AP42 Section:	11.7
Reference:	20
Title:	Report To American Standard On Stack Particulate Samples Collected At Tiffin, OH (Test Date August 18, 1992), Affiliated Environmental Services, Inc., Sandusky, OH, August 24, 1992.

R00

AP-42 Section 11.7
Reference 20
Report Sect. 4
Reference 18

affiliated Environmental services, inc.

American Standard Corp.
Attn: Mr. Dave Kiesel
324 Forth Ave.
Tiffin, OH 44883

REPORT TO AMERICAN STANDARD

ON

STACK PARTICULATE SAMPLES
COLLECTED AT
TIFFIN, OH

SUBMITTED BY

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

DATE OF TESTING: 8-18-92

DATE OF REPORT: 8-24-92

Joe Gillingham
FIELD TEST SUPERVISOR

Don Dauch
MANAGER, AIR SAMPLING DIVISION

3606 Venice Road • Sandusky, Ohio 44870 • (419) 627-1976 • FAX: (419) 625-3753

CONTACT REPORT--MRI Project No. 4603-01-05

From: Brian Shrager, Environmental Engineering Department

Date of Contact: June 4, 1996

Contacted by: Telephone

Company/Agency: Ohio EPA

Telephone Number: (419) 373-3117

Person(s) Contacted/Title(s)

Paul Chad, Air Quality Engineer

CONTACT SUMMARY: Mr. Chad returned an earlier call placed to Mr. Gerry Rich of the Ohio EPA. I contacted Mr. Rich to request some process information for several emission tests for American Standard (ceramic spray booths) that he sent to MRI in November, 1994. Specifically, I asked for a conversion factor to convert gallons per hour of glaze to tons per hour of glaze. Mr. Chad found information for two of the three spray booths. The glaze density from booth R001 from 1985 was 14.5 lb/gal as was the glaze density from booth R005 in 1995. Based on this consistent result, this factor is assumed to be valid for the tests conducted on these sources in 1992 and spray booth R008 in 1994.

DATE - AUGUST 7, 1994

Company Name	County	Source	Source #	Emission Rate	Production Rate	Test Method
American Standard	Seneca	Ceramic Glaze Spray Booth	R001	.95 lb/hr	60 gal/hr	1-5
		" "	R005	.24 lb/hr	24.6 gal./hr	1-5
		" "	R008	.31 lb/hr	~~340.75~~ 23.5 gal./hr	1-5

Tom Satler - handles test reports - will have someone copy reports & send them.

14.5 lb/gal Paul Chad
1985 R001 (419)373-3117
1995 R005

TABLE OF CONTENTS

INTRODUCTION

This report contains the results of stack particulate emissions testing performed by Affiliated Environmental Services, Inc. for American Standard, Tiffin, OH. Testing was performed on 8-18-92. This is a Ceramic Glaze line with 2 spray booths. The exhaust air is cleaned by a wet scrubber. Air is exhausted out a 34" diameter stack. Production was monitored by American Standard personnel and can be found in the appendix. This test was witnessed by a representative of the OEPA.

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 was performed on a computer. A description of the method 1-5 test follows on the next few pages.

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

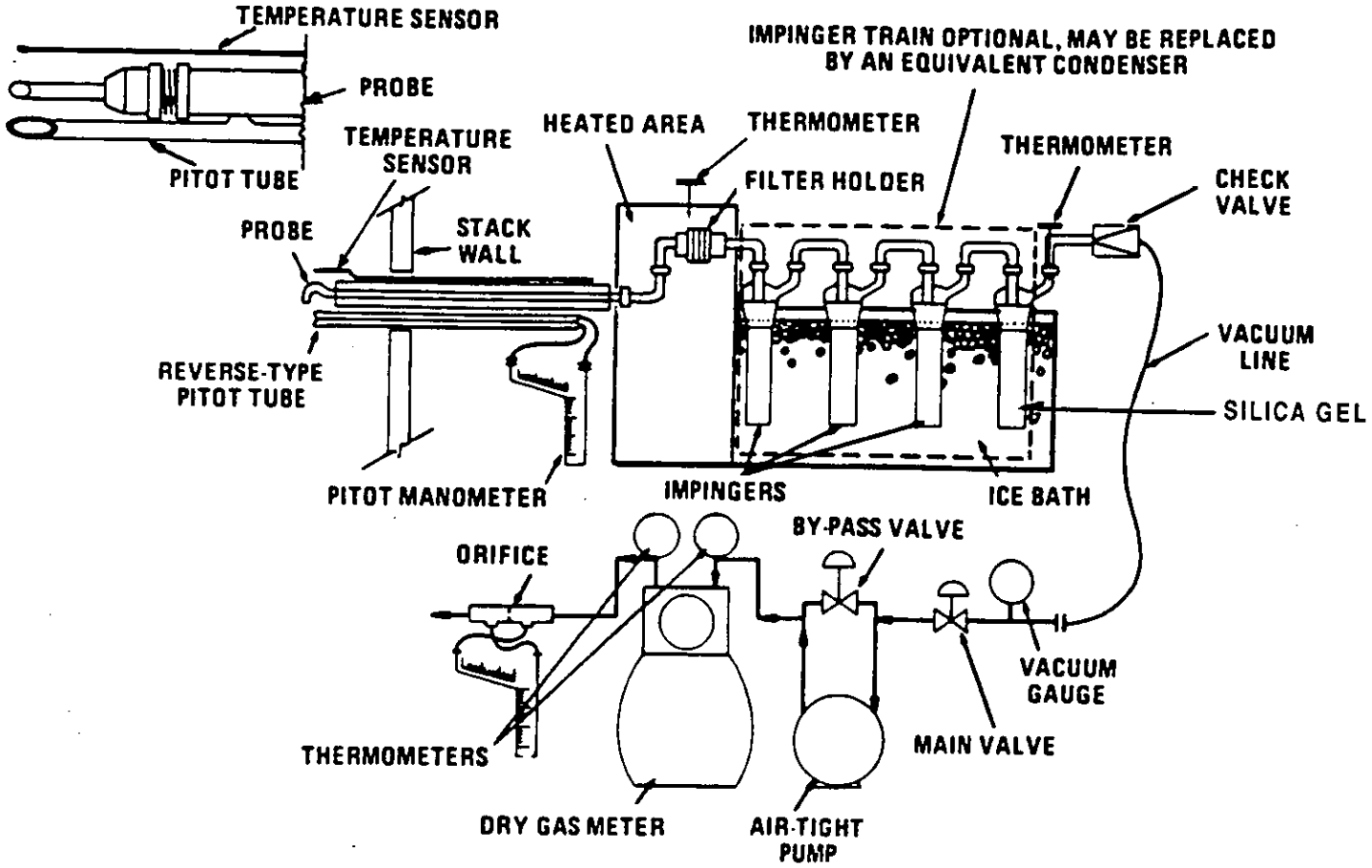
Determination of Moisture Content.

A gas sample is extracted at a constant rate from the source. Moisture is determined 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 SHEET

Test No.	gr/dscf(A)	x10^{-6} lbs/dscf(B)	lbs/hr
1	0.0038	0.05409	.9
2	0.0064	0.09161	1.47
3	0.0021	0.02973	.48

(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 %
1	27,644	86	4.4	0.0	21.0	0
2	26,831	85	5.4	0.0	21.0	0
3	26,814	86	4.5	0.0	21.0	0

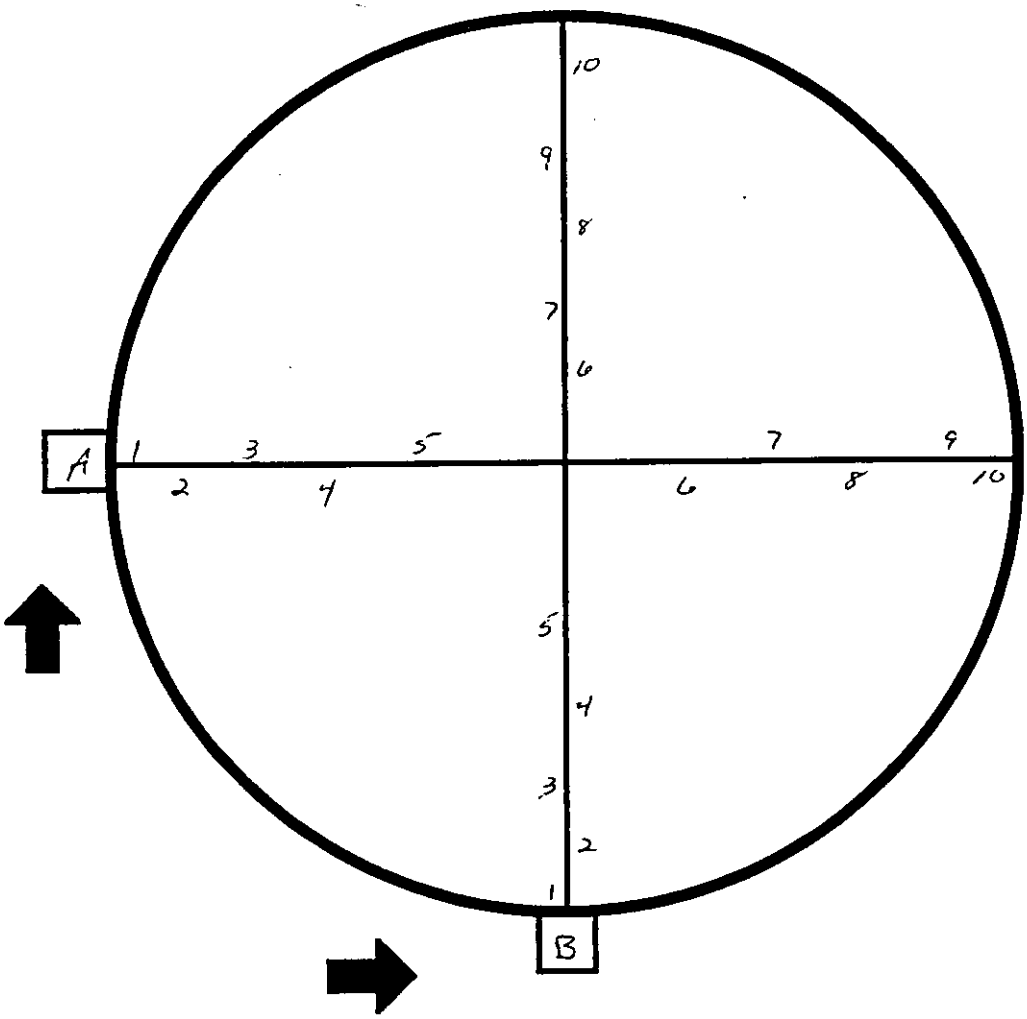
(A) = Dry standard cubic feet per minute at 68°F and 29.92 inches Hg

LOCATION OF SAMPLING POINTS DURING PARTICULATE EMISSIONS TESTING

Distance A= 25'

Distance B= 25'

34" diameter stack



Sample Point #	Distance from Inside of Stack Wall (inches)	Sample Point #	Distance from Inside of Stack Wall (inches)
1	1.0"	6	22.4"
2	2.8"	7	26.3"
3	5.0"	8	29.0"
4	7.7"	9	31.2"
5	11.6"	10	33.0"

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

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

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 collecte

PLANT NAME: AMERICAN STANDARD

SOURCE I.D.: R-001 outlet DATE: 8-18-92

STACK PARTICULATE SAMPLE LABORATORY DATA SHEET

Run # 1 Lab Analysis by: Joe Billingham

Date: 8-21-92

	FINAL WEIGHT mg	INITIAL WEIGHT mg	NET WEIGHT GAIN mg
Filter	639.5	638.4	1.1
Probe wash	104817.3	104806.1	11.2
Impingers	100735.7	100713.0	22.7

SILICA	IMPINGER
Final Weight = 558	Final Volume = 240
Initial Weight = 550	Initial Volume = 200
Total Gain +8	Total Gain +40

Total gain mg	35.0
Filter & Wash mg	12.3
- Acetone blank mg	-.15
Net Particulate Weight mg	12.15

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

PLANT NAME: American Standard

SOURCE I.D.: R-001 outlet DATE: 8-18-92

STACK PARTICULATE SAMPLE LABORATORY DATA SHEET

Run # 2 Lab Analysis by: Joe Tillinghast

Date: 8-21-92

	FINAL WEIGHT mg	INITIAL WEIGHT mg	NET WEIGHT GAIN mg
Filter	642.8	636.1	6.7
Probe wash	105225.0	105211.5	13.5
Impingers	109073.6	109039.2	34.4

SILICA	IMPINGER
Final Weight = 558	Final Volume = 250
Initial Weight = 550	Initial Volume = 200
Total Gain +8	Total Gain +50

Total gain mg	54.6
Filter & Wash mg	20.2
- Acetone blank mg	-.15
Net Particulate Weight mg	20.05

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

PLANT NAME: American Standard

SOURCE I.D.: R-001 outlet DATE: 8-18-92

STACK PARTICULATE SAMPLE LABORATORY DATA SHEET

Run # 3 Lab Analysis by: Joe Tillingham

Date: 8-21-92

	FINAL WEIGHT mg	INITIAL WEIGHT mg	NET WEIGHT GAIN mg
Filter	636.9	633.7	3.2
Probe wash	102834.6	102831.2	3.4
Impingers	105181.8	105180.2	1.6

SILICA	IMPINGER
Final Weight =	Final Volume =
Initial Weight =	Initial Volume =
Total Gain	Total Gain

Total gain mg	8.2
Filter & Wash mg	6.6
- Acetone blank mg	-.15
Net Particulate Weight mg	6.45

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: American Standard R001

DATE OF TEST: 8-18-92

STACK SAMPLING PARAMETERS

TEST RUN NUMBER 1

MINUTES OF TEST	60
VOLUME OF GAS COLLECTED cubic feet	51.134
METER CALIBRATION FACTOR Y	1
BAROMETRIC PRESSURE	30.02
PRESSURE DIFFERENTIAL ACROSS ORIFICE DELTA H	2.49
METER TEMPERATURE (+460)	550
STACK STATIC PRESSURE (HG)	.0044
STACK TEMPERATURE (+460)	546
AVERAGE SQUARE ROOT OF VELOCITY HEAD	1.37
VOLUME OF IMPINGER WATER COLLECTED ml	40
WEIGHT OF SILICA COLLECTED gms	8
AREA OF SAMPLING NOZZLE square feet	.0001928
PITOT TUBE COEFFICIENT	.84
AREA OF STACK square feet	6.305
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	49.533
VOLUME OF WATER VAPOR cubic feet	2.261
PERCENT MOISTURE IN STACK GAS	4.4
DRY GAS MOLECULAR WEIGHT	28.84
STACK GAS MOLECULAR WEIGHT	28.363
VELOCITY OF STACK GAS feet per second	78.768
FLOW RATE OF STACK GAS DSCFH	1658629
FLOW RATE OF STACK GAS DSCFM	27644
ISOKINICITY %	97.7
WEIGHT GAIN OF IMPINGERS mg	22.7
WEIGHT GAIN OF FILTER mg	1.1
WEIGHT GAIN OF PROBE WASH mg	11.2
PARTICULATES COLLECTED POUNDS/HOUR	.9
PARTICULATES COLLECTED GRAINS/DSCF	.0038
PARTICULATES COLLECTED POUNDS/DSCF	5.409E-07

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

PLANT NAME: American Standard R001

DATE OF TEST: 8-18-92

STACK SAMPLING PARAMETERS

TEST RUN NUMBER 2

MINUTES OF TEST	60
VOLUME OF GAS COLLECTED cubic feet	51.099
METER CALIBRATION FACTOR Y	1
BAROMETRIC PRESSURE	30.02
PRESSURE DIFFERENTIAL ACROSS ORIFICE DELTA H	2.4
METER TEMPERATURE (+460)	564
STACK STATIC PRESSURE (HG)	.0044
STACK TEMPERATURE (+460)	545
AVERAGE SQUARE ROOT OF VELOCITY HEAD	1.34
VOLUME OF IMPINGER WATER COLLECTED ml	50
WEIGHT OF SILICA COLLECTED gms	8
AREA OF SAMPLING NOZZLE square feet	.0001928
PITOT TUBE COEFFICIENT	.84
AREA OF STACK square feet	6.305
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	48.26
VOLUME OF WATER VAPOR cubic feet	2.732
PERCENT MOISTURE IN STACK GAS	5.4
DRY GAS MOLECULAR WEIGHT	28.84
STACK GAS MOLECULAR WEIGHT	28.255
VELOCITY OF STACK GAS feet per second	77.11901
FLOW RATE OF STACK GAS DSCFH	1609868
FLOW RATE OF STACK GAS DSCFM	26831
ISOKINICITY %	98
WEIGHT GAIN OF IMPINGERS mg	34.4
WEIGHT GAIN OF FILTER mg	6.7
WEIGHT GAIN OF PROBE WASH mg	13.5
PARTICULATES COLLECTED POUNDS/HOUR	1.47
PARTICULATES COLLECTED GRAINS/DSCF	.0064
PARTICULATES COLLECTED POUNDS/DSCF	9.161E-07

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

PLANT NAME: American Standard R001

DATE OF TEST: 8-18-92

STACK SAMPLING PARAMETERS

TEST RUN NUMBER 3

MINUTES OF TEST	60
VOLUME OF GAS COLLECTED cubic feet	51.007
METER CALIBRATION FACTOR Y	1
BAROMETRIC PRESSURE	30.02
PRESSURE DIFFERENTIAL ACROSS ORIFICE DELTA H	2.37
METER TEMPERATURE (+460)	568
STACK STATIC PRESSURE (HG)	.0044
STACK TEMPERATURE (+460)	546
AVERAGE SQUARE ROOT OF VELOCITY HEAD	1.33
VOLUME OF IMPINGER WATER COLLECTED ml	40
WEIGHT OF SILICA COLLECTED gms	8
AREA OF SAMPLING NOZZLE square feet	.0001928
PITOT TUBE COEFFICIENT	.84
AREA OF STACK square feet	6.305
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	47.83
VOLUME OF WATER VAPOR cubic feet	2.261
PERCENT MOISTURE IN STACK GAS	4.5
DRY GAS MOLECULAR WEIGHT	28.84
STACK GAS MOLECULAR WEIGHT	28.352
VELOCITY OF STACK GAS feet per second	76.483
FLOW RATE OF STACK GAS DSCFH	1608829
FLOW RATE OF STACK GAS DSCFM	26814
ISOKINICITY %	97.3
WEIGHT GAIN OF IMPINGERS mg	1.6
WEIGHT GAIN OF FILTER mg	3.2
WEIGHT GAIN OF PROBE WASH mg	3.4
PARTICULATES COLLECTED POUNDS/HOUR	.48
PARTICULATES COLLECTED GRAINS/DSCF	.0021
PARTICULATES COLLECTED POUNDS/DSCF	2.973E-07

A.E. SERVICES, INC. — PARTICULATE SAMPLE DATA SHEET (Method 5)

Avg. Fyrite Analysis: 0.0 % CO_2 21.0 % O_2

Location	American Standard	Ambient Temp.	65
Stack	R001 OUTLET	Barometric Pres.	30.02
Operator	TOM SATTLER	Assumed Moisture %	3%
Date	5-18-92	Heater Box Setting	248±25
Run Number	F	Probe Length & No.	3' /#
Pitot Tube Coeff.	.84 /#	Nozzle Diameter & No.	.188 /# AREA .0001928
Area of Stack	34" dia 6.305 AREA	Probe Heater Setting	248±25

Additional Information:

START	STOP
A- 8:18	- 9:48
B- 8:52	- 9:22

Base Unit # 4

STATIC PRESSURE "H2O (Ps) .06 = "Hg. .0044

LEAK CHECK "Hg Initial OK 4.005 AT 10" Final OK 4.015 AT 15"

PITOT LEAK CHECK Initial OK Final OK

10 MIN. CHECK Final 760.742 - 7.532 Initial 753.210

Witnessed by

Pt. #	Time Min.	Stack temp f	Δ P	√ Δ P	Δ H	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	85	1.5	1.22	1.95	760.328	70	70	236	241	6.0	1/2
2	3 - 6	87	1.5	1.22	1.95	762.2	72	70	248	254	6.0	50
3	6 - 9	85	1.8	1.34	2.34	764.5	82	70	256	258	7.0	54
4	9 - 12	86	2.0	1.41	2.6	766.9	88	72	258	261	7.0	54
5	12 - 15	88	2.1	1.45	2.73	769.3	90	74	255	253	7.5	56
6	15 - 18	85	2.1	1.45	2.73	772.0	96	78	252	258	7.5	56
7	18 - 21	83	2.0	1.41	2.60	774.8	96	78	251	255	7.5	54
8	21 - 24	85	2.0	1.41	2.60	777.4	96	78	250	252	7.5	54
9	24 - 27	88	2.0	1.41	2.60	780.2	98	78	253	259	7.5	56
10	27 - 30	56	1.9	1.38	2.51	782.6	106	82	255	261	7.0	56
1-B	0 - 3	86	2.0	1.41	2.64	785.4	102	82	253	256	7.0	54
2	3 - 6	87	1.9	1.38	2.51	787.8	108	84	250	258	7.0	54
3	6 - 9	89	2.1	1.45	2.77	790.4	108	84	249	260	7.5	58
4	9 - 12	55	2.1	1.45	2.77	793.1	108	86	253	261	7.5	56
5	12 - 15	87	2.1	1.45	2.77	795.7	110	86	255	259	7.5	56
6	15 - 18	85	2.1	1.45	2.77	798.4	112	86	258	256	7.5	56
7	18 - 21	84	2.1	1.45	2.77	801.2	112	86	256	253	7.5	58
8	21 - 24	86	1.8	1.34	2.38	803.9	114	88	251	249	7.0	54
9	24 - 27	85	1.6	1.26	2.11	806.7	114	88	258	255	6.0	54
10	27 - 30	85	1.3	1.14	1.72	809.1	114	86	256	248	5.0	54
						811.462						
total		1717		27.48	49.82		avg. 100	avg. 80				
Avg.		86		1.37	2.49	51.134	Avg. 90	550				

A.E. SERVICES, INC.

PARTICULATE SAMPLE DATA SHEET
(Method 5)

Avg. Fyrite Analysis: 0.0 % CO_2 21.0 %O_2

Location	AMERICAN STANDARD	Ambient Temp.	70
Stack	R001 OUTLET	Barometric Pres.	30.02
Operator	TOM SMITH	Assumed Moisture %	3%
Date	8-18-92	Heater Box Setting	248±25
Run Number	#F	Probe Length & No.	3' /#
Pitot Tube Coeff.	.84 /#	Nozzle Diameter & No.	.188 /#
Area of Stack	34" D.A AREA = 6.305	Probe Heater Setting	248 ±25

Additional Information:

START	STOP
A - 9:40	- 10:10
B - 10:12	- 10:42

Base Unit # 4

STATIC PRESSURE "H2O (Ps) .06 = "Hg. .0044

LEAK CHECK "Hg Initial O/C 4.0 @ 11.5" Final O/C 4.006 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
A-1	0-3	85	1.70	1.30	2.24	811.705	92	80	263	249	5.0	46
2	3-6	87	1.80	1.34	2.38	814.1	96	84	265	253	5.5	46
3	6-9	84	1.90	1.38	2.51	816.5	98	84	263	256	6.0	46
4	9-12	84	2.10	1.45	2.77	819.3	105	86	256	258	6.0	46
5	12-15	85	2.10	1.45	2.77	821.8	110	86	260	264	6.0	46
6	15-18	85	1.90	1.38	2.51	824.5	112	88	258	261	6.0	46
7	18-21	86	1.80	1.34	2.38	827.1	114	90	255	258	6.0	46
8	21-24	85	1.60	1.26	2.11	829.8	118	96	253	255	5.0	46
9	24-27	85	1.30	1.14	1.72	832.2	120	96	256	253	5.0	46
10	27-30	86	1.70	1.30	2.24	834.6	120	98	253	258	5.5	46
1-B	0-3	86	2.0	1.41	2.64	837.0	118	98	256	255	6.5	46
2	3-6	86	2.0	1.41	2.64	839.5	120	98	253	258	6.5	46
3	6-9	85	2.0	1.41	2.64	842.3	120	98	256	260	6.5	46
4	9-12	85	2.0	1.41	2.64	845.0	120	95	253	256	6.5	46
5	12-15	86	2.0	1.41	2.64	847.6	120	98	256	253	6.5	46
6	15-18	85	2.0	1.41	2.64	850.3	120	98	255	251	6.5	46
7	18-21	85	2.1	1.45	2.77	852.8	120	98	258	254	7.0	46
8	21-24	86	1.7	1.30	2.24	855.7	120	100	255	253	6.0	46
9	24-27	85	1.3	1.14	1.72	858.1	120	100	253	258	6.0	46
10	27-30	84	1.3	1.14	1.72	860.4	120	100	250	253	6.0	46
						862.804						
total		17016		26.83	42.92		avg. 114	avg. 94				
Avg.		85		1.34	2.40	51.099	Avg. 104	564				

A.E. SERVICES, INC.

PARTICULATE SAMPLE DATA SHEET
(Method 5)

Avg. Fyrite Analysis: 0.0 % CO_2 21.0 % O_2

Location	American Standard	Ambient Temp.	75
Stack	Roof Outlet	Barometric Pres.	30.02
Operator	Tom Smith	Assumed Moisture %	3%
Date	5-18-92	Heater Box Setting	245 ± 25
Run Number	III	Probe Length & No.	3' /#
Pitot Tube Coeff.	.84 /#	Nozzle Diameter & No.	.188 /#
Area of Stack	34" 6.305	Probe Heater Setting	248 ± 25

Additional Information:

	START	STOP
A	10:58	11:28
B	11:30	12:00

Base Unit # C1

STATIC PRESSURE "H2O (Ps) .06 = "Hg. .0044

LEAK CHECK "Hg Initial OK <.005 AT 10" Final OK <.005 AT 10"

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	86	1.9	1.38	2.51	863.028	98	98	236	245	6.0	46
2	3-6	85	1.9	1.38	2.51	865.4	100	98	244	256	6.0	46
3	6-9	85	1.9	1.38	2.51	867.6	100	98	247	262	6.0	46
4	9-12	85	2.1	1.45	2.77	870.7	102	98	251	263	6.5	48
5	12-15	85	2.1	1.45	2.77	873.2	104	98	256	258	6.5	48
6	15-18	86	2.1	1.45	2.77	876.0	100	98	258	261	6.5	48
7	18-21	85	1.8	1.34	2.38	878.7	108	100	260	253	6.0	48
8	21-24	86	1.6	1.27	2.11	881.3	110	100	263	255	6.0	48
9	24-27	86	1.3	1.14	1.72	883.7	112	100	260	258	6.0	48
10	27-30	85	1.3	1.14	1.72	885.9	114	100	256	255	6.0	48
1-B	0-3	86	1.7	1.30	2.27	888.4	112	102	255	253	6.5	48
2	3-6	86	1.9	1.38	2.51	890.6	116	102	258	254	6.5	48
3	6-9	87	2.0	1.41	2.70	893.2	118	102	260	242	6.5	48
4	9-12	85	2.1	1.45	2.84	895.9	120	104	263	245	7.0	48
5	12-15	86	2.1	1.45	2.84	898.8	122	104	258	250	7.0	52
6	15-18	86	1.8	1.34	2.43	901.6	124	106	254	257	7.0	52
7	18-21	85	1.7	1.30	2.30	904.2	126	106	252	244	7.5	54
8	21-24	86	1.6	1.27	2.16	906.7	126	106	251	249	7.0	54
9	24-27	85	1.3	1.14	1.76	909.1	128	106	257	254	6.5	52
10	27-30	85	1.3	1.14	1.76	911.7	128	106	254	256	6.5	54
						914.035						
total		1711		26.56	47.31		avg. 113	avg. 102				
Avg.		86		1.33	2.37	51.007	Avg. 108	568				

APPENDIX

Date 7-3-92

Metering System Identification: #4

Barometric pressure, P_b = 29.85 in. H_g

Calibrated by: [signature]

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	7.726	7.944	74	98	84	91	20
1.0	12.605	13.329	74	114	100	107	23
1.5	12.925	13.856	74	120	104	112	20
2.0	14.667	15.868	74	122	108	115	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 = 1.00	ΔH = 1.87
1.0	Y = 1.00	ΔH = 1.80
1.5	Y = 1.00	ΔH = 1.93
2.0	Y = .99	ΔH = 1.99
Average	Y = 1.00	ΔH = 1.90

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 7-3-92 Thermocouple number 3'55

Ambient temperature 23 °C Barometric pressure 29.89 in. Hg

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

other

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference[c], %
3A	Boiling water	99.9	98	0.5
			1	0.3
3B	ice bath	0.2	98	0.5
			2	0.7
3C			99	0.5
			2	0.7

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

[b] Type of calibration system used.

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

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 7-3-92 Thermocouple number RAC Meter Boxes

Ambient temperature 23 °C Barometric pressure 29.89 in. Hg

Calibrator [illegible] 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	73	74		
2	73	73		
3	74	74		
4	74	73		
6	73	74		

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

[b]Type of calibration system used.

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

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NOZZLE CALIBRATION DATA FORM

Date 8-18-92 Calibrated by Joe Tillingham

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	.188	.188	.188		.188
B	.188	.187	.188		.188
C	.187	.188	.188		.188

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.

ANALYTICAL BALANCE CALIBRATION FORM

Balance name Mettler Number H30

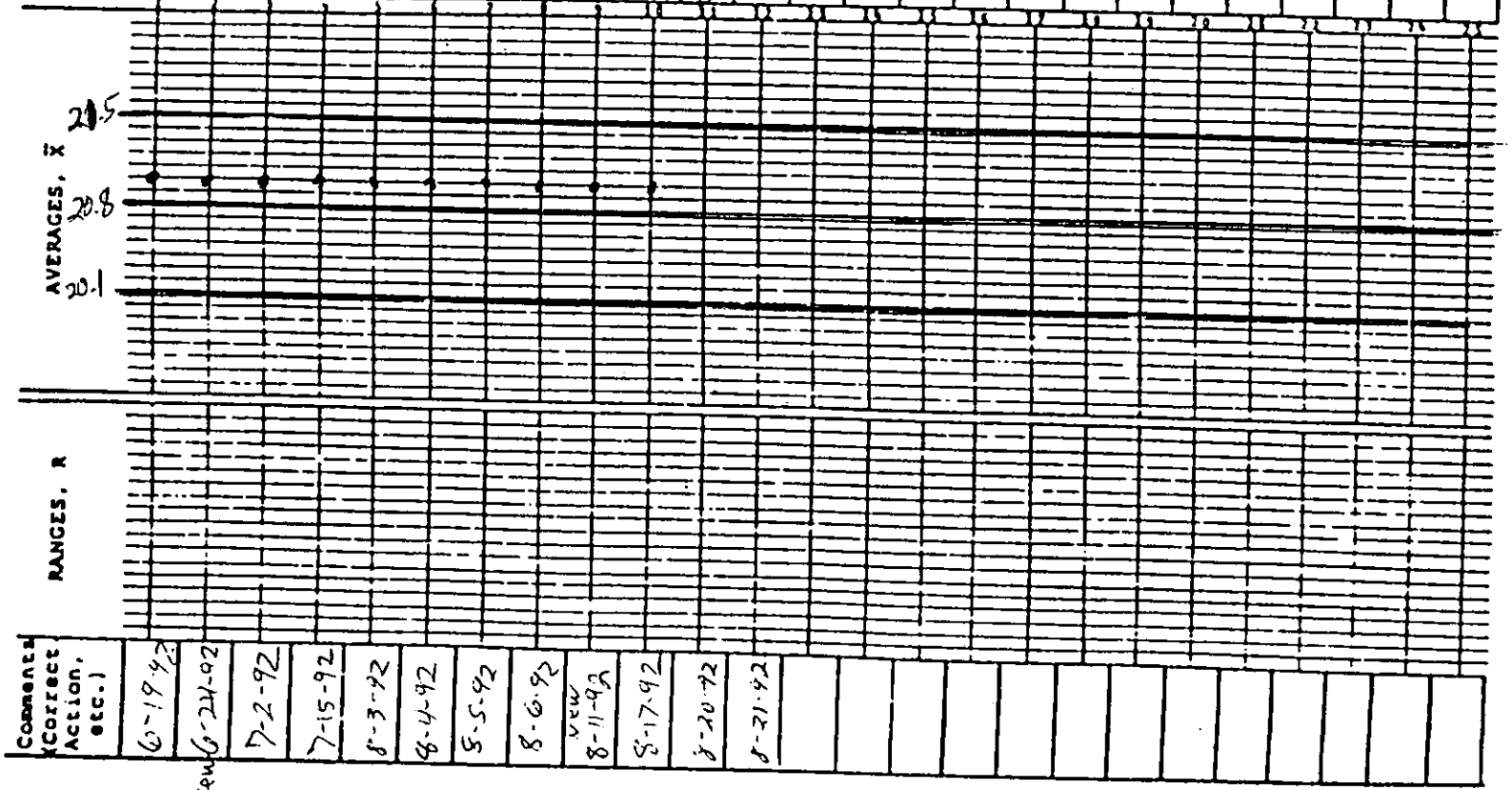
Classification of standard weights NBS

Date	0.2000 g	1.0000 g	10.000 g	50.0000 g	100.0000 g	Analyst
6-9-92	200.0	1.0000			100.0000	
6-11-92	200.0	1.0000			100.0000	
6-12-92	200.0	1.0000			100.0000	T.S.
6-15-92	200.0	1.0000			100.0000	
6-17-92	200.0	1.0000			100.0000	
6-18-92	200.0	1.0000			100.0000	
6-22-92	200.0	1.0000			100.0000	
6-30-92	200.0	1.0000			100.0000	JG
7-7-92	200.0	1.0000			100.0000	
7-13-92	200.0	1.0000			100.0000	JG
7-17-92	200.0	1.0000			100.0000	JG
7-20-92	200.0	1.0000			100.0000	TS
7-28-92	200.0	1.0000			100.0000	TS
8-4-92	200.0	1.0000			100.0000	TS
8-5-92	200.0	1.0000			100.0000	JG
8-6-92	200.0	1.0000			100.0001	
8-7-92	200.0	1.0000			100.0001	
8-10-92	200.0	1.0000			100.0001	
8-13-92	200.0	1.0000			100.0001	
8-15-92	200.0	1.0000			100.0001	
8-20-92	200.0	1.0000			100.0001	
8-21-92	200.0	1.0000			100.0001	

$\bar{X}$ AND R CHART

PROJECT NAME: Pyrite Calibration MEASUREMENT PERFORMED: AIR MEASUREMENT UNITS: Oxygen Percent V/V

DATE														
MEASUREMENT CODE		1												
		2												
		3												
MEASUREMENT RESULT	1	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	
	2	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	
	3	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	
SUM		63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	
AVERAGE $\bar{X}$		21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	
RANGE, R		0	0	0	0	0	0	0	0	0	0	0	0	



Comments (Correct Action, etc.)	6-19-92	6-24-92	7-2-92	7-15-92	8-3-92	8-4-92	8-5-92	8-6-92	new 8-11-92	8-17-92	8-20-92	8-21-92																		
		new																												

D-25

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? ✓ yes _____ no

Pitot tube openings damaged? ____ yes (explain below) ✓ no

α_1 = 3 ° (<10°), α_2 = 2 ° (<10°), β_1 = 1 ° (<5°),

β_2 = 1 ° (<5°)

γ = 2 °, θ = 1 °, A = 1.10 cm (in.)

z = A sin γ = 0.038 cm (in.); <0.32 cm (<1/8 in.),

w = A sin θ = 0.019 cm (in.); <.08 cm (<1/32 in.)

P_A 0.551 cm (in.) P_b 0.549 cm (in.)

D_t = 0.375 cm (in.)

Comments: 3' SS A Don Daniel 6-2-92

adjusted 0.84

Calibration required? ____ yes X no

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? ✓ yes ______ no

Pitot tube openings damaged? ______ yes (explain below) ✓ no

α_1 = 2 ° (<10°), α_2 = 2 ° (<10°), β_1 = 1 ° (<5°),
β_2 = 1 ° (<5°)

γ = 1 °, θ = 1 °, A = 1.10 cm (in.)

z = A sin γ = 0.019 cm (in.); <0.32 cm (<1/8 in.),
w = A sin θ = 0.019 cm (in.); <.08 cm (<1/32 in.)

P_A 0.552 cm (in.) P_b 0.545 cm (in.)

D_t = 0.375 cm (in.)

Comments: 3' SS B [illegible] 6-2-92
[illegible] 0.44

Calibration required? ______ yes X no

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? ✓ yes _____ no

Pitot tube openings damaged? _____ yes (explain below) ✓ no

α_1 = 2 ° (<10°), α_2 = 2 ° (<10°), β_1 = 1 ° (<5°),

β_2 = 2 ° (<5°)

γ = 2 °, θ = 1 °, A = 1.10 cm (in.)

z = A sin γ = 0.038 cm (in.); <0.32 cm (<1/8 in.),

w = A sin θ = 0.010 cm (in.); <.08 cm (<1/32 in.)

P_A 0.550 cm (in.) P_b 0.550 cm (in.)

D_t = 0.375 cm (in.)

Comments: 3' SS C (illegible) in-2-97

additional mod

Calibration required? _____ yes ✓ no

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