AP-42 Section Number: 9.9.4

Reference Number: 13

Title: Emission Test Report For Toledo Alfalfa, Oregon, OH

Owens-Illinois Analytical Services

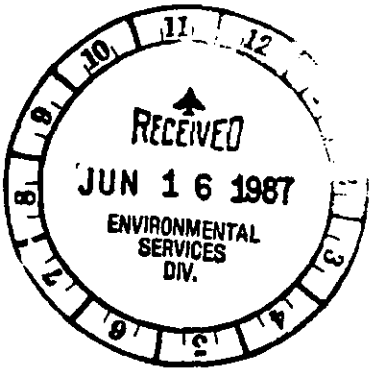
Owens-Illinois Analytical Services

June 1987

AP-42 Section 9.9.4
Reference 13
Report Sect.
Reference

TOLEDO ALFALFA
COAL FIRED DRYER

EMISSION TEST REPORT
MAY 26, 1987



DATE: June 4, 1987

PROJECT NO.: 03-8069-6254-003

PREPARED BY: Paul D. Sagert

PAUL D. SAGERT
OWENS-ILLINOIS ANALYTICAL SERVICES

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1. INTRODUCTION

1.1 PLANT LOCATION

Toledo Alfalfa Mills, Inc.
861 South Stadium Rd.
Oregon, OH 43616

1.2 SOURCE TESTED

Coal Fired Dryer
Ohio EPA Application 0448020004P001
Permit to Install 04-263

Triple-pass dryer

1.3 TEST DATE

May 26, 1987

1.4 TESTING ORGANIZATION

Owens-Illinois Analytical Services
Environmental Sampling Group
One SeaGate
Toledo, OH 43666
(419) 247-8928

1.5 SAMPLING PERSONNEL

Joseph O. Grau
Paul D. Sagert
Dennis Hiner
Richard Beiswenger

1.6 PURPOSE OF TEST

To document the particulate emissions as requested by Toledo Environmental Services.

1.7 POLLUTANTS MEASURED

Particulate

1.8 REFERENCE METHODS USED

USEPA Method 1 - Determination of sample points and cyclonic flow measurement.
USEPA Method 2 - Flue gas velocity measurements.
USEPA Method 3 - Flue gas molecular weight measurement.
USEPA Method 5 - Determination of particulate emissions.

1.9 OBSERVERS PRESENT

Linda Furlough - Toledo Environmental Services
Jeff Twaddle - Toledo Environmental Services

2. SUMMARY

2.1 EMISSIONS

A summary of the emission results is provided below. Additional information is found in Table 1.

Test No.	2	3	4	AVG.
Particulate (lbs/hr.)	28.8	35.7	34.3	32.9

2.2 PROCESS INFORMATION

A summary of the process data is provided below. The operation was running at capacity considering the moisture content of the alfalfa being processed.

~~13~~ 10 ~~14~~ % pellets (coal steam) ~ 8% moisture

Alfalfa Processed (dry) - 8,780 lbs/hr. — to hammermill
Coal Burned - 1,006 lbs/hr.

4.39 tons

NOTE: Test No. 1 was voided due to sampling error.

alfalfa into plant = 60% moisture

3. PROCESS DESCRIPTION

Toledo Alfalfa Mills dries alfalfa in a coal fired rotary dryer. The control equipment consists of the sulfur dioxide sorbant properties of the alfalfa in the drier and a cyclone for particulate removal.

4. SAMPLING AND ANALYTICAL PROCEDURES

4.1 SAMPLING LOCATION

The particulate reference method samples were taken in the cyclone exhaust stack. Cyclonic flow was present and was accounted for in the sampling and velocity measurements. A total of twenty-four (24) traverse points as prescribed in USEPA Method 1 were located on two perpendicular diameters of the stack. A schematic of the cyclone and traverse points can be found in Figure 1.

4.2 VELOCITY MEASUREMENTS

The velocity and angle of the flow were measured at each of the traverse points using an "S" type pitot tube. The procedures detailed in USEPA Methods 1 and 2 were followed. The differential pressures used to calculate the axial components of the flow were calculated by multiplying the measured differential pressures by the squares of the cosines of the angles of the flow with vertical.

4.3 PARTICULATE

4.3.1 Sampling

The Anderson Sampler, Model CU_2 train used is shown schematically in Figure 2. Particulate was collected on the filter and inside surfaces of the probe liner and nozzle. The probe was oriented at each of the traverse points so that the nozzle was pointing directly into the gas stream. The gas stream was sampled isokinetically at each traverse point for times proportional to the cosines of the angles to the flow with the axial direction. The total sampling time was approximately 60 minutes. The sampling train operating parameters monitored during each test are recorded on the field data sheets provided in Appendix 1.

4.3.2 Analytical

Moisture - The moisture was determined from the volume increase of the impingers and silica gel weight gain.

Particulate - The filters were oven dried at $105^{0}C$ for three hours and weighed to 0.1 mg. The acetone probe washes were evaporated at room temperature, dried, cooled, and weighed. The particulate collected was the sum of the weight increase of the filters and the probe wash residue. The Analytical report is provided in Appendix 2.

4.4 FLUE GAS ANALYSIS

The oxygen in the gas stream was measured with a Teledyne Model 320-P Oxygen Analyzer. Carbon dioxide was measured with a Fyrite combustion analyzer.

4.5 CALCULATIONS

The calculations were performed by computer using equations identical to those presented in the EPA reference methods. The printouts are included in Appendix 3. The input data for the velocity head pressure was modified to account for the cyclonic flow. Isokinetic calculations were performed by hand using the time weighed average velocity to account for the non-equal sampling times at the various sample points. These calculations can be found in Appendix 4.

5. SAMPLE HANDLING AND ASSURANCE PROCEDURES

5.1 CHAIN OF CUSTODY

Upon completion of the testing program, the emission samples were hand-carried by the test team to the Owens-Illinois Technical Center in Toledo, Ohio and submitted for subsequent analysis.

5.2 QUALITY ASSURANCE PROCEDURES

Owens-Illinois routinely uses standard methods and techniques combined with appropriate sample blanks in their analysis. Spiked samples are frequently used to insure the precision and accuracy of the analysis.

To further assure the quality of measured data, basic external quality controls, namely Q. A. audits are performed. Results from our most recent EPA Audits for NO_x, SO_2, CO_2, CO, and dry gas meter performance are illustrated in Figure 3.

The basic principles, as set forth in Volumes I, II, and III of the Quality Assurance Handbook prepared by the EPA quality Assurance Staff, are used as guidelines in all areas of our environmental testing.

6. PROCESS DATA AND TEST RESULTS

6.1 PROCESS INFORMATION

Process data recorded during the testing is provided on Table 1. There were no upsets or abnormal conditions reported during the testing periods.

6.2 TEST RESULTS

The particulate emissions reported are the total front half catch with the probe and filter maintained at a nominal 250^{0}F. The results are summarized on Table 1 with the detailed computer summaries provided in Appendix 3.

The initial test performed was voided due to improper probe orientation. The computer summary for this test is included in Appendix 3, however the results are not reported.

7. EQUIPMENT CALIBRATION

7.1 DRY GAS METER

The dry gas meter in pump box #1 was calibrated before and after the compliance tests. The volume correction factor (VCF) assigned to the meter is the average of these two calibrations.

Calibration consists of comparing the gas meter being calibrated to a wet test meter in series with the first meter. The wet test meter is calibrated semi-annually by using procedure ASTM D-1071, Section 19.

7.2 PITOT TUBE

The dimensions of pitot tube #22 were measured and are within the tolerances set forth in EPA Method 2 allowing the baseline coefficient of 0.84 to be used.

7.3 GRAVIMETRIC CHECK

Filter weighing was performed with a Mettler H43 balance (#99-28353) location in the Owens-Illinois North Technical Center Building, Toledo, Ohio. The balance is routinely checked by an outside instrument servicing company with NBS standard weights to assure consistent accuracy.

7.4 SAMPLE NOZZLE

The sample nozzle was measured at three equally spaced locations, using vernier calipers in accordance with Method 5. The measurements were recorded on the field data sheets.

All pertinent calibration data sheets are provided in Appendix 5.

TABLE 1
TOLEDO ALFALFA MILLS
PROCESS AND PARTICULATE
EMISSION SUMMARY - MAY 26, 1987

A.	GENERAL				
1.	Test No.	2	3	4	AVG
2.	Avg. Gas Temp (^{0}F)	224	224	224	224
3.	Avg. Gas Vel.(FPS)	51.9	51.8	51.7	51.8
4.	Avg. Gas Vol.(ACFM)	46,811	46,732	46,659	46,734
	(DSCFM)	28,842	28,644	29,309	28,932
5.	Isokinetic Sample Rate (%)	91	91	96	
B.	EMISSIONS				
	PARTICULATES				
	(gr/DSCF)	0.117	0.146	0.136	0.133
	(lbs./hr)	28.8	35.7	34.3	32.9
C.	FLUE GAS ANALYSIS				
1.	Moisture (%)	18.7	17.9	17.2	17.9
2.	Oxygen (%)	17.5	17.5	18	17.7
3.	Carbon Dioxide (%)	2.5	3.0	2.5	2.7
D.	PROCESS DATA				
1.	Alfalfa Processed (lbs./hr)	- 8,780 (dry)			
2.	Coal Usage (lbs./hr)	- 1,006			

NOTE: TEST NO. 1 WAS VOIDED DUE TO A SAMPLING ERROR.

FIGURE 1

CYCLONE SCHEMATIC AND

TRAVERSE POINTS

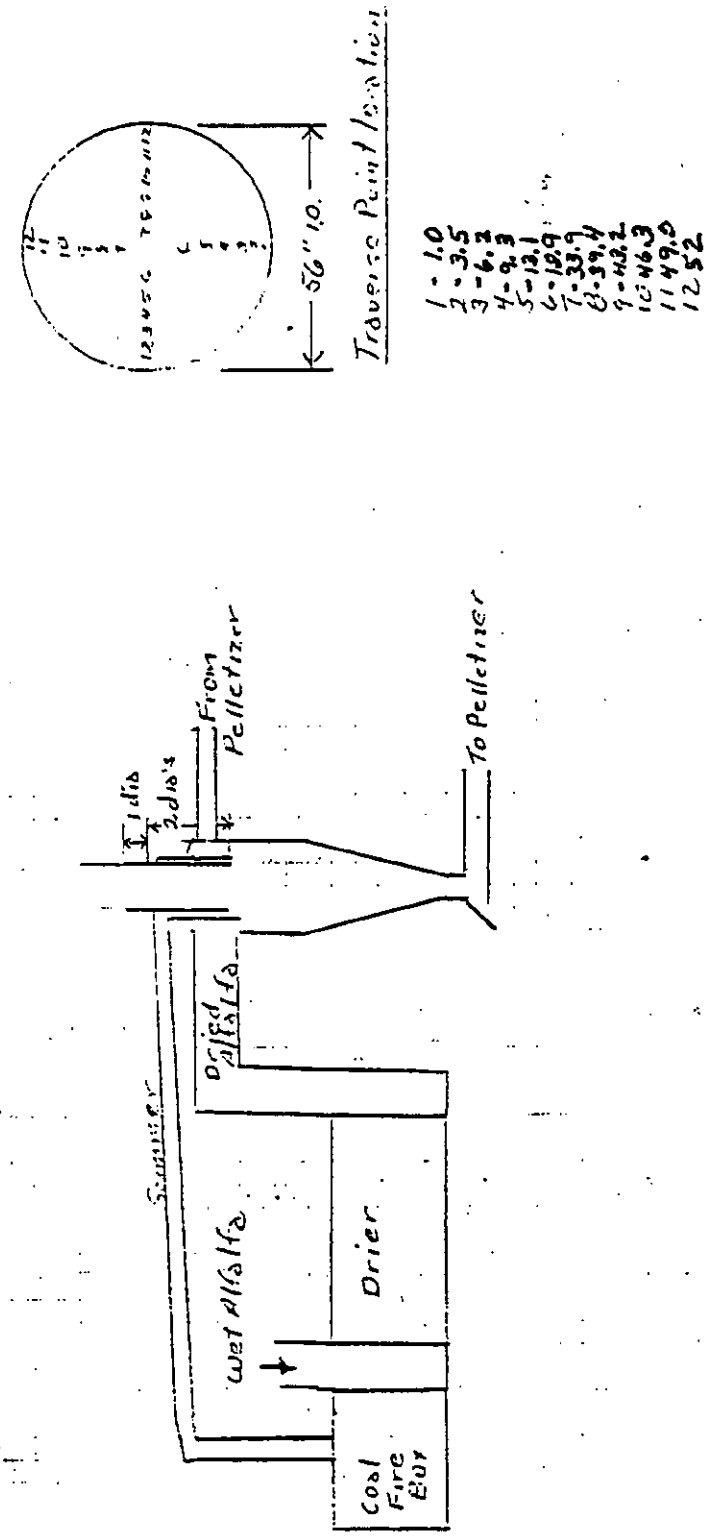


FIGURE 2

PARTICULATE SAMPLING TRAIN

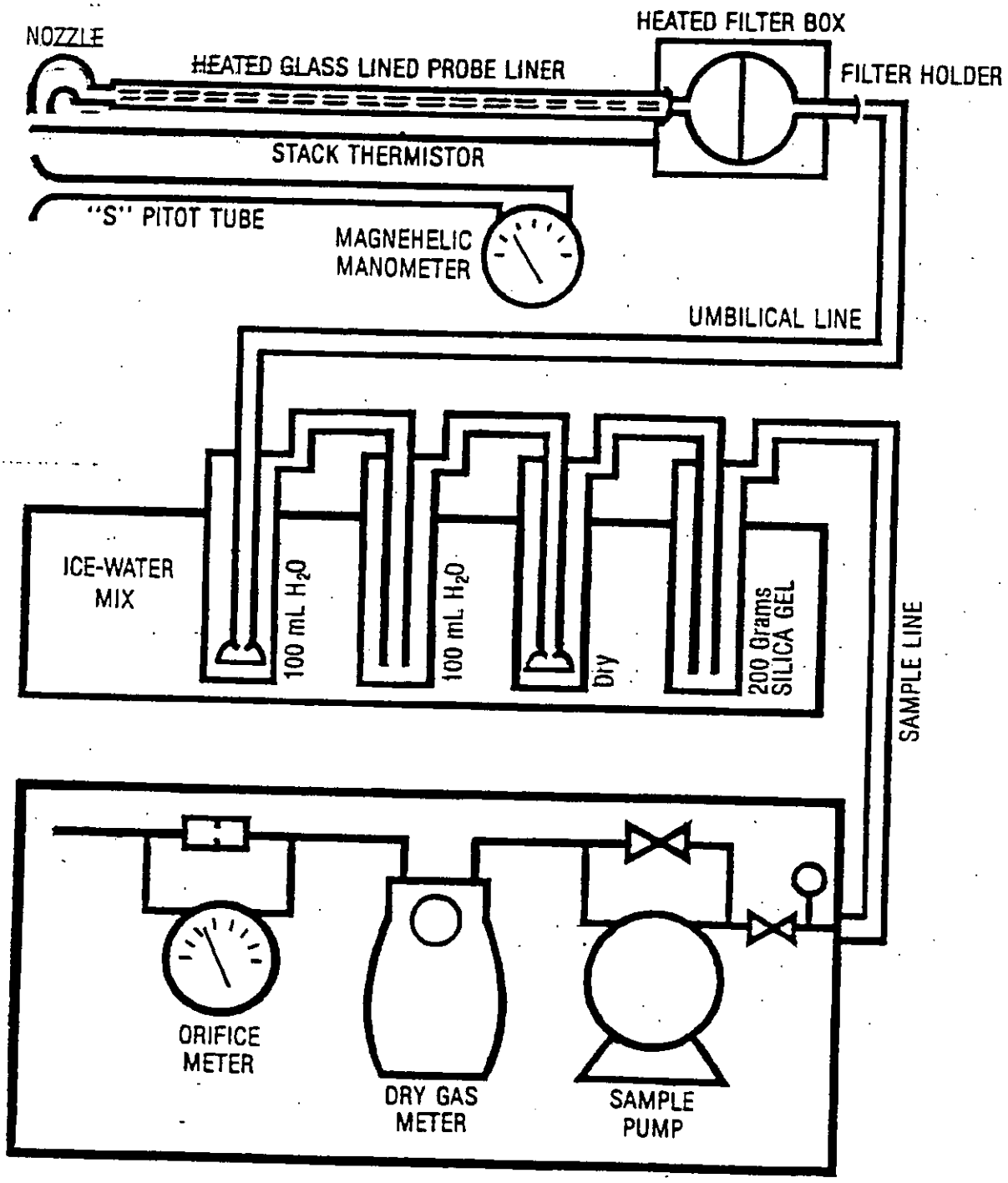
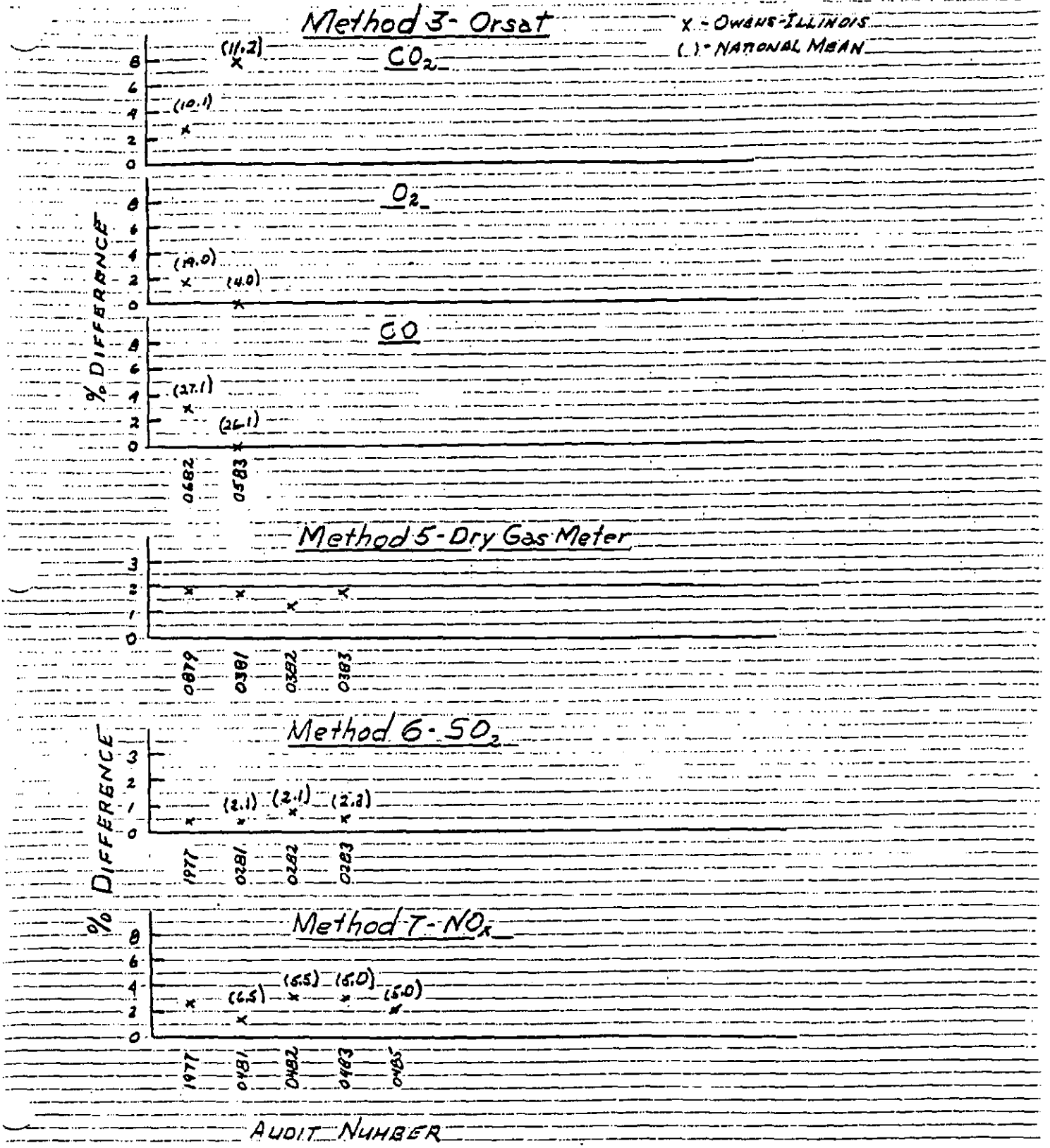


FIGURE 3

EPA Quality Assurance Audits



APPENDIX 1

FIELD DATA SHEETS

FIELD DATA SHEET

PLANT NO. _____
LOCATION TOL ALF
DATE 5-26-87
TEST NO. 3
SOURCE 4
FLUE DIA. 52 1/2 (IN.)
FLUE AREA _____ (FT^2)
BAROMETRIC PRESS. 29.70
STATIC PRESS. -0
PITOT NO. _____ CF _____
PUMP BOX NO. _____ YCF _____
FILTER WEIGHT _____ (mg)
PROBE WASH _____ (mg)

NOZZLE DIA. _____ (IN.)
FLUE GAS: CO _____ (PPM)
CO_2 _____ (%)
O_2 _____ (%)
OTHER _____
LEAK RATE: BEFORE ___ (SCFM) @ _____ (IN. Hg)
AFTER ___ (SCFM) @ _____ (IN. Hg)
WATER VAPOR: CONDENSATE _____ ML
SILICA GEL _____ ML
TOTAL _____ ML
C = _____ PITOT LEAK CHECK _____
Post " " _____

$$\Delta P_c = \frac{C \times (T_p + 460) \times \Delta H_p}{(T_s + 460)}$$

TIME	PT.	DIST. (IN.)	PITOT, ΔH_p (IN. H_2O)	STACK, T_s (°F)	METER, V_m CF	VAC: (IN. HG)	PROBE, T_p (°F)	FILTER, T_f (°F)	METER TEMP. (°F) IN / OUT	ORIFICE, ΔP_c (IN. H_2O)	ORIFICE, ΔP (IN. H_2O)
	0	---	---	---		---	---	---		---	---
	1	60	2.9	2.64	32.86		32:58				
	2	50	2.8	3.39	30.32		30:19				
	3	60	2.8	2.64	26.93		26:56				
	4	70	2.7	1.80	24.29		24:17				
	5	80	2.2	0.92	22.19		22:29				
	6	70	1.3	1.80	21.57		21:34				
	7	80	1.9	5.27	18.77		19:46				
	8	10	2.7	5.19	14.5		14:30				
	9	70	3.0	1.80	9.31		9:19				
	10	65	3.4	2.23	7.51		7:31				
	11	60	2.9	2.64	5.28		5:17				
	12	60	1.8	2.64	2.64		2:38				
	AVERAGE										

ΔP's
1.16
.70
.32
.066
.15
1.77
2.62
0.35
0.61
0.73
0.45

COMMENTS _____ PERFORMED BY _____

ALF.ODT

FIELD DATA SHEET

PLANT NO. ______

LOCATION ______

DATE 5/26/87

TEST NO. Vel. Traverse

SOURCE 29.86

FLUE DIA. 52 1/2 (IN.)

FLUE AREA 15.03 (FT^2)

BAROMETRIC PRESS. 29.90

STATIC PRESS. 0" H_2O

PITOT NO. 22 CF .85 x .99

PUMP BOX NO. ______ VCF ______

FILTER WEIGHT ______ (mg)

PROBE WASH ______ (mg)

NOZZLE DIA. ______ (IN.)

FLUE GAS: CO ______ (PPM)

CO_2 ______ (%)

O_2 ______ (%)

OTHER ______

LEAK RATE: BEFORE ___ (SCFM) @ ___ (IN. Hg)

AFTER ___ (SCFM) @ ___ (IN. Hg)

WATER VAPOR: CONDENSATE ______ ML

SILICA GEL ______ ML

TOTAL ______ ML

C = ______

PITOT LEAK CHECK ______

POST " " ______

$\Delta P_c = \frac{C \times (T_0 + 460) \times \Delta H_p}{(T_s + 460)}$

$\frac{2.5}{0.474} = 5.27$

Ave C_{Δ} = 0.474

SE Δp's

SE Δp's	TIME	PT.	DIST. (IN.) 0	PITOT, ΔH_p (IN. H_2O)	STACK, T_s (°F)	METER, V_m CF #	VAC. (IN. HG)	PROBE, T_p (°F)	FILTER, T_f (°F)	METER TEMP. (°F) IN / OUT	ORIFICE, ΔP_c (IN. H_2O)	ORIFICE, ΔP (IN. H_2O)
							---	---	---		---	---
		0	---	---	---							
1		1	50	2.8	3.39	26.99	26:59					
0.83		2	70	2.9	1.80	23.60	23:36					
0.92		3	55	2.8	3.02	21.80	21:48					
0.70		4	60	2.8	2.64	18.78	18:47					
.018		5	75	2.4	0.46	16.14	16:08					
.054		6	75	0.9	1.36	15.68	15:41					
.134		7	75	2.0	1.36	14.32	14:19					
0.21		8	75	3.1	1.36	12.96	12:58					
0.87		9	70	3.2	1.80	11.60	11:36					
0.95		10	55	2.9	3.02	9.80	9:48					
1.16		11	50	2.8	3.39	6.78	6:47					
1.03		12	50	2.5	3.39	3.39	3:23					
	AVERAGE											

COMMENTS ______

PERFORMED BY ______

865-3468

1 of 2

FIELD DATA SHEET

PLANT NO. _____

LOCATION _____

DATE 5-26-87

TEST NO. 1

SOURCE _____

FLUE DIA. 52 1/2 (IN.)

FLUE AREA _____ (FT^2)

BAROMETRIC PRESS. 29.90

STATIC PRESS. —

PITOT NO. 22 CF .85 x .99 1,038

PUMP BOX NO. 1 YCF 1.032 1,026

FILTER WEIGHT 201.4 (mg)

PROBE WASH 78.6 (ml) 2840 mg

NE Port

TEST VOIDED

NOZZLE DIA. 3/16 (IN.) .187 .188 .188

FLUE GAS: CO _____ (PPM)

CO_2 _____ (%)

O_2 _____ (%)

OTHER _____

LEAK RATE: BEFORE ___ (SCFM) @ ___ (IN. Hg)

AFTER ___ (SCFM) @ ___ (IN. Hg)

WATER VAPOR: CONDENSATE 182 ML

SILICA GEL 15 ML

TOTAL 197 ML

C = _____

PITOT LEAK CHECK _____

Post " " _____

$$\Delta P_c = \frac{C \times (T_o + 460) \times \Delta H_D}{(T_s + 460)}$$

TIME	PT.	DIST. (IN.)	PITOT, ΔH_p (IN. H_2O)	STACK, T_s (°F)	METER, V_m CF @	VAC. (IN. HG)	PROBE, T_p (°F)	FILTER, T_f (°F)	METER TEMP. (°F)	ORIFICE, ΔP_c (IN. H_2O)	ORIFICE, ΔP (IN. H_2O)
—	0	—	—	—	6242.285	—	—	—	IN / OUT	—	—
2.37	1		1.8	230	6244.3	—	250	220	98 / 97	0.44	
5.14	2		2.9	220	6246.6	1	240	210	105 / 102	0.72	
7.59	3		3.4	220	6248.0	1	250	210	108 / 103	0.86	
10.49	4		3.0	220	6250.3		280	200	110 / 103	0.76	
11.20	5		2.7	210	—		230	200	112 / 104	0.69	
11.27	6		1.8	210	—		270	200	115 / 107	0.46	
14.17	7		1.3	210	6254.2		290	190	115 / 110	0.34	
17.16	8		2.2	220	6256.8		280	175	118 / 111	0.56	
20.07	9		2.7	220	6259.1		250	170	120 / 113	0.69	
22.49	10		2.8	220	6259.5		220	180	121 / 115	0.72	
25.03	11		2.8	230	6261.6		280	220	120 / 120	0.73	
27.49	12		2.9	230	6263.77		270	270	125 / 123	0.75	
AVERAGE					44.29				122.0	0.66	

COMMENTS _____ PERFORMED BY _____

JHT
TES

2 of 2

FIELD DATA SHEET

PLANT NO. Toledo Alfalfa
LOCATION _____
DATE 5/26/87
TEST NO. 1
SOURCE _____
FLUE DIA. _____ (IN.)
FLUE AREA _____ (FT^2)
BAROMETRIC PRESS. _____
STATIC PRESS. _____
PITOT NO. _____ CF _____
PUMP BOX NO. _____ VCF _____
FILTER WEIGHT _____ (mg)
PROBE WASH _____ (mg)

TEST VOIDED

NOZZLE DIA. 3/16 (IN.)
FLUE GAS: CO _____ (PPM)
CO_2 2.5 (%)
O_2 17.5 (%)
OTHER _____
LEAK RATE: BEFORE 0.005 (SCFM) @ 15 (IN. Hg)
AFTER 0.000 (SCFM) @ 15 (IN. Hg)
WATER VAPOR: CONDENSATE 182 ML
SILICA GEL _____ ML
TOTAL _____ ML

C = 0.305
PITOT LEAK CHECK _____
Post " " _____

$$\Delta P_c = \frac{C \times (T_o + 460) \times \Delta H_p}{(T_s + 460)}$$

SE Port

TIME	PT.	DIST. (IN.)	PITOT, ΔH_p (IN. H_2O)	STACK, T_s (°F)	METER, V_m CF @	VAC. (IN. Hg)	PROBE, T_p (°F)	FILTER, T_f (°F)	METER TEMP. (°F)	ORIFICE, ΔP_c (IN. H_2O)	ORIFICE, ΔP (IN. H_2O)
									IN / OUT		
	0	—	—	—	6263.770	—	—	—	127 / 125	0.65	
2.19	1		2.5	230	—	1	250	290	128 / 126	0.73	
4.38	2		2.8	230	6267.25		210	290	130 / 127	0.76	
7.07	3		2.9	225	6269.2		255	285	131 / 128	0.84	
9.58	4		3.2	230	6271.65		280	260	134 / 130	0.81	
12.53	5		3.1	230	6274.0		260	240	135 / 130	0.52	
15.48	6		2.0	230	6275.9		250	230	136 / 131	0.21	
18.43	7		0.8	225	6277.25		235	230	137 / 132	0.64	
21.44	8		2.4	220	6280.6	2	230	240	138 / 134	0.74	
24.12	9		2.8	225	6281.5	2	255	250	140 / 135	0.74	
26.50	10		2.8	225	6283.3	1	170	270	137 / 135	0.74	
29.40	11		2.8	230	6286.7	1	270	270	138 / 136	0.75	
31.59	12			220	6286.570	1	270	270			
AVERAGE											

COMMENTS _____ PERFORMED BY _____

JH
TES

FIELD DATA SHEET

PLANT NO. Toledo Alfalfa
LOCATION _____
DATE 5/26/87
TEST NO. 2
SOURCE _____
FLUE DIA. _____ (IN.)
FLUE AREA _____ (FT^2)
BAROMETRIC PRESS. 29.40
STATIC PRESS. _____
PITOT NO. @ CF .84
PUMP BOX NO. 1 YCF 1.032
FILTER WEIGHT 192.5 (mg)
PROBE WASH 120.9 (mg)

1 of 2

3134

NE Port

NOZZLE DIA. 3/16 (IN.)
FLUE GAS: CO _____ (PPM)
CO_2 _____ (%)
O_2 _____ (%)
OTHER _____
LEAK RATE: BEFORE ___ (SCFM) @ _____ (IN. Hg)
AFTER ___ (SCFM) @ _____ (IN. Hg)
WATER VAPOR: CONDENSATE +189 ML
SILICA GEL 14.3 ML
TOTAL 203.3 ML
C = 0.321
PITOT LEAK CHECK _____
Post " " _____

$$\Delta P_c = \frac{C \times (T_o + 460) \times \Delta H_p}{(T_s + 460)}$$

TIME	PT.	DIST. (IN.)	PITOT, ΔH_p (IN. H_2O)	STACK, T_s (°F)	METER, V_m CF @	VAC. (IN. HG)	PROBE, T_p (°F)	FILTER, T_f (°F)	METER TEMP. (°F) IN / OUT	ORIFICE, ΔP_c (IN. H_2O)	ORIFICE, ΔP (IN. H_2O)
	0	---	---	---	6288.022	---	---	---		---	---
2:38	1		1.8	220	6289.7	—	260	210	112 / 112	0.49	
5:17	2		2.9	220	6291.8	—	240	280	115 / 114	0.79	
7:31	3		3.4	220	6293.8	1	270	315	117 / 117	0.93	
9:19	4		3.0	220	6295.3	1	265	300	121 / 118	0.82	
14:30	5		2.7	220	6299.3	1	245	270	122 / 118	0.74	
19:46	6		1.8	220	6302.65	1	235	235	125 / 120	0.49	
21:34	7		1.3	220	6303.68	1	280	210	127 / 121	0.36	
22:29	8		2.2	220	6304.3	2	240	220	127 / 122	0.61	
26:17	9		2.7	230	6305.75	2	230	225	127 / 122	0.74	
26:56	10		2.8	230	6307.8	2	250	235	128 / 122	0.76	
30:19	11		2.8	230	6310.6	1	220	260	130 / 123	0.76	
32:59	12		2.9	240	6312.718	1	280	250	131 / 125	0.78	
AVERAGE					45.47				127.6	0.70	

COMMENTS _____ PERFORMED BY _____

SAT
TES

FIELD DATA SHEET

PLANT NO. Toledo Alfalfa
LOCATION _____
DATE 5/26/87
TEST NO. 3
SOURCE _____
FLUE DIA. _____ (IN.)
FLUE AREA _____ (FT^2)
BAROMETRIC PRESS. _____
STATIC PRESS. _____
PITOT NO. _____ CF _____
PUMP BOX NO. _____ YCF _____
FILTER WEIGHT _____ (mg)
PROBE WASH _____ (mg)

2 of 2

NOZZLE DIA. _____ (IN.)
FLUE GAS: CO _____ (PPM)
CO_2 _____ (%)
O_2 _____ (%)
OTHER _____
LEAK RATE: BEFORE 0.005 (SCFM) @ 8 (IN. Hg)
AFTER .01 (SCFM) @ 10 (IN. Hg)
WATER VAPOR: CONDENSATE _____ ML
SILICA GEL _____ ML
TOTAL _____ ML
C = _____
PITOT LEAK CHECK _____ Post " " _____

$$\Delta P_c = \frac{C \times (T_o + 460) \times \Delta H_p}{(T_s + 460)}$$

SE Port

TIME	PT.	DIST. (IN.)	PITOT, ΔH_p (IN. H_2O)	STACK, T_s (°F)	METER, V_m CF @	VAC. (IN. HG)	PROBE, T_p (°F)	FILTER, T_f (°F)	METER TEMP. (°F) IN / OUT	ORIFICE, ΔP_c (IN. H_2O)	ORIFICE, ΔP (IN. H_2O)
	0	---	---	---	6312.718	---	---	---		---	---
3:23	1		2.5	220	6315.3	1	230	240	133 / 128	0.69	
6:47	2		2.8	230	6318.0	1	260	230	135 / 129	0.77	
9:48	3		2.9	230	6320.5	1	240	230	133 / 129	0.80	
11:36	4		3.2	230	6322.0	1	230	240	135 / 130	0.88	
12:58	5		3.1	230	6323.15	2	260	260	136 / 130	0.85	
14:19	6		2.0	230	6324.35	2	270	275	137 / 130	0.55	
15:41	7		0.8	220	6325.4		250	260	137 / 130	0.22	
16:01	8		2.4	220	6326.8	2	240	270	138 / 131	0.67	
18:07	9		2.8	220	6327.8	1	280	250	139 / 132	0.78	
21:48	10		2.8	230	6330.4	1	260	240	140 / 132	0.77	
23:36	11		2.8	230	6331.7	1	250	230	141 / 133	0.77	
26:59	12		2.9	220	6333.489		240	230	141 / 135	0.79	
AVERAGE											

COMMENTS _____ PERFORMED BY _____

SAT
TES

FIELD DATA SHEET

PLANT NO. Toledo Alfalfa
LOCATION _____
DATE 5/26/87
TEST NO. 3
SOURCE _____
FLUE DIA. _____ (IN.)
FLUE AREA _____ (FT^2)
BAROMETRIC PRESS. _____
STATIC PRESS. _____
PITOT NO. _____ CF .84
PUMP BOX NO. 1 YCF _____
FILTER WEIGHT 232.8 (mg)
PROBE WASH 157.0 (mg) 389.8
NE Port

1 of 2

NOZZLE DIA. 3/16 (IN.)
FLUE GAS: CO _____ (PPM)
CO_2 3 (%)
O_2 17½ (%)
OTHER _____
LEAK RATE: BEFORE ___ (SCFM) @ _____ (IN. Hg)
AFTER ___ (SCFM) @ _____ (IN. Hg)
WATER VAPOR: CONDENSATE 183 ML
SILICA GEL 11.5 ML
TOTAL 194.5 ML
C = _____ PITOT LEAK CHECK _____
Post " " _____

$$\Delta P_c = \frac{C \times (T_o + 460) \times \Delta H_p}{(T_s + 460)}$$

TIME	PT.	DIST. (IN.)	PITOT, ΔH_p (IN. H_2O)	STACK, T_s (°F)	METER, V_m CF @	VAC. (IN. HG)	PROBE, T_p (°F)	FILTER, T_f (°F)	METER TEMP. (°F) IN / OUT	ORIFICE, ΔP_c (IN. H_2O)	ORIFICE, ΔP (IN. H_2O)
	0	---	---	---	6338.588	---	---	---		---	---
2:38	1		1.8	220	6336.2	2	240	290	127 / 128	0.50	
5:17	2		2.9	230	6338.55	3	270	290	125 / 127	0.79	
7:31	3		3.4	230	6340.6		240	290	125 / 125	0.93	
9:19	4		3.0	220	6342.05	2	280	275	128 / 126	0.82	
14:30	5		2.7	220	6346.2	3	270	240	128 / 126	0.75	
19:46	6		1.8	230	6349.65	2	240	230	130 / 127	0.49	
21:34	7		1.3	220	6350.6		250	230	131 / 127	0.36	
22:29	8		2.2	220	6351.3		230	230	132 / 128	0.61	
24:17	9		2.7	220	6352.7	2	250	230	132 / 129	0.75	
26:56	10		2.8	220	6354.8	2½	240	240	135 / 130	0.78	
30:19	11		2.8	230	6356.55	2	250	250	135 / 130	0.77	
32:58	12		2.9	220	6359.762	2	270	260	137 / 131	0.81	
AVERAGE					76.51				134.7	0.71	

COMMENTS _____ PERFORMED BY _____

JHT
TRS

FIELD DATA SHEET

PLANT NO. Toledo Alfalfa
LOCATION _____
DATE 5/26/87
TEST NO. 3
SOURCE _____
FLUE DIA. _____ (IN.)
FLUE AREA _____ (FT^2)
BAROMETRIC PRESS. _____
STATIC PRESS. _____
PITOT NO. _____ CF _____
PUMP BOX NO. _____ VCF _____
FILTER WEIGHT _____ (mg)
PROBE WASH _____ (mg)

Page 2 of 2

NOZZLE DIA. _____ (IN.)
FLUE GAS: CO _____ (PPM)
CO_2 _____ (%)
O_2 _____ (%)
OTHER _____
LEAK RATE: BEFORE 0.005 (SCFM) @ 11 (IN. Hg)
AFTER 0.005 (SCFM) @ 10 (IN. Hg)
WATER VAPOR: CONDENSATE +183 ML
SILICA GEL _____ ML
TOTAL _____ ML
C = _____ PITOT LEAK CHECK _____
Post " " _____

$$\Delta P_c = \frac{C \times (T_D + 460) \times \Delta H_p}{(T_s + 460)}$$

SE Port

TIME	PT.	DIST. (IN.)	PITOT, ΔH_p (IN. H_2O)	STACK, T_s (°F)	METER, V_m CF @	VAC. (IN. HG)	PROBE, T_p (°F)	FILTER, T_f (°F)	METER TEMP. (°F) IN / OUT	ORIFICE, ΔP_c (IN. H_2O)	ORIFICE, ΔP (IN. H_2O)
	0	—	—	—	6359.762	—	—	—		—	—
3:23	1		2.5	220	6362.4	2	250	290	131 / 132	0.70	
6:47	2		2.8	220	6365.15	2	240	320	139 / 134	0.79	
9:48	3		2.9	220	6367.75	2½	230	290	141 / 135	0.82	
11:56	4		3.2	220	6369.25	3	260	280	142 / 136	0.90	
12:58	5		3.1	220	6370.41	3	240	270	144 / 137	0.87	
14:19	6		2.0	220	6371.4	2	230	260	145 / 138	0.57	
15:41	7		0.8	220	6372.05	1	260	250	146 / 139	0.23	
16:08	8		2.4	220	—		240	240	146 / 139	0.68	
18:47	9		2.8	220	6374.4		225	220	145 / 140	0.79	
21:49	10		2.8	220	6376.86		260	210	146 / 140	0.79	
22:36	11		2.8	220	6378.4	2½	230	180	147 / 140	0.79	
24:59	12		2.8	220	6381.093	2½	230	200	146 / 140	0.79	
AVERAGE											

COMMENTS _____ PERFORMED BY _____

TES

FIELD DATA SHEET

PLANT NO. Toledo Alfalfa
LOCATION _____
DATE 5/26/87
TEST NO. 4
SOURCE _____
FLUE DIA. _____ (IN.)
FLUE AREA _____ (FT^2)
BAROMETRIC PRESS. _____
STATIC PRESS. _____
PITOT NO. _____ CF .84
PUMP BOX NO. 1 YCF 1.032
FILTER WEIGHT 261.4 (mg)
PROBE WASH 125.2 (mg) 386.6
NE Port

NOZZLE DIA. 3/16 (IN.)
FLUE GAS: CO _____ (PPM)
CO_2 2½ (%)
O_2 18 (%)
OTHER _____
LEAK RATE: BEFORE ___ (SCFM) @ ___ (IN. Hg)
AFTER ___ (SCFM) @ ___ (IN. Hg)
WATER VAPOR:CONDENSATE 182 ML
SILICA GEL 10.4 ML
TOTAL 192.4 ML
C = _____ PITOT LEAK CHECK _____
Post " " _____

$$\Delta P_c = \frac{C \times (T_s + 460) \times \Delta H_p}{(T_s + 460)}$$

TIME	PT.	DIST. (IN.)	PITOT, ΔH_p (IN. H_2O)	STACK, T_s (°F)	METER, V_m CF @	VAC. (IN. HG)	PROBE, T_p (°F)	FILTER, T_f (°F)	METER TEMP. (°F) IN / OUT	ORIFICE, ΔP_c (IN. H_2O)	ORIFICE, ΔP (IN. H_2O)
	0	---	---	---	6381.222	---	---	---		---	---
2:38	1		1.9	230	6383.35	—	250	200	125 / 125	0.49	
5:17	2		2.9	230	6385.7	—	240	260	125 / 125	0.79	
7:31	3		3.4	235	6387.35	1	220	300	125 / 123	0.92	
9:19	4		3.0	230	6389.83	1	250	310	125 / 123	0.81	
14:30	5		2.7	230	6393.05	1	215	275	127 / 124	0.73	
19:46	6		1.8	230	6396.5	—	235	250	127 / 123	0.49	
21:34	7		1.3	220	6397.55	—	240	250	128 / 123	0.36	
22:29	8		2.2	220	6398.1		210	240	127 / 123	0.61	
26:17	9		2.7	220	6399.55		240	235	128 / 123	0.74	
26:52	10		2.8	220	6401.7	1	265	235	129 / 123	0.77	
30:19	11		2.8	220	6404.4	1	230	250	129 / 123	0.77	
32:55	12		2.9	220	6406.609	1	250	255	129 / 123	0.80	
AVERAGE					47.69				124.8	0.70	

COMMENTS _____ PERFORMED BY _____

JHT
TES

FIELD DATA SHEET

PLANT NO. Toledo Alfalfa
LOCATION _____
DATE 5/26/87
TEST NO. A
SOURCE _____
FLUE DIA. _____ (IN.)
FLUE AREA _____ (FT^2)
BAROMETRIC PRESS. _____
STATIC PRESS. _____
PITOT NO. _____ CF _____
PUMP BOX NO. _____ VCF _____
FILTER WEIGHT _____ (mg)
PROBE WASH _____ (mg)

page 2 of 2

NOZZLE DIA. _____ (IN.)
FLUE GAS: CO _____ (PPM)
CO_2 _____ (%)
O_2 _____ (%)
OTHER _____
LEAK RATE: BEFORE 0.002 (SCFM) @ 11 (IN. Hg)
AFTER 0.000 (SCFM) @ 10 (IN. Hg)
WATER VAPOR: CONDENSATE _____ ML
SILICA GEL _____ ML
TOTAL _____ ML
C = _____ PITOT LEAK CHECK _____
Post " " _____

$$\Delta P_c = \frac{C \times (T_p + 460) \times \Delta H_p}{(T_s + 460)}$$

SE Port

TIME	PT.	DIST. (IN.)	PITOT, ΔH_p (IN. H_2O)	STACK, T_s (°F)	METER, V_m CF @	VAC. (IN. HG)	PROBE, T_p (°F)	FILTER, T_f (°F)	METER TEMP. (°F) IN / OUT	ORIFICE, ΔP_c (IN. H_2O)	ORIFICE, ΔP (IN. H_2O)
	0	---	---	---	6406.604	---	---	---		---	---
3:23	1		2.5	220	6409.24	—	270	280	127 / 123	0.69	
6:47	2		2.8	220	6412.9		240	265	128 / 123	0.77	
9:48	3		2.9	220	6414.6		250	250	127 / 123	0.80	
11:36	4		3.2	220	6416.2		220	250	129 / 123	0.88	0.88
12:58	5		3.1	220	6417.9		250	250	129 / 123	0.85	
14:19	6		3.0	220	6419.5		220	260	130 / 123	0.55	
15:41	7		0.8	[illegible]	[illegible]				13[illegible] / [illegible]	0.22	
16:08	8		2.4	—							
18:47	9		2.8								
21:48	10		2.8								
23:36	11		2.9								
26:59	12		2.9								
AVERAGE											

COMMENTS _____ PERFORMED BY _____

JAM
TES

FIELD DATA SHEET

PLANT NO. Toledo Alfalfa
LOCATION _____
DATE 5/26/87
TEST NO. A
SOURCE _____
FLUE DIA. _____ (IN.)
FLUE AREA _____ (FT^2)
BAROMETRIC PRESS. _____
STATIC PRESS. _____
PITOT NO. _____ CF _____
PUMP BOX NO. _____ YCF _____
FILTER WEIGHT _____ (mg)
PROBE WASH _____ (mg)

NOZZLE DIA. _____ (IN.)
FLUE GAS: CO _____ (PPM)
CO_2 _____ (%)
O_2 _____ (%)
OTHER _____
LEAK RATE: BEFORE ___ (SCFM) @ _____ (IN. Hg)
AFTER ___ (SCFM) @ _____ (IN. Hg)
WATER VAPOR: CONDENSATE _____ ML
SILICA GEL _____ ML
TOTAL _____ ML
C = _____
PITOT LEAK CHECK _____
Post " " _____

$$\Delta P_c = \frac{C \times (T_o + 460) \times \Delta H_p}{(T_s + 460)}$$

TIME	PT.	DIST. (IN.)	PITOT, ΔH_p (IN. H_2O)	STACK, T_s (°F)	METER, V_m CF @	VAC. (IN. HG)	PROBE, T_p (°F)	FILTER, T_f (°F)	METER TEMP. (°F) IN / OUT	ORIFICE, ΔP_c (IN. H_2O)	ORIFICE, ΔP (IN. H_2O)
	0	---	---	---		---	---	---		---	---
	1										
	2										
	3										
	4										
	5										
	6										
15:41	7		6.8	220	6420.5				130 / 124	0.22	
16:08	8		2.9	220	6421.1		230	290	123 / 121	0.77	
18:37	9		2.8	220	6422.55		250	255	123 / 121	0.62	
21:48	10		2.9	220	6424.8	1	230	240	123 / 121	0.77	
23:30	11		2.8	220	6426.6	1	270	220	123 / 121	0.77	
26:59	12		2.8	220	6428.910	1	250	230	126 / 121	0.77	
AVERAGE											

COMMENTS _____ PERFORMED BY _____

JHT
TES

APPENDIX 2

ANALYTICAL DATA

DATE RECEIVED 5/27/87
DATE COMPLETED 5/29/87

TOLEDO ALFALFA MILLS
GRAVIMETRIC ANALYSIS

FILTERS: Oven dried 105^{0}C for three hours and weighed.

TEST NO.	TARE WT. (Grams)	DRY WT. (Grams)	PATRICULATE (Grams)
1 *	0.8082	1.0096	0.2014
2	0.7963	0.9888	0.1925
3	0.8034	1.0362	0.2328
4	0.8000	1.0614	0.2614
Blank	0.8010	0.8010	0.0000

ACETONE PROBE WASHES:

Transferred to platinum weighing dishes evaporated in air, oven dried 105^{0}C/3 hours, cooled in desiclator, weighed. One hour cycles to constant weight.

TEST NO.	TARE WT. (Grams)	DRY WT. (Grams)	PATRICULATE (Grams)
1 *	91.4222	91.5008	0.0786
2	93.3362	93.4571	0.1209
3	92.2610	92.4180	0.1570
4	90.7843	90.9095	0.1252
Blank	94.9590	94.9595	0.0005

*Results shown but not included, Test #1 was voided.

APPENDIX 3

COMPUTER CALCULATIONS

OWENS ILLINOIS, INC.

TEST VOIDED

PLANT: TOLEDO ALFALFA MILLS
DATE: 5-26-87
UNIT TESTED: TEST #1

	VH(IN H2O)	TS(K)	TS(F)	VS(MPS)	VS(FPS)
1	0.730	383.	230.	17.4	57.2
2	1.160	383.	230.	22.0	72.0
3	0.700	377.	220.	16.9	55.6
4	0.320	377.	220.	11.5	37.6
5	0.660	377.	220.	16.4	54.0
6	0.150	372.	210.	7.8	25.5
7	1.770	372.	210.	26.7	87.7
8	2.620	372.	210.	32.5	106.7
9	0.350	377.	220.	12.0	39.3
10	0.610	377.	220.	15.8	51.9
11	0.730	377.	220.	17.3	56.7
12	0.450	383.	230.	13.7	44.9
13	1.160	383.	230.	22.0	72.0
14	0.330	380.	225.	11.7	38.3
15	0.920	380.	225.	19.5	63.9
16	0.700	380.	225.	17.0	55.8
17	0.018	383.	230.	2.7	9.0
18	0.054	383.	230.	4.7	15.5
19	0.134	383.	230.	7.5	24.5
20	0.210	383.	230.	9.3	30.7
21	0.370	380.	225.	12.4	40.5
22	0.950	383.	230.	19.9	65.2
23	1.160	383.	230.	22.0	72.0
24	1.030	383.	230.	20.7	67.9
	AVERAGE	380.	224.	15.8	51.9

PS =747. MMHG (29.40 INHG)
DS = 1.33 M (52.5 IN)
A = 1.40 SQM (15.03 SQFT)
%CO2= 2.5
%CO = 0.0
%O2 = 17.5
%N2 = 80.0

ST = 60. MIN
MD = 29.10

CP = 0.840
VCF = 1.032
DH = 1. MMHG (0.7 INH2O)
PB =747. MMHG (29.40 INHG)
TM = 50. C (122.0 F)
WC =197. ML
VMC = 1.254 CUM (44.290 CUFT)
VSTD= 1.156 CUM (40.81 CUFT)
DN = 4.78 MM (0.188 IN)
MS = 27.04

MG COLLECTED

PARTICULATES 280.0

OWENS ILLINOIS, INC.

TEST VOIDED

PLANT: TOLEDO ALFALFA MILLS
DATE: 5-26-87
UNIT TESTED: TEST #1

	CONCENTRATION G/DSCM	CONCENTRATION GR/DSCF	EMISSION RATE G/SEC	EMISSION RATE LB/HR
PARTICULATES	0.243	0.106	3.30	26.2

FLUE GAS VOLUME 22.08 ACMS (46789.ACFM)

13.64 DSCMS(28908.DSCFM)

MOISTURE 18.51%

STANDARD CONDITIONS- 68.F, 29.92INHG

OWENS ILLINOIS, INC.

PLANT: TOLEDO ALFALFA MILLS
DATE: 5-26-87
UNIT TESTED: TEST #2

	VH(IN H2O)	TS(K)	TS(F)	VS(MPS)	VS(FPS)
1	0.730	383.	230.	17.4	57.2
2	1.160	383.	230.	22.0	72.1
3	0.700	377.	220.	16.9	55.6
4	0.320	377.	220.	11.5	37.6
5	0.660	377.	220.	16.5	54.0
6	0.150	372.	210.	7.8	25.5
7	1.770	372.	210.	26.7	87.7
8	2.620	372.	210.	32.5	106.7
9	0.350	377.	220.	12.0	39.3
10	0.610	377.	220.	15.8	51.9
11	0.730	377.	220.	17.3	56.8
12	0.450	383.	230.	13.7	44.9
13	1.160	383.	230.	22.0	72.1
14	0.330	380.	225.	11.7	38.3
15	0.920	380.	225.	19.5	64.0
16	0.700	380.	225.	17.0	55.8
17	0.018	383.	230.	2.7	9.0
18	0.054	383.	230.	4.7	15.6
19	0.134	383.	230.	7.5	24.5
20	0.210	383.	230.	9.3	30.7
21	0.370	380.	225.	12.4	40.6
22	0.950	383.	230.	19.9	65.2
23	1.160	383.	230.	22.0	72.1
24	1.030	383.	230.	20.7	67.9
	AVERAGE	380.	224.	15.8	51.9

PS =747. MMHG (29.40 INHG)
DS = 1.33 M (52.5 IN)
A = 1.40 SQM (15.03 SQFT)
%CO2= 2.5
%CO = 0.0
%O2 = 17.5
%N2 = 80.0

ST = 60. MIN
MD = 29.10

CP = 0.840
VCF = 1.032
DH = 1. MMHG (0.7 INH2O)
PB =747. MMHG (29.40 INHG)
TM = 53. C (127.6 F)
WC =203. ML
VMC = 1.288 CUM (45.470 CUFT)
VSTD= 1.175 CUM (41.51 CUFT)
DN = 4.78 MM (0.188 IN)
MS = 27.02

MG COLLECTED

PARTICULATES 313.4

OWENS ILLINOIS, INC.

PLANT: TOLEDO ALFALFA MILLS
DATE: 5-26-87
UNIT TESTED: TEST #2

	CONCENTRATION		EMISSION RATE	
	G/DSCM	GR/DSCF	G/SEC	LB/HR
PARTICULATES	0.267	0.117	3.63	28.8

FLUE GAS VOLUME 22.09 ACMS (46811.ACFM)

13.61 DSCMS(28842.DSCFM)

MOISTURE 18.74%

STANDARD CONDITIONS- 68.F, 29.92INHG

OWENS ILLINOIS, INC.

PLANT: TOLEDO ALFALFA MILLS
DATE: 5-26-87
UNIT TESTED: TEST #3

	VH(IN H2O)	TS(K)	TS(F)	VS(MPS)	VS(FPS)
1	0.730	383.	230.	17.4	57.1
2	1.160	383.	230.	21.9	72.0
3	0.700	377.	220.	16.9	55.5
4	0.320	377.	220.	11.4	37.5
5	0.660	377.	220.	16.4	53.9
6	0.150	372.	210.	7.8	25.5
7	1.770	372.	210.	26.7	87.6
8	2.620	372.	210.	32.5	106.6
9	0.350	377.	220.	12.0	39.2
10	0.610	377.	220.	15.8	51.8
11	0.730	377.	220.	17.3	56.7
12	0.450	383.	230.	13.7	44.8
13	1.160	383.	230.	21.9	72.0
14	0.330	380.	225.	11.7	38.2
15	0.920	380.	225.	19.5	63.9
16	0.700	380.	225.	17.0	55.7
17	0.018	383.	230.	2.7	9.0
18	0.054	383.	230.	4.7	15.5
19	0.134	383.	230.	7.5	24.5
20	0.210	383.	230.	9.3	30.6
21	0.370	380.	225.	12.3	40.5
22	0.950	383.	230.	19.8	65.1
23	1.160	383.	230.	21.9	72.0
24	1.030	383.	230.	20.7	67.8
	AVERAGE	380.	224.	15.8	51.8

PS =747. MMHG (29.40 INHG)
DS = 1.33 M (52.5 IN)
A = 1.40 SQM (15.03 SQFT)
%CO2= 2.5
%CO = 0.0
%O2 = 17.5
%N2 = 80.0

ST = 60. MIN
MD = 29.10

CP = 0.840
VCF = 1.032
DH = 1. MMHG (0.7 INH2O)
PB =747. MMHG (29.40 INHG)
TM = 57. C (134.7 F)
WC =195. ML
VMC = 1.317 CUM (46.510 CUFT)
VSTD= 1.170 CUM (41.31 CUFT)
DN = 4.78 MM (0.188 IN)
MS = 27.11

MG COLLECTED

PARTICULATES 389.8

OWENS ILLINOIS, INC.

PLANT: TOLEDO ALFALFA MILLS
DATE: 5-26-87
UNIT TESTED: TEST #3

	CONCENTRATION		EMISSION RATE	
	G/DSCM	GR/DSCF	G/SEC	LB/HR
PARTICULATES	0.334	0.146	4.50	35.7

FLUE GAS VOLUME 22.06 ACMS (46732.ACFM)

13.52 DSCMS(28644.DSCFM)

MOISTURE 17.92%

STANDARD CONDITIONS- 60.F, 29.92INHG

OWENS ILLINOIS, INC.

PLANT: TOLEDO ALFALFA MILLS
DATE: 5-26-87
UNIT TESTED: TEST #4

	VH(IN H2O)	TS(K)	TS(F)	VS(MPS)	VS(FPS)
1	0.730	383.	230.	17.4	57.0
2	1.160	383.	230.	21.9	71.8
3	0.700	377.	220.	16.9	55.4
4	0.320	377.	220.	11.4	37.5
5	0.660	377.	220.	16.4	53.8
6	0.150	372.	210.	7.8	25.5
7	1.770	372.	210.	26.7	87.5
8	2.620	372.	210.	32.4	106.4
9	0.350	377.	220.	11.9	39.2
10	0.610	377.	220.	15.8	51.7
11	0.730	377.	220.	17.2	56.6
12	0.450	383.	230.	13.6	44.8
13	1.160	383.	230.	21.9	71.8
14	0.330	380.	225.	11.6	38.2
15	0.920	380.	225.	19.4	63.8
16	0.700	380.	225.	17.0	55.6
17	0.018	383.	230.	2.7	9.0
18	0.054	383.	230.	4.7	15.5
19	0.134	383.	230.	7.4	24.4
20	0.210	383.	230.	9.3	30.6
21	0.370	380.	225.	12.3	40.4
22	0.950	383.	230.	19.8	65.0
23	1.160	383.	230.	21.9	71.8
24	1.030	383.	230.	20.6	67.7
	AVERAGE	380.	224.	15.8	51.7

PS =747. MMHG (29.40 INHG)
DS = 1.33 M (52.5 IN)
A = 1.40 SQM (15.03 SQFT)
%CO2= 2.5
%CO = 0.0
%O2 = 17.5
%N2 = 80.0

ST = 60. MIN
MD = 29.10

CP = 0.840
VCF = 1.032
DH = 1. MMHG (0.7 INH2O)
PB =747. MMHG (29.40 INHG)
TM = 52. C (124.8 F)
WC =192. ML
VMC = 1.351 CUM (47.690 CUFT)
VSTD= 1.239 CUM (43.74 CUFT)
DN = 4.78 MM (0.188 IN)
MS = 27.20

MG COLLECTED

PARTICULATES 386.6

OWENS ILLINOIS, INC.

PLANT: TOLEDO ALFALFA MILLS
DATE: 5-26-87
UNIT TESTED: TEST #4

	CONCENTRATION		EMISSION RATE	
	G/DSCM	GR/DSCF	G/SEC	LB/HR
PARTICULATES	0.313	0.136	4.32	34.3

FLUE GAS VOLUME 22.02 ACMS (46659.ACFM)

13.83 DSCMS(29309.DSCFM)

MOISTURE 17.15%

STANDARD CONDITIONS- 68.F, 29.92INHG

APPENDIX 4

ISOKINETIC CALCULATIONS

SAMPLE POINT	ΔHp ("H_2O)	SAMPLING TIME (min)
1	1.8	2.64
2	2.9	2.64
3	3.4	2.23
4	3.0	1.80
5	2.7	5.19
6	1.8	5.27
7	1.3	1.80
8	2.2	0.92
9	2.7	1.80
10	2.8	2.64
11	2.8	3.39
12	2.9	2.64
13	2.5	3.39
14	2.8	3.39
15	2.9	3.02
16	3.2	1.80
17	3.1	1.36
18	2.0	1.36
19	0.8	1.36
20	2.4	0.46
21	2.8	2.64
22	2.8	3.02
23	2.8	1.80
24	2.8	3.39

$\Sigma\sqrt{\Delta Hp}$: S.T. = 95.46
59.95 MIN.
1.59 = Time Weighted $\overline{\sqrt{\Delta p}}$

TEST NO.	-2-	-3-	-4-
DN	<-------	0.188"	------>
$\overline{BWO}$	<-------	17.9%	------>
$\overline{Ts}$	<-------	224^0F	------>
Ps	<-------	29.40	------>
$\overline{Ms}$	<-------	27.11	------>
VSTD	41.51	41.31	43.74
An(ft^2)	<-------	0.000192	----->

$$\overline{V_s} = cp \cdot 85.49 \cdot \sqrt{\Delta Hp} \cdot \sqrt{\frac{Ts}{MS \cdot PS}} =$$

$$0.840 \cdot 85.49 \cdot 1.59 \cdot \sqrt{\frac{684}{27.11 \cdot 29.40}} = 105.8 \text{ FPS}$$

$$I = \frac{T_s \; VSTD \; PSTD \; 100}{P_s \; Tstd \; V_s \; ST \; An \; 60 \; (1-BWD)} = \%$$

TEST NO.	-2-	-3-	-4-
% Isokinetic Rate	91.2	90.8	96.1

APPENDIX 5

EQUIPMENT CALIBRATIONS

Date 5-28-87 Meter No. 1

Barometric Pressure 29.85 in Hg

DRY GAS METER Orifice Setting	Volume	Temperatures	WET Volume	TEST Temp	Pres	Time	METER Indicated Flow	Correction Factor
Ho 0.25	Vm1 6437.000 Vm2 6439.000 Vm 5.000	ti1 85 to1 80 ti2 91 to2 85 tm 85.3 to 82.5	Vw 4.991 (196.241)	tw1 78.5 tw2 78.5 tw 78.5	Pw 0.45	θ 10.40 (10.24)	cfm 0.48	CF 1.028
Ho 0.50	Vm1 6440.000 Vm2 6445.000 Vm 5.000	ti1 92 to1 86 ti2 100 to2 90 tm 92 to 88	Vw 4.882 (192.132)	tw1 78.5 tw2 78.1 tw 78.3	Pw 0.56	θ 7.65 (7.39)	cfm 0.64	CF 1.034
Ho 0.75	Vm1 6446.000 Vm2 6451.000 Vm 5.000	ti1 101 to1 91 ti2 110 to2 99 tm 100.3 to 95	Vw 4.829 (190.079)	tw1 78.1 tw2 77.9 tw 78.0	Pw 0.78	θ 6.31 (6.19)	cfm 0.76	CF 1.038
Ho 1.00	Vm1 6452.000 Vm2 6457.000 Vm 5.000	ti1 110 to1 100 ti2 115 to2 101 tm 106.8 to 100.5	Vw 4.778 (188.028)	tw1 77.9 tw2 77.9 tw 77.9	Pw 0.88	θ 5.52 (5.31)	cfm 0.92	CF 1.043
Ho 1.25	Vm1 6458.000 Vm2 6463.000 Vm 5.000	ti1 116 to1 101 ti2 121 to2 109 tm 111.8 to 105	Vw 4.670 (183.770)	tw1 77.9 tw2 77.7 tw 77.8	Pw 1.05	θ 4.9 (4.54)	cfm 0.95	CF 1.046

Orifice Setting Ho	Y: $\frac{Vm \cdot CF \cdot (Pb - \frac{Pw}{13.6}) \cdot (tm+460)}{Vm \cdot (Pb + \frac{Ho}{13.6}) \cdot (tw+460)}$	K: $\frac{17.65 \cdot Y \cdot Vm \cdot (Pb + \frac{Ho}{13.6})}{(tm+460) \cdot \sqrt{Ho}}$	KD: $K\sqrt{(to+460)/Pb}$
0.25	1.037	0.964	4.11
0.50	1.033	0.912	3.91
0.75	1.040	0.897	3.87
1.00	1.045	0.882	3.82
1.28	1.033	0.861	3.75
Average	1.038		3.89

Calibrated by Paul Leyendecker

Date 5-14-87 Meter No. 1

Barometric Pressure 29.75 in Hg

DRY GAS METER					WET TEST				METER	
Orifice Setting	Volume	Temperatures			Volume	Temp	Pres	Time	Indicated Flow	Correction Factor
Ho .25	Vm1 6219.000	ti1 79	to1 78			tw1 74.8			cfm 0.46	
	Vm2 6223.000	ti2 84	to2 80			tw2 74.6				
	Vm 4.000	tm 80.3	to 79	Vw 3.964		tw 74.7	Pw 0.35	θ 9.55		CF 1.027
				15 (.214)				8.33		
Ho .50	Vm1 6224.000	ti1 85	to1 81			tw1 74.6			cfm 0.63	
	Vm2 6229.000	ti2 92	to2 86			tw2 74.4				
	Vm 5.000	tm 85.8	to 83	Vw 4.854		tw 74.5	Pw 0.59	θ 7.67		CF 1.034
				19 (.104)				7.40		
Ho .75	Vm1 6230.000	ti1 93	to1 87			tw1 74.4			cfm 0.76	
	Vm2 6235.000	ti2 100	to2 91			tw2 74.4				
	Vm 5.000	tm 92.8	to 89	Vw 4.798		tw 74.4	Pw .074	θ 6.35		CF 1.038
				19 (.048)				6.21		
Ho 1.00	Vm1 6236.000	ti1 101	to1 92			tw1 74.4			cfm .086	
	Vm2 6241.000	ti2 107	to2 99			tw2 74.4				
	Vm 5.000	tm 99.5	to 95	Vw 4.727		tw 74.4	Pw 0.95	θ 5.50		CF 1.042
				18 (.227)				5.30		
Ho ____	Vm1 ____	ti1 ____	to1 ____			tw1 ____			cfm ____	
	Vm2 ____	ti2 ____	to2 ____			tw2 ____				
	Vm ____	tm ____	to ____	Vw ____		tw ____	Pw ____	θ ____		CF ____

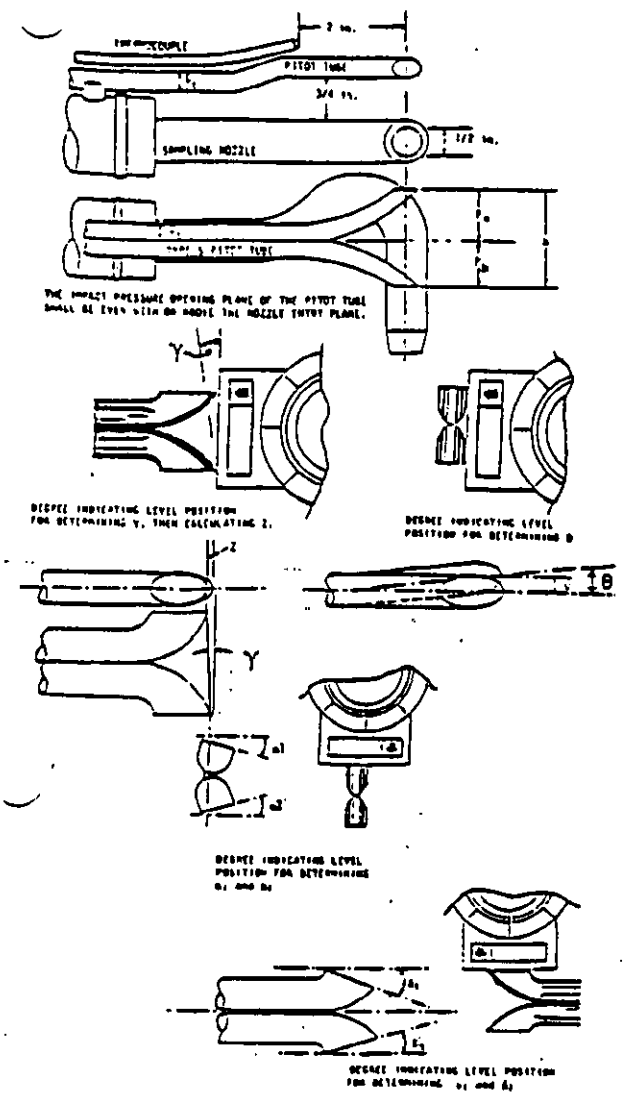
Orifice Setting Ho	Y: $\frac{Vw \times CF \times (Pb - \frac{Pw}{13.6}) \times (tm+460)}{Vm \times (Pb + \frac{Ho}{13.6}) \times (tw+460)}$	K: $\frac{17.65 \times Y \times Vm \times (Pb + \frac{Ho}{13.6})}{(tm+460) \times \theta \times \sqrt{Ho}}$	KO: $K \times \sqrt{(to+460)/Pb}$
0.25	1.027	.934	3.98
0.50	1.022	.908	3.88
0.75	1.027	0.888	3.82
1.00	1.026	0.878	3.79
____	____	____	____
Average	1.026	____	3.87

Calibrated by Paul Scapert

PITOT TUBE INSPECTION DATA SHEET

Company Name: _____

Date 1/6/87



Yes	level?	
No	obstructions?	
No	damaged?	
-2	$-10° < \alpha_1 < +10°$	
+2	$-10° < \alpha_2 < +10°$	
+2	$-5° < \beta_1 < +5°$	
-3	$-5° < \beta_2 < +5°$	
2	γ	
2	θ	
0.614	A	
0.307	$1.05\ D_t < P_a < 1.5\ D_t$	
0.307	$1.05\ D_t < P_b < 1.5\ D_t$	
0.257	$3/16" \leq D_t \leq 3/8"$	
0.021	A tan γ < 0.125"	
0.021	A tan θ < 0.03125"	
Yes	$P_a = P_b \pm 0.063"$	

Comments: _____

Pitot tube/probe number 22 meets or exceeds all specifications criteria and/or applicable design features* and is hereby assigned a pitot tube calibration factor of 0.84.

Signature _____

Date 1/6/87

*See 40 CFR 60, Vol. 42, No. 160, Method 2. Verify the minimum 2 inch setback of the thermocouple and the minimum 3/4 inch separation between the pitot tube and the nozzle as shown at the top of this page.