔP	ΔH	Gas Sample Volume ft	Dry gas temp. inlet °f	Dry gas temp. outlet °f	Probe temp. °f	Box temp. °f	Vac. "Hg	Imp. gas temp. °f
A 1	0 - 3	194	1.00	1.00	.940	539.460	96	84	238	241	4.0	50
2	3 - 6	190	1.20	1.10	1.10	541.1	100	84	243	250	5.0	46
3	6 - 9	196	1.30	1.14	1.20	542.9	104	86	253	259	5.0	48
4	9 - 12	196	1.30	1.14	1.20	544.9	106	86	258	261	5.0	48
5	12 - 15	193	1.30	1.14	1.20	546.8	108	88	261	255	5.0	48
6	15 - 18	195	1.40	1.18	1.30	548.5	110	88	257	251	5.5	48
7	18 - 21	197	1.40	1.18	1.30	550.5	112	90	254	250	5.5	48
8	21 - 24	196	1.40	1.18	1.30	552.7	114	90	260	254	5.5	50
9	24 - 27	194	1.40	1.18	1.30	554.5	116	90	255	261	5.5	50
10	27 - 30	192	1.40	1.18	1.30	556.4	116	92	263	267	5.5	50
1B		194	1.10	1.05	1.00	558.4	110	94	253	264	4.5	50
2		194	1.20	1.10	1.10	560.1	112	94	260	253	5.0	52
3		197	1.30	1.14	1.20	561.9	114	94	254	261	5.5	52
4		194	1.30	1.14	1.20	564.3	116	96	250	260	5.5	52
5		195	1.40	1.18	1.30	565.6	116	96	250	260	6.0	52
6		190	1.30	1.14	1.20	567.6	118	96	260	257	6.0	54
7		192	1.30	1.14	1.20	569.6	118	96	251	255	6.0	54
8		196	1.40	1.18	1.30	571.5	120	98	247	249	6.5	54
9		194	1.40	1.18	1.30	573.9	120	98	245	252	6.5	54
10		194	1.40	1.18	1.30	575.5	120	100	245	250	6.5	56
						577.448						
total							avg.112	avg.92				
Avg.		194		1.14	1.21	37.988	Avg. 102	562				

(654)

A.E. SERVICES, INC.

PARTICULATE SAMPLE DATA SHEET
(Method 5)

Location: VERHOFF ALFALFA
Stack: outlet
Operator: JOE GILLINGHAM
Date: 9-18-92
Run Number: 2
Pitot Tube Coeff.: .84 I#
Area of Stack: 42" AREA = 9.621

Ambient Temp.: 65°
Barometric Pres.: 29.95
Assumed Moisture %: 15%
Heater Box Setting: 248
Probe Length & No.: 5'SS I#
Nozzle Diameter & No.: 3/16 .187 I# AREA .000190?
Probe Heater Setting: 24

Avg. Fyrite Analysis: 0.0 % CO_2 ≤ 0 % O_2

Additional Information:

START / STOP

A 10:58 - 11:28

B 11:30 - 12:00

Base Unit # 2 Y = .99

STATIC PRESSURE "H2O (Ps) 1.40 = "Hg. .0294

LEAK CHECK "Hg Initial .004 At 7" Final .003 At 5"

PITOT LEAK CHECK Initial ok Final ok

10 MIN. CHECK Final Initial

Witnessed by

Pt. #	Time Min.	Stack temp f	ΔP	√ΔP	ΔH	Gas Sample Volume ft	Dry gas temp. inlet °f	Dry gas temp. outlet °f	Probe temp. °f	Box temp. °f	Vac. "Hg	Imp. gas temp. °f
A1	0 3	194	1.10	1.00	1.00	527.694	102	96	230	240	3.0	50
2	3 6	195	1.30	1.14	1.20	579.4	106	98	235	242	3.5	50
3	6 9	197	1.30	1.14	1.20	581.3	110	98	240	243	3.5	52
4	9 12	196	1.40	1.18	1.30	583.4	112	98	249	251	4.0	52
5	12 15	194	1.40	1.18	1.30	585.3	114	98	253	260	4.0	54
6	15 18	194	1.20	1.10	1.10	587.3	116	98	255	263	3.5	54
7	18 21	195	1.30	1.14	1.20	589.0	118	98	250	260	3.5	54
8	21 24	198	1.30	1.14	1.30	591.0	118	98	252	265	3.5	56
9	24 27	196	1.40	1.18	1.30	592.9	120	100	261	260	4.0	56
10	27 30	196	1.40	1.18	1.30	594.9	120	100	255	253	4.0	56
1B		193	1.00	1.00	.940	597.0	110	98	262	249	3.5	58
2		196	1.30	1.10	1.10	598.6	114	100	260	250	3.5	58
3		196	1.30	1.14	1.20	600.5	116	100	263	259	4.0	58
4		195	1.30	1.14	1.20	602.4	116	100	260	253	4.0	58
5		193	1.40	1.18	1.30	604.4	118	100	255	250	4.5	58
6		195	1.30	1.14	1.20	606.3	118	100	260	253	4.5	58
7		194	1.40	1.18	1.30	608.3	120	100	250	243	4.5	60
8		197	1.40	1.18	1.30	611.3	120	100	243	249	4.5	60
9		199	1.40	1.18	1.30	612.2	120	100	253	252	4.5	60
10		195	1.40	1.18	1.30	614.2	122	102	260	255	4.5	60
						616.249						
							avg. 116	avg. 99				
total												
Avg.		195		1.14	1.21	38.555	Avg. 108	568				

(1655)

A.E. SERVICES, INC.

PARTICULATE SAMPLE DATA SHEET
(Me 5)

Location: VERHOFT AIFAIFA
Stack: outlet
Operator: JOE GILLINGHAM
Date: 9-18-92
Run Number: 3
Pitot Tube Coeff.: .84 I#
Area of Stack: 42" AREA = 2621

Ambient Temp.: 68°
Barometric Pres.: 29.95
Assumed Moisture %: 15%
Heater Box Setting: 248
Probe Length & No.: 5'SS I#
Nozzle Diameter & No.: 3/16 .187 I# AREA .0001907
Probe Heater Setting: 248

Avg. Fyrite Analysis: 0.0 % CO_2 @ 0 % O_2

Additional Information:

START: A 12:11 – 12:41
STOP: B 12:43 – 1:13

Base Unit # 2 Y=.99

STATIC PRESSURE "H2O (Ps) +.40 = "Hg. .0294

LEAK CHECK "Hg Initial .012 At 8" Final .009 At 6"

PITOT LEAK CHECK Initial OK Final OK

10 MIN. CHECK Final Initial

Witnessed by

Pt. #	Time Min.	Stack temp f	ΔP	√ΔP	ΔH	Gas Sample Volume ft	Dry gas temp. inlet °f	Dry gas temp. outlet °f	Probe temp. °f	Box temp. °f	Vac. "Hg	Imp. gas temp. °f
A1	0 – 3	193	1.10	1.05	1.00	616.589	106	100	240	251	3.0	54
2	3 – 6	194	1.20	1.10	1.10	618.3	110	100	243	255	3.5	54
3	6 – 9	196	1.30	1.14	1.20	620.2	112	100	249	257	4.0	54
4	9 – 12	198	1.30	1.14	1.20	622.1	116	100	252	259	4.0	54
5	12 – 15	197	1.30	1.14	1.20	624.1	118	102	257	261	4.0	54
6	15 – 18	195	1.40	1.18	1.30	626.0	120	102	261	263	4.0	56
7	18 – 21	193	1.30	1.14	1.20	628.0	120	102	266	265	4.0	56
8	21 – 24	193	1.30	1.14	1.20	630.0	122	102	250	260	4.0	56
9	24 – 27	196	1.30	1.14	1.20	631.9	122	102	247	260	4.0	56
10	27 – 30	195	1.40	1.18	1.30	633.9	122	104	251	251	4.0	56
1B		192	1.10	1.05	1.00	635.9	114	102	261	253	3.5	56
2		194	1.30	1.14	1.20	637.7	118	102	262	254	4.0	56
3		196	1.40	1.18	1.30	639.6	120	102	257	255	4.5	58
4		198	1.40	1.18	1.30	641.5	120	104	259	261	4.5	58
5		197	1.40	1.18	1.30	643.5	120	104	262	267	4.5	58
6		195	1.30	1.14	1.20	645.4	122	104	250	260	4.5	58
7		193	1.30	1.14	1.20	647.4	122	104	250	250	4.0	60
8		194	1.30	1.14	1.20	649.4	122	104	247	240	4.0	60
9		196	1.30	1.14	1.20	651.3	122	104	245	245	4.0	60
10		196	1.30	1.14	1.20	653.1	122	104	250	255	4.0	60
						655.120						
total							avg.119	avg.102				
Avg.		195		1.14	1.20	38.531	Avg. 111	571				

(1055)

~ 3% loss in hammermill

VERHOFF ALFALFA
HOYTVILLE SEPT 18 1992

PRODUCT

#1 RUN SCALE READING FINISH
START 0 STOP 86 107# A Dump 9100# 9202 lbs (4.6 Tons) after pulled mill

WET HAY 10 SCOOPS OF HAY
2610# PER SCOOP

SAWDUST 3.5 SCOOP 1300# Scoop

#2 RUN
SCALE START 96 STOP 179 107" A PUMP 8988 lbs 4.49 Tons (4.5 Tons)

WET HAY 9.5 Scoops 2610 Per Scoop

SAW Dust 3.5 Scoops 1300# Per Scoop

#3 Run
START 185 STOP 272 107# A Pump 9309 lbs 4.65 Tons (4.7 Tons)

WET HAY 10 Scoops 2610 Per Scoop

SAW Dust 3½ Scoops 1300# Scoop

NOZZLE CALIBRATION DATA FORM

Date 9-18-92 Calibrated by Joe Tillman

Nozzle identification number	Nozzle Diameter[a]			ΔD,[b] mm (in.)	D_{avg}[c]
	D_1, mm (in.)	D_2, mm (in.)	D_3, mm (in.)		
A	.1875	.1875	.1875		.1875
B	.187	.188	.187		.187
C	.187	.187	.186		.187

where:

[a] $D_{1,2,3}$ = three different nozzles diameters, mm (in.); each diameter must be within (0.025 mm) 0.001 in.

[b] ΔD = maximum difference between any two diameters, mm (in.), $\Delta D \leq$ (0.10 mm) 0.004 in.

[c] D_{avg} = average of D_1, D_2, and D_3.

STANDARD SOLUTION AND CONTROL SAMPLE ANALYTICAL DATA FORM

Plant Verhoff Alfalfa Date 9-19-92

Analyst Don Dauck Optimum wavelength 410 nm

Blank used as reference? yes

Sample number	Sample, µg	Working solution	Control sample	Measured, absorbance, OD	Calculated absorbance,[a] OD	Absorbance comparison error,[b] %
A1	100	x		0.198	-	-
A2	200	x		0.425	-	-
A3	300	x		0.680	-	-
A4	400	x		0.910	-	-
S1	100		x			
S2	200		x			
S3	300		x			
						Avg[c]

$$K_c = 100 \left[\frac{A_1 + 2A_2 + 3A_3 + 4A_4}{A_1^2 + A_2^2 + A_3^2 + A_4^2} \right] = 446.$$

[a] Calculated absorbance: OD = (µg)/K_c i.e., S1 calculated absorbance = 100/K_c.

[b] Absorbance comparison errors:

$$\% = 100 \times \frac{\text{(measured absorbance, OD) - (calculated absorbance, OD)}}{\text{calculated absorbance, OD}}$$

[c] Average of absolute values.

(1)

NITROGEN OXIDE CALCULATION FORM
(English units)

flask #7

Sample Volume

V_f = 2060 ml, P_f = 29.00 in. Hg, T_f = 530 °R

P_i = 2.50 in. Hg, T_i = 527. °R

$V_{sc} = 17.64\ (V_f - 25)\ \left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right]$ = 1794 ml Equation 6.1

Total µg NO_2 Per Sample

K_c = 446., A = 0.005 OD, F = ---. Equation 6.2

$m = 2K_c\ AF$ = 4.46 µg of NO_2

Sample Concentration

$C = 6.243 \times 10^{-5} \left[\frac{m}{V_{sc}}\right]$ = 0.016 × 10^{-5} lb/dscf

= < 0.29 lb/Rq

Quality Assurance Handbook M7-6.1A

(2)

NITROGEN OXIDE CALCULATION FORM
(English units)

flask #5

Sample Volume

V_f = 2058 ml, P_f = 29.00 in. Hg, T_f = 530 °R

P_i = 2.40 in. Hg, T_i = 527. °R

$$V_{sc} = 17.64\ (V_f - 25)\left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right] = 1799 \text{ ml}$$ Equation 6.1

Total µg NO_2 Per Sample

K_c = 446., A = 0.005 OD, F = ____ Equation 6.2

$m = 2K_c\,AF$ = 4.46. µg of NO_2

Sample Concentration

$$C = 6.243 \times 10^{-5}\left[\frac{m}{V_{sc}}\right] = 0.015 \times 10^{-5} \text{ lb/dscf}$$

0.15×10^{-6} lb/dscf $\times\ 1.805032 \times 10^{6}$ dscf/hr

$= 0.27$ lb/hr

Quality Assurance Handbook M7-6.1A

(3)

NITROGEN OXIDE CALCULATION FORM
(English units)

flask #3

Sample Volume

V_f = 2055 ml, P_f = 29.00 in. Hg, T_f = 530 °R

P_i = 2.30 in. Hg, T_i = 527. °R

$$V_{sc} = 17.64\ (V_f - 25)\left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right] = 1803 \text{ ml}$$ Equation 6.1

Total µg NO_2 Per Sample

K_c = 446., A = ≤.005 OD, F = ____ Equation 6.2

m = $2K_c$ AF = ≤4.46. µg of NO_2

Sample Concentration

$$C = 6.243 \times 10^{-5}\left[\frac{m}{V_{sc}}\right] = \leq 0.015 \times 10^{-5} \text{ lb/dscf}$$

$< 0.15 \times 10^{-6}$ lb/dscf × 1.806697×10^{6} dscf/hr

= <0.27 lb/hr

Quality Assurance Handbook M7-6.1A

Date 9-14-92

Metering System Identification: #2

Barometric pressure, P_b = 30.26 in. H_g

Calibrated by: T. Lohr

Orifice manometer setting ΔH in. H_2O	Spirometer (wet meter) gas volume V_w ft^3	Dry gas meter volume V_m ft^3	Temperatures				Time θ min.
			Spirometer (wet meter) t_w °F	Dry Gas Meter			
				Inlet T_i °F	Outlet T_o °F	Average T_m °F	
.5	7.495	8.053	74	112	98	105	20
1.0	10.843	11.482	74	114	92	103	20
1.5	13.002	13.938	74	122	100	111	20
2.0	14.930	16.139	74	128	104	116	20

CALCULATIONS

ΔH in. H_2O	Y $\frac{V_w P_b (t_m + 460)}{V_m \left[P_b + \frac{\Delta H}{13.6}\right] (t_w + 460)}$	ΔHθ $\frac{0.0317\ \Delta H}{P_b (t_o + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
.5	Y = .98	ΔH = 1.91
1.0	Y = .99	ΔH = 1.84
1.5	Y = .99	ΔH = 1.89
2.0	Y = .99	ΔH = 1.90
Average	Y = .99	ΔH = 1.89

Y = Ratio of reading wet test meter to dry test meter; tolerance for individual values ± 0.02 from average.

ΔHθ = Orifice pressure differential that equates to 0.75 cfm of air ∂ 68°F and 29.92 inches of mercury, in. H_2O; tolerance for individual values ± 0.20 from average.

Figure 5.6. Example data sheet for calibration of metering system (English units).

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 9-9-92 Thermocouple number 5' SS

Ambient temperature 24 °C Barometric pressure 30.08 in. Hg

Calibrator D.R. Reference: mercury-in-glass ASTM

other

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[c] %
5A	Boiling water	99.9	99	0.2
			1	0.3
	Ice Bath	0.2		
5B			99	0.2
			2	0.7
5C			98	0.5
			1	0.3

[a] Every 30°C (50°F) for each reference point.

[b] Type of calibration system used.

[c] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%$.

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 9-9-92 Thermocouple number RAC Meter Boxes

Ambient temperature 24 °C Barometric pressure 30.08 in. Hg

Calibrator David Reference: mercury-in-glass _____

other _____

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[c] %
RAC #	Inlet	Outlet		
1	76	76		
2	74	75		
3	75	76		
4	76	74		
6	76	76		

[a] Every 30°C (50°F) for each reference point.

[b] Type of calibration system used.

[c] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%$.