OGDEN MARTIN SYSTEMS OF HILLSBOROUGH INC.

40 LANE ROAD
CN 2615
FAIRFIELD, NEW JERSEY 07007-2615
(201) 882-9000

AN OGDEN COMPANY

DER
JUN 15 1987
BAQM

June 11, 1987

HC-0867L
C-1005

Mr. Jerry Campbell
Hillsborough County Environmental Protection Commission
1900 9th Avenue
Tampa, FL 33605

Subject: Hillsborough County Florida
Solid Waste Energy Recovery Project
Supplemental Information for Retesting
Scheduled Week of June 15,1987

Dear Mr. Campbell:

This notice is sent as a matter of clarification to my letter of June 10, 1987, advising you of our intent to utilize CARB 100 as the procedure for retesting for volatile hydrocarbons (VOC) at the Hillsborough County Solid Waste Energy Recovery Facility. The procedure referred to as CARB 100 is, in fact, EPA method 25A and is at present being utilized by EPA in testing currently in progress at Ogden Martin Systems Marion County Oregon Facility.

By separate cover, we have forwarded to your attention a full copy of the "Radian Source Test Plan" prepared for the EPA testing at Marion County. It is our intent to utilize EPA method 25A as stated in the provided Radian Test Plan for Marion County for the retesting for VOC's at the Hillsborough County Solid Waste Energy Recovery Project the week of June 15th, 1987.

As discussed with W. Schroeder (HCEPC) and Dave McNeil (EPA Region IV) by conference call on June 11, 1987, OMSH will test using EPA method 25A separate and simultaneous in both a wet and dry DIF configuration. OMSH understands that EPA Region IV recognizes the wet DIF configuration. We are conducting the dry configuration for comparison.

We hope this clarification will allow us to proceed with our plan for retesting. Please advise us of any further questions or comments directly associated with this issue.

Sincerely,

J. R. Treshler
Senior Project Manager

JRT:hn

cc: R. Hauser
P. Stoller
D. Strobridge
Daryl Smith
Tom Smith
D. Elias
D. Dee
D. Knight
W. Schroeder
Claire Fancy
Paul Reinermann
D. McNeil

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JUN 15 1987

BAQM

June 10, 1987

HC-0866L
C-1005

Mr. Jerry Campbell
Hillsborough County Environmental Protection Commission
1900 9th Avenue
Tampa, FL 33605

Subject: Hillsborough County Florida
Solid Waste Energy Recovery Project
Environmental Testing Report

Dear Mr. Campbell:

Per the request of Bill Schroder, we are officially advising you of our intent to delay issuance of the Emssions Testing Report for the above stated project from the scheduled date of June 15 1987 until June 22, 1987.

As has been discussed with you, in our conversation of June 9, 1987, we have found certain irregularities in the results obtained for H_2SO_4 acid gas mist and VOC testing. We feel essential that we explain and document to you as part of our report submittal. We feel we will have our explanation prepared and ready for issuance to you by June 22, 1987.

We appreciate your cooperation on this issue.

Sincerely yours,

J. R. Treshler
Senior Project Manager

JRT:hn

cc: D. Strobridge
P. Stoller
R. Hauser
T. Smith
D. Dee
D. Knight
Daryl Smith
A. Phillips
Ken Hernandez
W. Schroder
Paul Reinermann
Claire Fancy
Chi-Sun Lee

Hillsborough County — DER - 4/10/87

Buck Oven	DER	904-487-2522
Donald E. Elias	RTP Env. Assoc.	201 968-9600
Julie Costas	DER-OGC	904/488-9730
Barry Andrews	DER-BAQM	904 488-1344
Henry Von Dem Fange	Ogden Projects	(415) 420-1766
David Dee	Carlton Fields	(904) 224-1585
DAVID T. KNIGHT	Shackleford Farrior for Ogden	813-2735000
Wm. A. GILLEN JR.	"	813-273-5000
Joseph Treshler	Ogden Projects	201-882-9000
Richard Seelinger	" " " " "	
Tom ROGERS	DER-BAQM	(904) 488-1344
Pradeep Raval	"	"
C H Fancy	"	"

2 Nov. 1987
Atlanta, GA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET
ATLANTA, GEORGIA 30365

NOV 2 1987

4APT/APB-am

DER
NOV 4 1987
BAQM

Mr. C. H. Fancy, P.E., Chief
Bureau of Air Quality Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301-2400

Re: Hillsborough County PSD-FL-120

Dear Mr. Fancy:

This is to acknowledge receipt of your October 14, 1987, PSD final determination for modifications at the above referenced facility. We have reviewed the changes made to the draft permits submitted to EPA on July 14, 1987, and find them to be in accordance to our recommendations of September 11, 1987. We, therefore, concur on your final determination and the permits issued to Hillsborough County.

We will retain copies of the determinations and permits for our records.

Sincerely yours,

Bruce P. Miller

Bruce P. Miller, Chief
Air Programs Branch
Air, Pesticides, and Toxics
Management Division

Copied: CHF/BT
Barry Andrews
Jon Rogers
11/6/87

HILLSBOROUGH COUNTY
RESOURCE RECOVERY FACILITY
METHOD 8 RETEST
JUNE 16, 1987

Prepared For:

OGDEN PROJECTS, INC.
WATERGATE TOWER I, SUITE 400
1900 POWELL STREET
EMERYVILLE, CA 94608

Prepared By:

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.
5119 NORTH FLORIDA AVENUE
TAMPA, FLORIDA 33603

June 24, 1987

TABLE OF CONTENTS

I. SUMMARY

On June 16, 1987, Environmental Engineering Consultants, Inc. conducted a retest of emissions at the Hillsborough County Resource Recovery Facility in Tampa, Florida. The source tested was the No. 1 steam boiler burning municipal garbage to generate electricity.

Compliance with specified emissions limits was determined using Method 8 for sulfuric acid mist. Carbon monoxide levels were determined using EPA Method 10 to demonstrate normal combustion conditions.

The testing was performed as specified in the Ogden Projects, Inc. source test plan. Carbon monoxide and sulfuric acid mist/sulfur dioxide tests were conducted on a single boiler taken as respresentative of the of fuel-related emission levels.

The tests were conducted by Carl Fink, Jack Fross, Byron Burrows, and James Root of Environmental Engineering Consultants, Inc. with the assistance and cooperation of Ogden Projects, Inc. and the employees of the Hillsborough County Resource Recovery Facility.

During testing the boiler was operating at ±10% of its rated capacity.

A summary of the test results is shown in Tables 1 and 2. The average sulfuric acid mist concentration was 0.0052 grains per dry standard cubic foot, corrected to 12% CO2 (gr/dscf-12%). The current permitted concentration is 0.0040 gr/dscf-12%. The average carbon monoxide concentration was 0.002 gr/dscf-12%. The permitted concentration is 0.093 gr/dscf-12%.

The permitted concentration for sulfuric acid mist was exceeded in this emissions test. The carbon monoxide concentrations indicated normal combustion levels.

I hereby certify that these results are true and correct and were obtained by the procedures and methods described herein.

Respectfully Submitted;

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

Carl F. Fink
Test Team Leader
Senior Air Pollution Engineer

TABLE 1

TEST SUMMATION

PLANT: Hillsborough County Resource Recovery

SOURCE: Boiler No. 1

DATE: June 16, 1987

PARAMETER: Sulfuric Acid Mist

Run No.	Sample Vol. (DSCF)	Flow Rate (ACFM)	Flow Rate (DSCFM)	H20 (%)	Isokinetics (%)	Stack Temp. (°F)	Carbon Dioxide (%)	Acid Mist Concentration (gr/dscf-12%)	Acid Mist Emissions (lb/hr)
1	48.573	89,227	46,156	16.38	98.7	390	9.6	0.0071	2.25
2	46.620	84,425	43,041	16.77	101.6	397	9.9	0.0052	1.59
3	47.568	85,757	43,671	16.24	105.0	404	9.6	0.0033	0.97
Average		86,470	44,289	16.46	101.8	397	9.7	0.0052	1.60

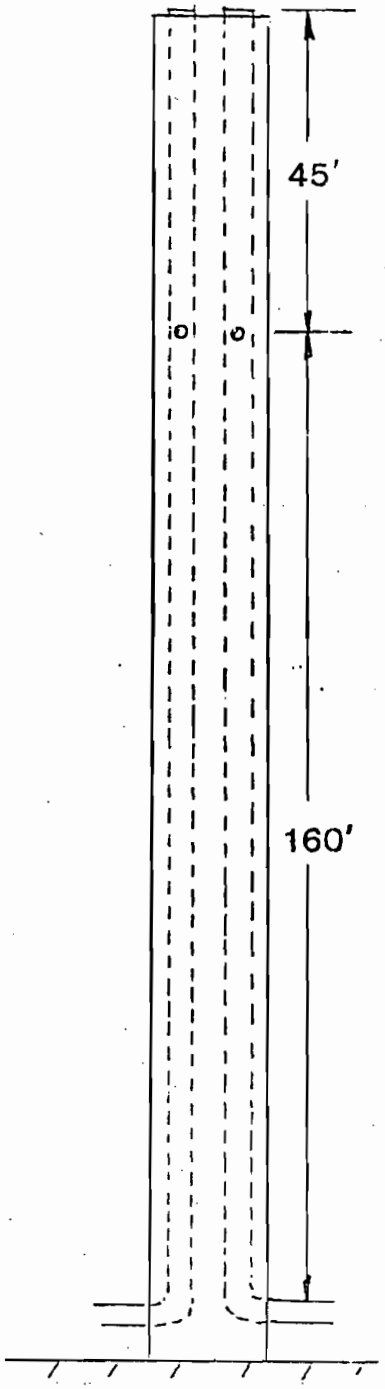
TABLE 2

TEST SUMMATION

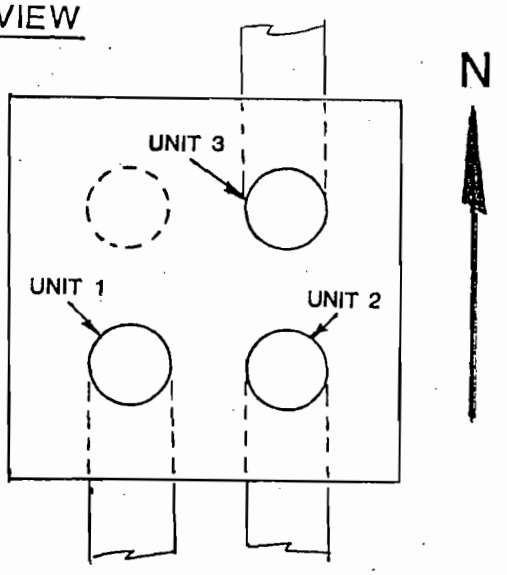
PLANT: Hillsborough County Resource Recovery

PARAMETER: Carbon Monoxide (CO)

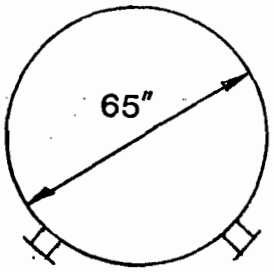
Source/Date	Run Number	Carbon Dioxide (%)	CO Concentration (ppm)	CO Concentration (gr/DSCF-12%)	CO (lb/hr)
Boiler No. 1	1	9.6	4.1	.0026	0.81
June 16, 1987	2	9.9	2.6	.0016	0.48
	3	9.6	2.7	.0017	0.51
	Average			.0020	0.60



TOP VIEW



STACK CROSS SECTION



SAMPLING POINT NUMBER	DISTANCE FROM STACK WALL (IN.)
1	2.86
2	9.49
3	19.24
4	45.76
5	55.51
6	62.14

HILLSBOROUGH CO. RESOURCE RECOVERY
SAMPLING POINT LOCATIONS

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.
CONSULTING ENGINEERS & ENVIRONMENTAL SCIENTISTS

Figure 1

II. SOURCE DESCRIPTION

The Hillsborough County Resource Recovery Facility is located on Faulkenburg Road in Tampa, Florida. Municipal garbage from Hillsborough County is delivered to the facility and charged into three combustion units each firing a boiler to produce steam at a rate of approximately 95,000 pounds per hour. The steam produced drives a turbine generator to produce electricity which is sold to Tampa Electric Company for use in its distribution system.

The exhaust gases from each boiler pass through a separate electrostatic precipitator for particulate matter removal before being vented through separate 65 inch diameter ducts and exhausted at an elevation of 220 ft. The two sampling ports in each duct are located at a point 8.3 stack diameters upstream and 29.5 stack diameter downstream from disturbances in the exhaust flow (see Figure 1). For the continuous measurement type sampling (Method 8) sample ports located as close to ground level as possible were utilized in each of the three ducts.

III. METHODS AND PROCEDURES

CARBON MONOXIDE: EPA Method 10

The Method 10 sampling system was assembled as shown in Figure 2 for each carbon monoxide test. A gas sample was continuously extracted from the duct through a heated pyrex glass probe, heated filter, and teflon tubing to a condenser to remove moisture. After moisture removal the gas was conveyed through teflon tubing to a sample manifold for distributing sample gas at suitable pressure to the appropriate analyzer and for introducing calibration gases directly to the analyzer.

The CO analyzer used was a Thermo Electron Model 48 nondispersive infrared (NDIR) type analyzer operated on the 0-50 ppm scale. The CO values were determined from a continuous stripchart recording of the analyzer output.

The analyzer was calibrated on site before testing using NBS reference gas and a gas dilution system, the use of which was approved on site by HCEPC personnel. At the end of each one hour test run and at the completion of the test, a zero and span drift check was performed. All calibrations and zero and calibration checks were within specified limits.

SULFURIC ACID MIST/SULFUR DIOXIDE: EPA Method 8

The Method 8 sampling train was assembled as shown in Figure 3 for each acid mist/sulfur dioxide test. A six foot probe with a heated pyrex glass liner was used for all test runs. Stack temperature measurements were conducted at each point during sampling. An integrated gas sample was collected through a 1/4"

diameter stainless steel probe fixed to the sampling probe assembly.

The first impinger was a standard Greenburg-Smith (G-S) type charged with 100 ml of 80% isopropanol; the second impinger was modified G-S design charged with 100 ml of 3% hydrogen peroxide; the third was a standard G-S type also charged with 100 ml of 3% hydrogen peroxide; and the fourth impinger was modified G-S type charged with approximately 200 grams of indicator grade silica gel. All impingers were weighed to the nearest 0.5 gram after charging for use in determining moisture collected. Crushed ice was placed around the impingers during sampling to maintain the temperature of the gas leaving the last impinger below 68 ^{o}F.

A borosilicate glass fiber filter in a glass filter holder was placed between the first and second impingers for final acid mist collection. The filter was not heated.

Leak tests were performed before and after each sampling run by blocking the nozzle inlet. No leakages were observed at vacuum levels equal to or exceeding those experienced during sampling.

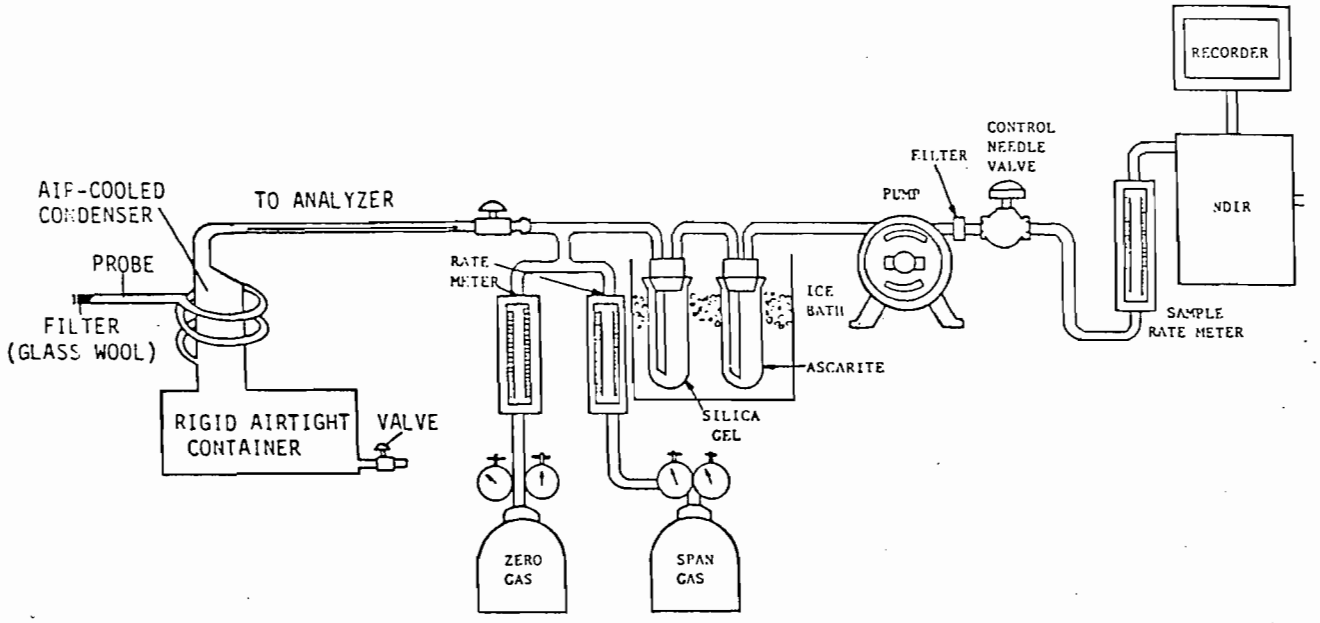
Each sampling run consisted of 12 points, 6 points through each of two ports. Each point was sampled for 5 minutes, giving a total test time of 60 minutes per run.

At the end of each run, after the final leak check, the probe was disconnected, the ice bath drained, and the impingers purged with ambient air for 15 minutes at the average flowrate used in that sampling run. After purging, the impingers were weighed to the nearest 0.5 gram to determine the weight of moisture collected.

The contents of the first impinger and an 80% isopropanol rinse of the nozzle, probe, all glassware before the filter, and the front half of the filter bell were collected in a storage container as the acid mist sample. The filter was removed and added to this container.

The contents of the second and third impingers were transferred to a separate storage container as the sulfur dioxide sample. A distilled water rinse of the second and third impingers and all connecting glassware including the back half of the filter bell was added to this container.

The acid mist analysis was performed at Thornton Laboratories, Inc. under the direction of Mr. Fred Hartledge. The samples were passed through an ion exchange column prior to analysis to eliminate metal ion interference. The analysis was performed utilizing the standard barium-throin titration as described in EPA Method 8.

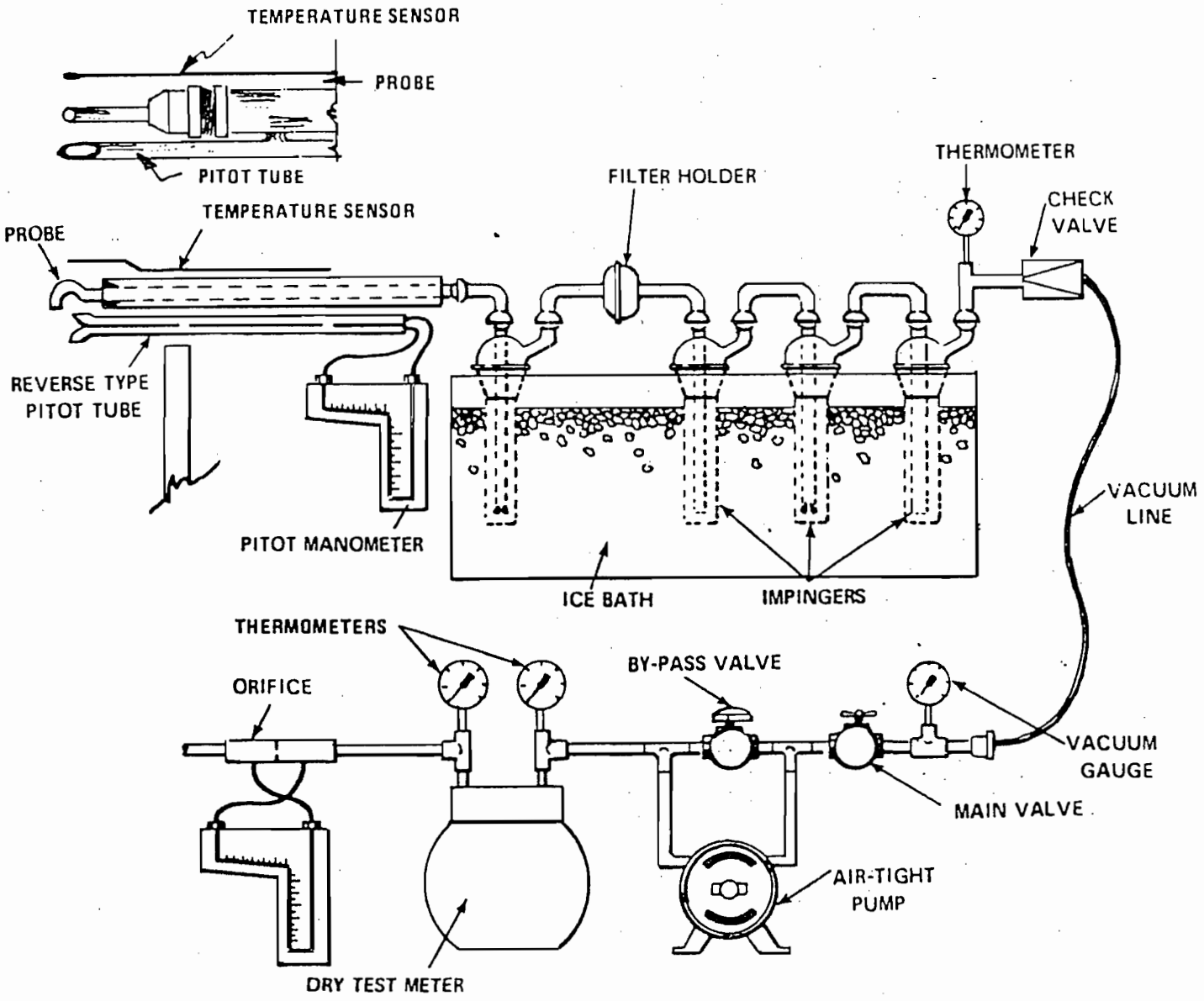


METHOD 10 SAMPLING TRAIN

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS & ENVIRONMENTAL SCIENTISTS

Figure 2



METHOD 8 SAMPLING TRAIN

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS & ENVIRONMENTAL SCIENTISTS

Figure 3

APPENDIX A

DATA SUMMARIES AND CALCULATIONS

SOURCE TESTING NOMENCLATURE AND DIMENSIONS

An:	Cross sectional area of nozzle, ft^2
As:	Cross sectional area of stack, ft^2
Bws:	Water vapor in the gas stream, proportion by volume
Cs:	Concentration of particulate matter in stack gas at standard conditions, gr/dscf
Cp:	Pitot tube coefficient
E:	Source emission rate, lbs/hr
I:	Percent of isokinetic sampling
Md:	Molecular weight of stack gas, dry basis, lb/lb-mole
Ms:	Molecular weight of stack gas, wet basis, lb/lb-mole
Mn:	Total particulate collected, less acetone blank correction; grams
Pb:	Barometric pressure at test site, in. Hg
Ps:	Absolute stack gas pressure, in. Hg
Qs:	Volumetric flow rate, dry at standard conditons, SCFM
Tm:	Absolute average dry gas meter temperature, ^oR
Ts:	Absolute average stack gas temperature, ^oR
Vlc:	Total volume of liquid collected in impingers and silica gel, ml
Vm:	Volume of gas sampled under actual conditons, DCF
Vm(std):	Volume of gas sampled corrected to standard conditions, DSCF

Vs:	Stack gas velocity, ft/sec
Vw:	Volume of water in sample corrected to standard conditions, DSCF
Y:	Dry gas meter calibration factor
θ:	Total sampling time, min.
^P:	Velocity head, in H2O
^H:	Averge pressure differential across orifice meter, in. H2O

SUMMARY OF TEST DATA

Plant: Hillsborough County Resource Recovery

Source: Boiler No. 1

Date: June 16, 1987

Parameter: Sulfur Dioxide /Acid Mist

	Run 1	Run 2	Run 3
Time Interval:	1000-1102	1158-1300	1353-1455
Test Time, min.:	60	60	60
Stack Area, Sq. ft.:	23.044	23.044	23.044
Nozzle Diameter, in.:	0.274	0.274	0.274
Barometric Pressure, in. Hg.:	29.86	29.84	29.84
Absolute Stack Pressure, in. Hg.:	29.82	29.77	29.79
Volume Liquid Collected, ml:	202.0	199.5	195.8
Stack Gas Moisture Content, %:	16.38	16.77	16.24
Stack Gas Temperature, F:	390	397	404
Sample Volume, DSCF:	48.573	46.620	47.568
Gas Velocity, FPS:	64.534	61.061	62.024
Gas Flowrate, ACFM:	89,227	84,425	85,757
Gas Flowrate, DSCFM:	46,156	43,041	43,671
Percent Isokinetic %:	98.7	101.6	105.0
Percent CO2, Volume:	9.6	9.9	9.6
Percent O2, Volume:	9.7	9.4	10.0
Acid Mist collected, g.:	0.018	0.013	0.008
Acid Mist conc., gr/DSCF-12%:	0.0071	0.0052	0.0033
Acid Mist emissions, lb/hr.:	2.25	1.59	0.97

PLANT HILLSBOROUGH COUNTY RESOURCE RECOVERY

SOURCE BOILER #1

DATE 6-16-87

RUN NO. 1

CALIBRATION

C_p .84

Y 1.050

D_n 0.274 in.

A_n 4.095×10^{-4} ft²

NEW DATA

P_b 29.86 in. Hg.

P_s 29.82 in. Hg.

A_s 23.044 ft²

θ 60 min.

V_m 49.721 DCF

ΔH 2.77 in. H_2O

T_m 570 °R

T_s 850 °R

V_{lc} 202.0 ml

$(\sqrt{\Delta P})_{avg.}$ .8902

M_n 0.018 g.

$$V_{m(std)} = \frac{17.64\, V_m\, Y\, (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64\,(49.721)(1.050)(29.86 + \frac{2.77}{13.6})}{(570)} = 48.573 \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471\,(202.0) = 9.5142 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.5142)}{(9.5142) + (48.573)} = 0.1638$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.6) + 0.32(9.7) + 0.28(80.7) = 29.924$$

$$M_s = M_d(1 - B_{ws}) + 18\, B_{ws} = (29.924)(.8362) + 18(.1638) = 27.97 \text{ DR}$$

$$V_s = 85.49\, C_p\, (\sqrt{\Delta P})_{avg.}\, (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.8902)\left[\frac{(850)}{(29.82)(27.9708)}\right]^{1/2} = 64.5335 \text{ FPS}$$

$$Q_s = 1058\,(1 - B_{ws})\, V_s\, A_s\, (P_s / T_s) =$$

$$1058\,(.8362)(64.5335)(23.044)\frac{(29.82)}{(850)} = \frac{46.156}{89,227} \begin{matrix} \text{DSCFM} \\ \text{ACFM} \end{matrix}$$

$$I = \frac{100\, V_{m(std)}\, A_s}{\theta\, Q_s\, A_n} = \frac{100\,(48.573)(23.044)}{(60)(46152)(4.095 \times 10^{-4})} = 98.7\%$$

$$C_s = 15.43\, \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.018)}{(48.573)} = 0.0057 \text{ g}^{\#}/\text{DSCF}$$

$$E = \frac{C_s\, Q_s}{116.67} = \frac{(.0057)(46152)}{116.67} = 2.25 \text{ LB/HR}$$

$$C_{s12} = C_s \left(\frac{12}{\%CO_2}\right)$$

$$= 0.0171$$

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT [illegible]

SOURCE BOILER #1

DATE 6-16-87

RUN NO. 2

CALIBRATION

C_p .84

Y 1.050

D_n 0.274 in.

A_n 4.095×10^{-1} ft^2

NEW DATA

P_b 29.84 in.Hg.

P_s 29.77 in.Hg.

A_s 23.044 ft^2

θ 60 min.

V_m 47.768 DCF

ΔH 2.45 in.H_2O

T_m 574 °R

T_s 857 °R

V_{lc} 199.5 ml

$(\sqrt{\Delta P})_{avg.}$ .8379

M_n [illegible] g.

$$V_{m(std)} = \frac{17.64\, V_m\, Y\, (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64\,(47.768)(1.050)(29.84 + \frac{2.45}{13.6})}{(574)} = 46.620 \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471\,(199.5) = 9.3965 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.3965)}{(9.3965) + (46.620)} = .1677$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.9) + 0.32(9.4) + 0.28(80.7) = 29.96$$

$$M_s = M_d(1 - B_{ws}) + 18\, B_{ws} = (29.96)(.8323) + 18(.1677) = 27.9543$$

$$V_s = 85.49\, C_p\, (\sqrt{\Delta P})_{avg.}\, (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.8379)\left[\frac{(857)}{(29.77)(27.9543)}\right]^{1/2} = 61.061 \text{ FPS}$$

$$Q_s = 1058\,(1 - B_{ws})\, V_s\, A_s\, (P_s / T_s) =$$

$$1058\,(.8323)(61.061)(23.044)\frac{(29.77)}{(857)} = \frac{43041 \text{ DSCFM}}{84,425 \text{ ACFM}}$$

$$I = \frac{100\, V_{m(std)}\, A_s}{\theta\, Q_s\, A_n} = \frac{100\,(46.620)(23.044)}{(60)(43041)(4.095 \times 10^{-1})} = 101.6\ \%$$

$$C_s = 15.43\,\frac{M_n}{V_{m(std)}} = \frac{(15.43)(.013)}{(46.620)} = 0.0043 \text{ gr/DSCF}$$

$$E = \frac{C_s\, Q_s}{116.67} = \frac{(.0043)(43041)}{116.67} = 1.59 \text{ LB/HR}$$

$$C_{s_2} = C_s\left(\frac{12}{\%CO_2}\right)$$

$$= 0.0052$$

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT HILLSBOROUGH COUNTY RESOURCE RECOVERY

SOURCE BOILER #1

DATE 6-16-87

RUN NO. 3

CALIBRATION

C_p .84

Y 1.050

D_n .274 in.

A_n 4.095×10^{-4} ft^2

NEW DATA

P_b 29.84 in. H_g

P_s 29.79 in. H_g

A_s 23.044 ft^2

θ 60 min.

V_m 48.913 DCF

ΔH 2.54 in. H_2O

T_m 576 °R

T_s 864 °R

V_{lc} 195.8 ml

$(\sqrt{\Delta P})_{avg.}$ .8466

M_n 0.008 g.

$$V_{m(std)} = \frac{17.64\, V_m\, Y\, (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64\,(48.913)(1.050)(29.84 + \frac{2.54}{13.6})}{(576)} = 47.568 \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471\,(195.8) = 9.2222 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.2222)}{(9.2222)+(47.568)} = .1624$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.6) + 0.32(10.0) + 0.28(80.4) = 29.936$$

$$M_s = M_d(1 - B_{ws}) + 18\,B_{ws} = (29.936)(.8376) + 18(.1624) = 27.9976$$

$$V_s = 85.49\, C_p\, (\sqrt{\Delta P})_{avg.}\, (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.8486)\left[\frac{(864)}{(29.79)(27.9976)}\right]^{1/2} = 62.024 \text{ FPS}$$

$$Q_s = 1058\,(1 - B_{ws})\, V_s\, A_s\, (P_s / T_s) =$$

$$1058\,(.8376)(62.024)(23.044)\frac{(29.79)}{(864)} = \frac{43671 \text{ DSCFM}}{85757 \text{ ACFM}}$$

$$I = \frac{100\, V_{m(std)}\, A_s}{\theta\, Q_s\, A_n} = \frac{100\,(48.913)(23.044)}{(60)(43671)(4.095 \times 10^{-4})} = 105.0\ \%$$

$$C_s = 15.43\,\frac{M_n}{V_{m(std)}} = \frac{(15.43)(.008)}{(47.568)} = .0026 \text{ gr/DSCF}$$

$$E = \frac{C_s\, Q_s}{116.67} = \frac{(\quad)(\quad)}{116.67} = \quad \text{LB/HR}$$

$$C_{s_{12}} = C_s\left(\frac{12}{8.2}\right)$$

$$= 0.0023$$

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

APPENDIX B

FIELD AND LABORATORY DATA SHEETS

Best Available Copy

FIELD DATA LOG

PLANT Hillsborough County Resource Recovery 1 SOURCE Boiler # 1

NOZZLE I.D. NO. 9	
DIA 1	.276
DIA 2	.273
DIA 3	.274
AVERAGE	.274

FINAL VOLUME 252.521
INITIAL VOLUME 202.800
NET VOLUME 49.721

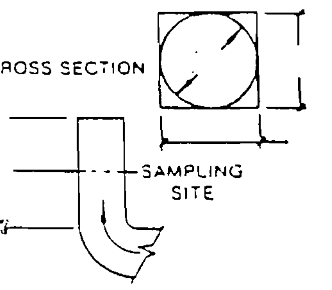
RUN NO 1
DATE 6-16-87
OPERATORS Burrows & Root
METER BOX NO EEC-2
FILTER NO N/A

NOMOGRAPH VALUES

ΔH@ ______ C FACTOR ______
Tm ______ AVG ΔP ______
%H2O ______ T_s ______
REFERENCE 3.45

BAROMETRIC PRESSURE 29.86
STATIC PRESSURE [illegible]
AMBIENT TEMPERATURE 105°F
PROBE LENGTH 6 FT.
PROBE LINER Pyrex
PORT LENGTH 8½"
PORT DIAMETER ______
METER SYSTEM LEAK-CHECK 0.0@15"Hg
ORSAT LEAK-CHECK ✓
SAMPLE BAG LEAK-CHECK ✓

SCHEMATIC OF STACK



TRAVERSE POINT NUMBER	SAMPLING TIME CLOCK	SAMPLING TIME SAMPLE	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔPs)	VELOCITY HEAD (√ΔPs)	ORIFICE METER (ΔH)	GAS SAMPLE VOLUME (Vm) ft³	DRY GAS METER TEMP (Tm) °F	PROBE TEMP °F	SAMPLE BOX TEMP °F	TEMP OF GAS LEAVING LAST IMPINGER °F	PUMP VACUUM GAUGE in. Hg
	1000	0										
1		5	406	.93		3.26	207.10	106		221	56	9
2		10	406	.88		3.08	211.75	106		230	60	9
3		15	408	1.00		3.50	215.99	108		219	60	10
4		20	407	.85		2.93	220.30	109		219	60	8
5		25	407	.75		2.59	224.90	109		218	60	6
6		30	281	.43		1.48	227.53	110		217	65	4
1		35	404	.76		2.62	231.55	110		215	67	7
2		40	405	.87		3.00	235.73	111		221	62	8
3		45	405	.85		2.93	240.00	111		221	62	8
4		50	406	.89		3.07	244.65	112		222	62	8
5		55	406	.83		2.86	248.78	113		221	61	8
6		60	335	.57		1.97	252.521	113		221	59	5
	1102											
			4676	10.6821		33.29		1318				
			390					110				
			850°R	0.8902		2.77		570				
TOTAL												
AVERAGE												

STATIC PITOT LEAK-CHECK @ 15 sec ✓
IMPACT PITOT LEAK-CHECK @ 15 sec ✓
TRAIN LEAK RATE @ 60 sec 0.00 cf @ 10 in

VOLUME OF LIQUID WATER COLLECTED	IMPINGER WEIGHT (g) ~~OR VOLUME (ml)~~ 1	2	3	4
FINAL	[illegible]	[illegible]	562.4	[illegible]
INITIAL	[illegible]	553.7	574.3	[illegible]
LIQUID COLL.	[illegible]	54.6	[illegible]	[illegible]
TOTAL VOLUME		[illegible]		

	TIME	CO_2	O_2	CO	N_2
1		9.6	9.8		
2		9.3	9.7		
3		9.7	9.7		
4	AVG	9.5	9.7		80.7

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

SIGNATURE [signature]
TEST TEAM CHIEF

[illegible]

FIELD DATA LOG

Best Available Copy

PLANT HILLSBOROUGH COUNTY RESOURCE RECOVERY SOURCE ROLLER #1

NOZZLE I.D. NO. 9
DIA 1
DIA 2
DIA 3
AVERAGE .274

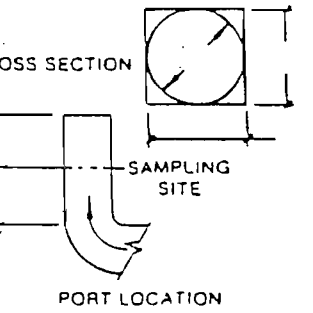
FINAL VOLUME 312.768
INITIAL VOLUME 265.000
NET VOLUME 47.768

RUN NO. 2
DATE 6-16-87
OPERATORS BURROWS & ROOT
METER BOX NO EEC-2
FILTER NO N/A

NOMOGRAPH VALUES	
ΔH@	C FACTOR
Tm	AVG ΔP
"H2O	T_s
REFERENCE	K=3.53

BAROMETRIC PRESSURE 29.84
STATIC PRESSURE -0.92 "H2O
AMBIENT TEMPERATURE 105°F
PROBE LENGTH 6 FT
PROBE LINER PYREX
PORT LENGTH
PORT DIAMETER
METER SYSTEM LEAK-CHECK 0.0015 cfm
ORSAT LEAK-CHECK ✓
SAMPLE BAG LEAK-CHECK ✓

SCHEMATIC OF STACK



TRAVERSE POINT NUMBER	SAMPLING TIME CLOCK	SAMPLING TIME SAMPLE	STACK TEMP (T_s) °F	VELOCITY HEAD (Δ Psi)	VELOCITY HEAD ($\sqrt{\Delta}$ Psi)	ORIFICE METER (ΔH)	GAS SAMPLE VOLUME (Vm) ft³	DRY GAS METER TEMP (Tm) °F	PROBE TEMP °F	SAMPLE BOX TEMP °F	TEMP OF GAS LEAVING LAST IMPINGER °F	PUMP VACUUM GAUGE in. Hg
	1158	0					265.000					
1		5	412	.87		3.00	269.45	111		224	59	7
2		10	412	.87		3.00	273.35	111		222	54	7
3		15	409	.62		2.14	277.66	111		220	61	5
4		20	405	.69		2.38	281.45	112		219	66	6
5		25	405	.69		2.38	285.50	113		221	66	6
6		30	341	.40		1.38	288.59	114		217	66	3
1		35	399	.77		2.66	292.60	114		224	65	6
2		40	400	.83		2.83	296.95	115		226	65	7
3		45	398	.77		2.66	301.00	114		230	65	6
4		50	399	.77		2.66	305.09	116		230	67	6
5		55	399	.70		2.47	309.19	116		230	67	6
6		60	384	.53		1.87	312.768	117		223	67	5
	1300											
			476		10.0549	29.43		1364				
			397					114				
			857°R		0.8379	2.9525		574°R				
TOTAL												
AVERAGE												

STATIC PITOT LEAK-CHECK @ 15 sec	
IMPACT PITOT LEAK-CHECK @ 15 sec	
TRAIN LEAK RATE @ 60 sec 0.00 cf @ 12 in	

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

VOLUME OF LIQUID WATER COLLECTED	IMPINGER WEIGHT (g) OR VOLUME (ml) 1	2	3	4
FINAL				
INITIAL				
LIQUID COLL.				
TOTAL VOLUME				

GAS MEASUREMENTS	TIME	CO_2	O_2	CO	N_2
1		9.9	7.5		
2		10.0	7.4		
3		9.9	7.4		
4	AVG	9.9	7.4		80.7

SIGNATURE
TEST TEAM CHIEF

P. 62 3 2.36
32.5.30

FIELD DATA LOG

Best Available Copy

PLANT HILLSBOROUGH COUNTY RESOURCE RECOVERY SOURCE BOILER #1

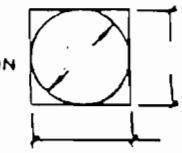
NOZZLE I.D. NO.	9
DIA 1	
DIA 2	
DIA 3	
AVERAGE	.279

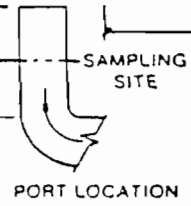
RUN NO	3
DATE	6-16-87
OPERATORS	BURROWS & ROOT
METER BOX NO	EBC-2
FILTER NO	N/A

NOMOGRAPH VALUES			
ΔH@		C FACTOR	
Tm		AVG ΔP	
%H2O		Ts	
REFERENCE	353		

BAROMETRIC PRESSURE	29.81
STATIC PRESSURE	-2.00
AMBIENT TEMPERATURE	105°F
PROBE LENGTH	6 FT.
PROBE LINER	PYREX
PORT LENGTH	
PORT DIAMETER	
METER SYSTEM LEAK-CHECK	2.00" @ 15" Hg
ORSAT LEAK-CHECK	✓
SAMPLE BAG LEAK-CHECK	✓

SCHEMATIC OF STACK





TRAVERSE POINT NUMBER	SAMPLING TIME CLOCK	SAMPLING TIME SAMPLE	STACK TEMP (T_s) °F	VELOCITY HEAD (Δ Psi)	VELOCITY HEAD ($\sqrt{\Delta}$ Psi)	ORIFICE METER (ΔH)	GAS SAMPLE VOLUME (Vm) ft³	DRY GAS METER TEMP (Tm) °F	PROBE TEMP °F	SAMPLE BOX TEMP °F	TEMP OF GAS LEAVING LAST IMPINGER °F	PUMP VACUUM GAUGE in. Hg
	1353	0					325.500			202		
1		5	404	.80		2.82	329.60	113		~~202~~ 206	54	7
2		10	404	.80		2.82	333.79	114		207	54	7
3		15	406	.83		2.93	338.06	114	350	205	63	7
4		20	406	.74		2.61	342.46	114		202	66	7
5		25	405	.69		2.44	346.65	116		200	~~64~~ 64	6
6		30	~~384~~ 398	.64		2.26	350.50	116	281	203	65	6
			402							~~224~~ 224	~~65~~ 65	
1		35	406	.80		2.82	354.75	116		224	65	7
2		40	406	.70		2.40	358.65	116		224	66	6
3		45	405	.67		2.37	362.58	117		230	67	6
4		50	403	.70		2.47	366.66	117	254	226	60	6
5		55	402	.67		2.33	370.60	117		227	60	6
6		60	398	.62		2.19	374.413	118	225	226	61	6
	1455											
			484		10.830	30.46		1388				
			404					116				
			864°R		0.8986	2.5385		576°R				
TOTAL												
AVERAGE												

STATIC PITOT LEAK-CHECK @ 15 sec	✓
IMPACT PITOT LEAK-CHECK @ 15 sec	✓
TRAIN LEAK RATE @ 20 sec	cf @ in

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

VOLUME OF LIQUID WATER COLLECTED	IMPINGER WEIGHT (g) OR VOLUME (ml) 1	2	3	4
FINAL	630.7	600.0	[illegible]	[illegible]
INITIAL	584.1	555.4	[illegible]	[illegible]
LIQUID COLL.	46.6	50.6	[illegible]	[illegible]
TOTAL VOLUME		197.2		

GAS MEASUREMENTS				
	TIME	CO_2	O_2	CO	N_2
1		9.5	10.0		
2		9.6	10.0		
3		9.6	9.9		
4	AVG	9.5	10.0		80.4

SIGNATURE

TEST TEAM CHIEF

PURGE - 37452

THORNTON LABORATORIES, INC.
1145 EAST CASS STREET
TAMPA, FLORIDA 33601 - 2880
MARINE, ANALYTICAL AND ENVIRONMENTAL SERVICES

TWX 810 876-9134
THORNT LAB TPA

TELEPHONE (813) 223-9702
P.O. BOX 2880

June 24, 1987

Laboratory Number 662469-662472

Sample of Stack Solution

Date Received June 17, 1987

For Environmental Engineering Consultants
P.O. Box 7854
Tampa, Florida 33673

Attention Carl Fink

Marks: See Below

CERTIFICATE OF ANALYSIS

LABORATORY NUMBER	MARKS	SO_2 (EPA Method 8)
662469	Blank, 80% Isopropanol, 6/16/87	0.0008 grams
662470	Boiler #1, Run #1, 6/16/87, Alcohol Wash	0.019 grams
662471	Boiler #1, Run #2, 6/16/87, Alcohol Wash	0.014 grams
662472	Boiler #1, Run #3, 6/16/87, Alcohol Wash	0.009 grams

LABORATORY ID #84147 and T84100

THORNTON LABORATORIES, INC.

THORNTON LABORATORIES, INC.
1145 EAST CASS STREET
TAMPA, FLORIDA 33601 - 2880
MARINE, ANALYTICAL AND ENVIRONMENTAL SERVICES

TWX 810 876-9134
THORNT LAB TPA

TELEPHONE (813) 223-9702
P.O. BOX 2880

June 24, 1987

Laboratory Number 662473-662474

Sample of Stack Solution

Date Received June 17, 1987

For Environmental Engineering Consultants
P.O. Box 7854
Tampa, Florida 33673

Attention Carl Fink

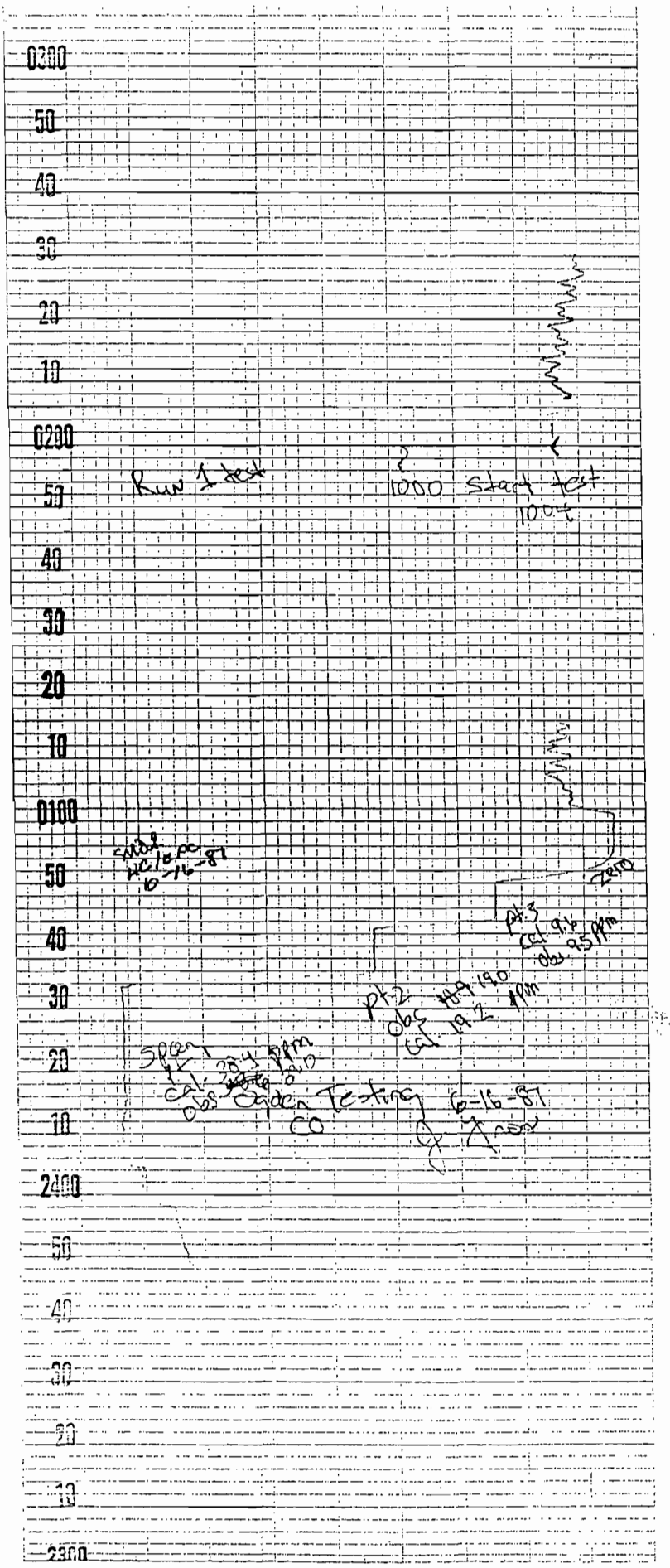
Marks: See Below

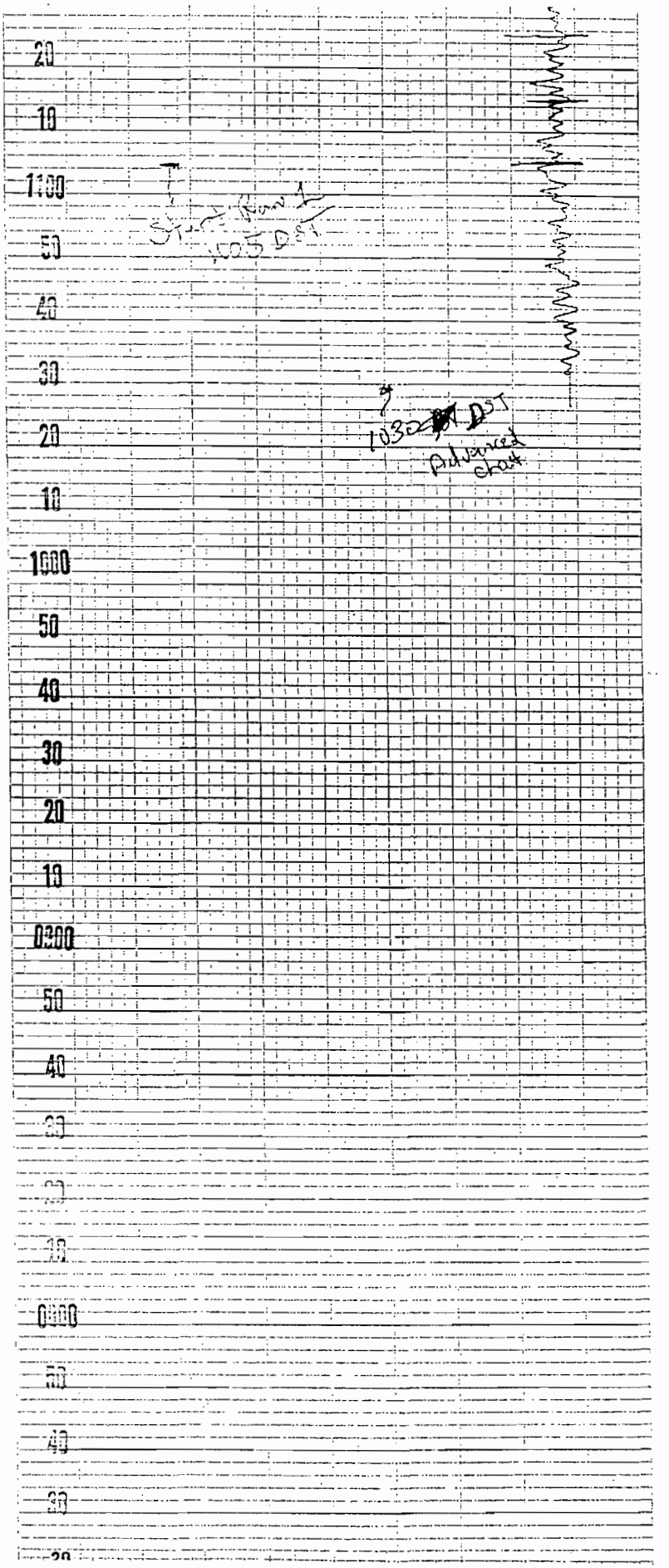
CERTIFICATE OF ANALYSIS

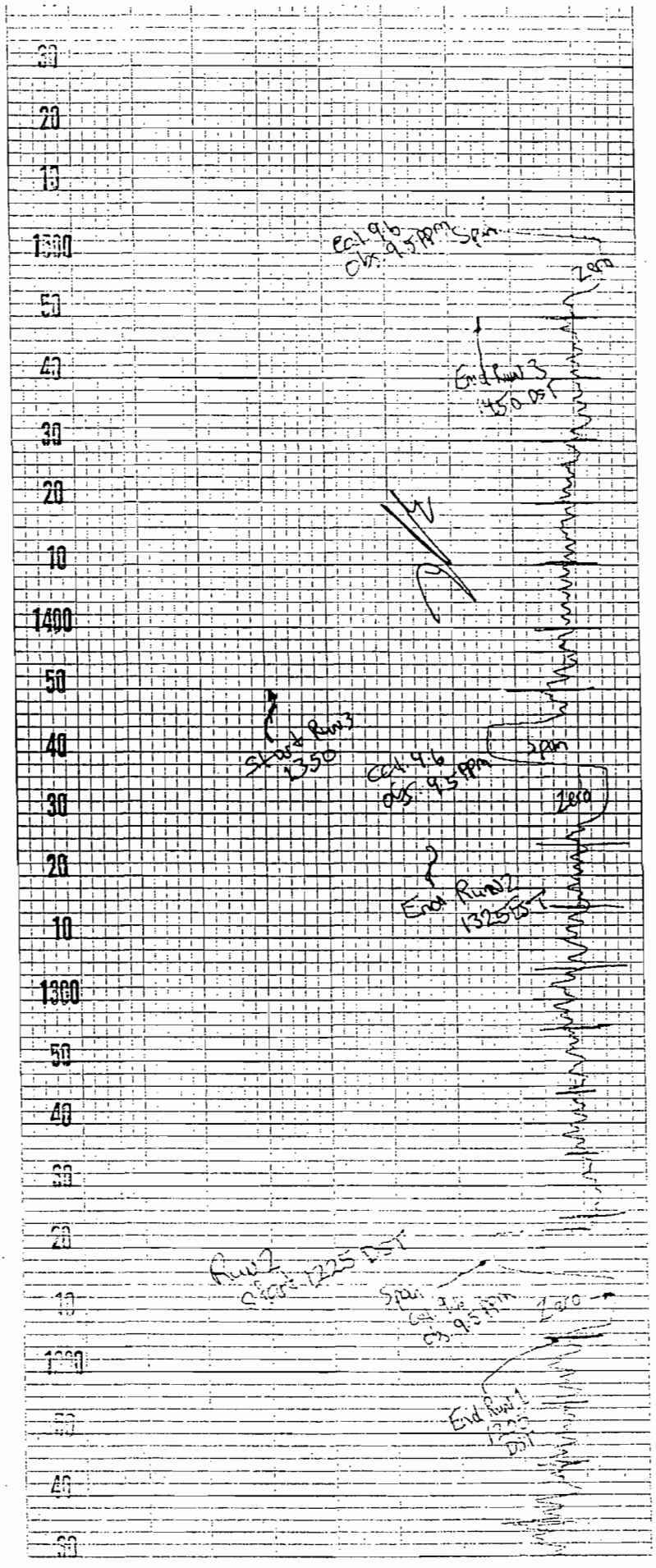
LABORATORY NUMBER	MARKS	SO_2 (EPA Method 8)
662473	EPA Compliance Audit A00401	1.53 g/dscm
662474	EPA Compliance Audit A02804	0.72 g/dscm

LABORATORY ID #84147 and T84100

THORNTON LABORATORIES, INC.







APPENDIX C

CALIBRATION DATA

SUMMARY OF EQUIPMENT CALIBRATION

Equipment	Calib. Date	Place	Method	Results
Nozzle #9	06-16-87	On-site	3 measurements w/vernier caliper	Dn=0.274 in.
Pitot Tube P-4	02-23-87	EEC, Inc.	EPA Method	Cp=0.84
Meter Console EEC-2	03-30-87	EEC, Inc.	Wet Test Meter	Y=1.050 ^H@=2.09
Post-Test Check	06-18-87	EEC, Inc.	Wet Test Meter	Y=1.036
Thermocouples	02-02-87	EEC, Inc.	Comparison to ASTM Thermometer	Correct to ±1% (°R)

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? X yes _____ no

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

α_1 = 1.0 ° (<10°), α_2 = 0 ° (<10°), β_1 = 2.0 ° (<5°),

β_2 = 2.0 ° (<5°)

γ = 1.5 °, θ = 0 °, A = 2.4 cm (in.)

z = A sin γ = 0.063 cm (in.); <0.32 cm (<1/8 in.),

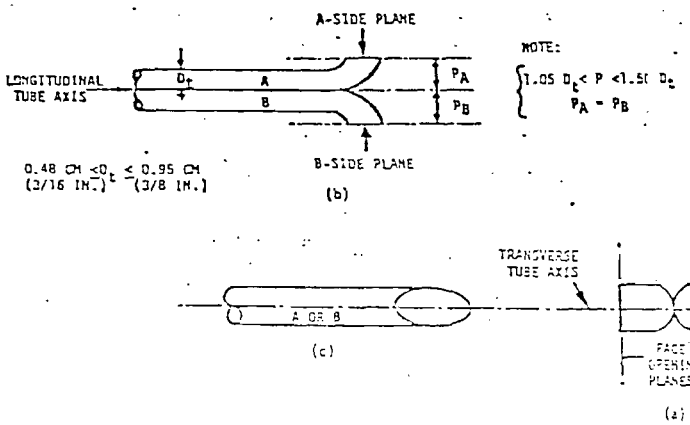
w = A sin θ = 0 cm (in.); <.08 cm (<1/32 in.)

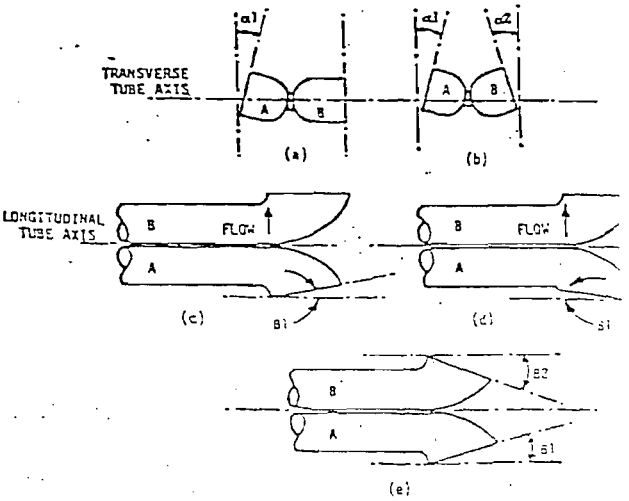
P_A 1.2 cm (in.) P_b 1.2 cm (in.)

D_t = 0.98 cm (in.)

Comments: _____

Calibration required? _____ yes X no





Pitot tube I.D. Number: P-4

Inspection Date: 2/23/87

Inspected By: _____

Environmental Engineering Consultants, Inc.

METER BOX CALIBRATION DATA AND CALCULATION FORM

Date 3/30/87 Meter box number EEC-2

Barometric pressure, P_b = 29.81 in. Hg Calibrated by Paul D. Keel

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperatures: Wet test meter (t_w), °F	Temperatures: Dry gas meter: Inlet (t_{d_i}), °F	Temperatures: Dry gas meter: Outlet (t_{d_o}), °F	Temperatures: Dry gas meter: Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	3.738	3.687	71	78	77	77.5	10	1.025	2.00
1.0	5.206	5.114	71	78	77	77.5	10	1.028	2.06
1.5	6.325	6.145	71	79	77	78	10	1.039	2.09
2.0	7.294	6.931	71	80	78	79	10	1.063	2.09
2.5	8.121	7.648	71	80	78	79	10	1.071	2.11
3.0	8.801	8.252	71	80	78	79	10	1.075	2.16
							Avg	1.050	2.09

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
0.5	0.0368	$Y_1 = \frac{3.738(29.81)(537.5)}{3.687(29.847)(531)} = 1.025$	$\Delta H_1 = \frac{0.0317(0.5)}{29.81(537.5)}\left[\frac{531(10)}{3.738}\right]^2 = 1.996$
1.0	0.0737	$Y_2 = \frac{5.206(29.81)(537.5)}{5.114(29.884)(531)} = 1.028$	$\Delta H_2 = \frac{0.0317(1.0)}{29.81(537.5)}\left[\frac{531(10)}{5.206}\right]^2 = 2.058$
1.5	0.110	$Y_3 = \frac{6.325(29.81)(539)}{6.145(29.92)(531)} = 1.039$	$\Delta H_3 = \frac{0.0317(1.5)}{29.81(539)}\left[\frac{531(10)}{6.325}\right]^2 = 2.090$
2.0	0.147	$Y_4 = \frac{7.294(29.81)(539)}{6.931(29.957)(531)} = 1.063$	$\Delta H_4 = \frac{0.0317(2.0)}{29.81(539)}\left[\frac{531(10)}{7.294}\right]^2 = 2.091$
2.5	0.184	$Y_5 = \frac{8.121(29.81)(539)}{7.648(29.994)(531)} = 1.071$	$\Delta H_5 = \frac{0.0317(2.5)}{29.81(539)}\left[\frac{531(10)}{8.121}\right]^2 = 2.107$
3.0	0.221	$Y_6 = \frac{8.801(29.81)(539)}{8.252(30.031)(531)} = 1.075$	$\Delta H_6 = \frac{0.0317(3.0)}{29.81(539)}\left[\frac{531(10)}{8.801}\right]^2 = 2.155$

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

RECHECK OF ORIFICE AND DGM CALIBRATION

CALIBRATION CHECK BY: [signature] DATE: 6-18-87 CONTROL BOX NO. EEC-2

LEAK CHECK OF METER SYSTEM _____ BAROMETRIC PRESSURE ("Hg) 30.03 09

-ΔHW ("H_2O)	ΔHd ("H_2O)	Wet Meter Volume (ft^3)	Final Dry Meter Volume (ft^3)	Initial Dry Meter Volume (ft^3)	Net Dry Meter Volume (ft^3)	Wet Test Meter (^oF)	Dry Test Meter Inlet (^oF)	Dry Test Meter Outlet (^oF)	Time (Min)	Vacuum Setting ("Hg)
X	2.5	8.008	467.771	460.019	7.752	75	91	90	10	10
X	2.5	8.016	475.534	467.771	7.763	75	91	90	10	10
	2.5	8.010	483.341	475.534	7.807	75	91	90	10	10
01	02	03			04	05	06	07	08	

Perform three calibration runs at a single intermediate orifice meter setting (ΔHd) with the vacuum set at the maximum value reached during the previous test series. If the calibration factor γ deviates by <5% from the initial calibration factor γ, then the dry gas meter volumes obtained during the test series are acceptable. If γ deviates by >5%, recalibrate the metering system, and use whichever meter coefficient (initial or recalibrated) that yields the lowest gas volumes for each test run.

$$\gamma = Vm\,(Pb - (\Delta Hw/13.6))(td + 460)/(Vd(Pb + (\Delta Hd/13.6))(tw + 460))$$

$$\Delta Hd = 0.0317\,(\Delta H)/(Pb(td + 460)) \times ((tw + 460)\,\theta/Vw)^2$$

Prior Calibration γ = 1.050

Recheck Calibration γ = 1.036

% Difference = -1.4 (If <5%, then use prior calibration γ for calculations.)

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 2-2-87 Thermocouple number UNIT A EEC-2

Ambient temperature 75 °F Barometric pressure _____ in. Hg

Calibrator ASTM Reference: mercury-in-glass ASTM

other _____

Reference point number	Source[a] (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature, °F	Temperature difference,[b] °F
1	AMBIENT AIR	75	77	+2
2	ICE BATH	32	36	+4
3	HOT OIL	500	493	-7

[a] Type of calibration system used.

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

[redacted] Environmental Engineering Consultants, [redacted] Inc.

Instrument

Manufacture Thermo Electron
Model No. 48
Serial No. 48-20608-191
Range 0-50 ppm
Zero Pot. 738
Span Pot. 815
Zero (D.L.) NA
% Chart 5.0

Recorder

Manufacture ESTERLINE-ANGUS
Model No. MS401B
Serial No. S-22087-1A
Chart Speed 6 cm/hr

Digital Multimeter

Manufacture NLS
Model No. PM450
Serial No. 193260/193261
Calibration Date 3-30-87

Calibration System

Manufacture EEC
Model No. NA
Serial No. NA
Type GAS DILUTION

SO_2 Cylinder

Manufacture NBS
Cylinder No. FF-20051
Concentration 959
Expiration Date 10-17-88

Mass Flowmeter

Manufacture DATAMETRICS
Model No. 831
Serial No. 1205/545
Transducer S/N NA
Range 0-10,000 / 0-50scfm

Data Logger

Manufacture N/A
Model # _____
S/N _____

Level 1 Span % Diff. _____ Site Name OGDEN TESTING HILLSBOROUGH CO. Date 6-16-87

Point	Dilution Flow (cc/min)	0 Flow (cc/min)	Observed Conc. (ppm)	Calculated Conc. (ppm)	% Diff.
1	1500	-0-	0.0	0.0	0
2	1200	50	39.0	38.4	+1.6
3	2450	50	19.0	19.2	-1.0
4	4950	50	9.5	9.6	-1.0

Signature [signature] Average _____

Environmental Engineering Consultants, Inc.

Recorder Calibration

Hillsborough County Solid Waste-to-Energy Facility

Site 2115 N. Faulkenburg Rd. Parameter NO_x

Recorder:
- Manufacturer Esterline Angus
- Model No. M5401R
- Serial No. S-22087-1A
- Range 0-1 Volt

Digital Multimeter:
- Manufacturer Simpson
- Model No. 463
- Serial No. A15560
- Calibration Date 3-12-87

Voltage Source:
- Manufacturer EEC.
- Model No. NA
- Serial No. NA

Calibrated By Jack Tarr
Date 4-15-87 (on site)

	VOLTAGE		RECORDER READING	
Test Point	Unadjusted	Adjusted	% Chart Unadjusted	% Chart Adjusted
1	.000		4.9	
2	.255		30.5	
3	.555		60.5	
4	.955		100.5	
5	.753		80.0	
6	.405		45.0	
7	.152		20.0	
8	.000		5.0	
9				
10				

Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

Purchase Date: 10-17-86

National Bureau of Standards
Certificate of Analysis

Standard Reference Material 1681b

Carbon Monoxide in Nitrogen

(Nominal Concentration 1000 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of carbon monoxide in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related.

Carbon monoxide concentration: 959 ± 9 μmole/mole (ppm)

Cylinder Number: FF-20051 Sample Number: 1-25-F

The concentration of carbon monoxide is relative to all other constituents of the gas.

The uncertainty shown is the estimated upper limit of error of the carbon monoxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

The original development and evaluation of the carbon monoxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by J. M. Ives and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by T. E. Gills.

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

datametrics

DATAMETRICS • DRESSER INDUSTRIES, INC.
340 FORDHAM ROAD • WILMINGTON, MASS 01887 • (617) 658-5410

CUSTOMER ENVIRONMENTAL ENG JOB NO. R1178-4 DATE 2-18-87

MODEL 831-1CL4-AIR-V-4B-X SERIAL NO. 1205 RANGE 10L GAS AIR

TEST GAS N_2 CORRECTION FOR GAS O LINE PSIG 40 PSIG

TEMP. F 75 BAROMETRIC PRESSURE 29.47 CORRECTION FACTOR

VALVE TYPE SERIAL NO. ORIFICE

STANDARD ±.2%

% OF FULL SCALE	831 V_{OUT}	BROOKS VOL-U-METER GAS CALIBRATOR			831 V_{OUT}
0	.000	.000			000
10	.920	1.000			.994
20		2.000			1.985
30	2880	3.000			2.989
40		4.000			3.994
50	4.865	5.000			4.998
60	5.874	6.000			6.006
70		7.000			7.013
80	7.861	8.000			8.021
90		9.000			9.017
100	9.821	10.000			10.000
%	V_{DC}	SCCM / (SLPM)			V_{DC}

AS RECIEVED

READJUSTED FULL SCALE + R_3 AND UNIT RETURNED TO ORIGINAL CALIBRATION.

→ AFTER CALIBRATION

COMMENTS:

LINEARIZER TEST POINT (PIN "E") SHOULD NOT BE ADJUSTED.

ONCE R_3 HAS BEEN ADJUSTED THIS CURVE IS NO LONGER VALID, AS WELL AS FULL SCALE GAIN CONTROL (R_{17}).

Michael J. Amott

FIELD TECHNICIAN

datametrics
DATAMETRICS • DRESSER INDUSTRIES, INC.
340 FORDHAM ROAD • WILMINGTON, MASS. 01887 • (617) 658-5410

CERTIFICATE OF CALIBRATION

CUSTOMER: ENVIRONMENTAL ENGINEERING CONSULTANTS

CUSTOMER P.O.: 87050

TRANSDUCER MODEL: 831-1CL4-AIR-V-4B-X

TRANSDUCER SERIAL #: 1205

This is to certify that the above items were calibrated using a Brooks Vol-u-meter. Model numbers 1052, 1054, 1055, 1057, 1058 at an accuracy of ± .2%, whose Calibration is traceable to the U.S. National Bureau of Standards.

CALIBRATED BY: Michael J. Amisk

DATE: 2-18-87

REMARKS:

Mass Flowmeter Calibration

Location TAMPA, FL

Date 2-5-87

Signature [signature]

Instrument

Manufacture DATAMETRICS

Model 831

Serial No. 545

Transducer S/N NA

Range 0-50 cc

Voltage Range 0-5V

Calibration Instrument

Manufacture BUBBLEMETER

Model —

Serial No. —

Volume 10 cc

UNADJUSTED CALIBRATION

Test Point	R.T. °C	B.P. mmHg	C.F.	Obs. Flow	Meter Reading	Actual Flowrate	% D.
1	24	29.99	.9762	47.62	46.44	46.49	0.0
2	24	29.99	.9762	37.04	36.39	36.16	-0.6
3	24	29.99	.9762	26.09	25.34	25.47	-0.5
4	24	29.99	.9762	15.27	14.85	14.90	-0.3
5	24	29.99	.9762	11.30	10.82	11.03	-1.9

ADJUSTED CALIBRATION

Test Point	R.T. °C	B.P. mmHg	C.F.	Obs. Flow	Meter Reading	Actual Flowrate	% D.

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

Mass Flowmeter Calibration Worksheet

Byron A. Barnes 2-5-87

UNADJUSTED CALIBRATION						ADJUSTED CALIBRATION					
Parameter / Point	1	2	3	4	5	Parameter / Point	1	2	3	4	5
Time (sec)	12.6	16.2	23.6	39.3	53.2	Time (sec)					
Time (sec)	12.6	16.3	23.0	39.3	53.1	Time (sec)					
Time (sec)	12.7	16.2	23.0	39.3	53.0	Time (sec)					
Average	12.6	16.2	23.0	39.3	53.1	Average					
Volume (cc)	10	10	10	10	10	Volume (cc)					
Flowrate cc/min	47.62	37.04	26.09	15.27	11.30	Flowrate cc/min					

Best Available Copy

Tampa Instrumentation Center, Inc.
6801 NORTH 54th STREET * TAMPA, FLORIDA 33610
(813) 623-3979

Certificate of Inspection

OWNER OF ITEM Environmental Engineering REPORT NO. 006062

ITEM Digital Multimeter MFR. Simpson

MODEL NO. 463 SERIAL NO. A15560

CALIBRATION DATE 3/12/87 RECALIBRATION DUE 3/12/88

TECHNICIAN JSH PROCEDURE USED Mfg

ENVIRONMENTAL CONDITIONS 72 °F 45 %RH

ITEM FOUND: [X] WITHIN TOLERANCE [ ] OUT OF TOLERANCE (ADJUSTMENT REQ'D)
[ ] OUT OF TOLERANCE, REPAIR REQ'D [ ] INOPERATIVE UPON RECEIPT

ITEM RETURNED: [X] WITHIN TOLERANCE [ ] CORRECTION CHART SUPPLIED

SPECIFICATIONS/REMARKS:

The above listed instrument has been duly tested and inspected and found to meet all published physical and operating specifications.

STANDARDS USED IN THIS CALIBRATION:

MFR.	MODEL	SERIAL NO.	DATE CAL.	DUE	REMARKS
Fluke	760	TIC-011	2/2/87	2/2/88	

The accuracy of the listed above standards used in performing the calibration were periodically compared to directly, or indirectly with a National Standard or accuracy was derived thru ratio self-calibration techniques.

INSP. INSP. TIC 42 BY Jim Hinkle

CALIBRATED AT LABORATORY [X] IN PLANT [ ]

Environmental Engineering Consultants, Inc.

~~Recorder~~ Calibration

DVM

~~Site~~ _____ ~~Parameter~~ _____

CALIBRATED AGAINST:

~~Recorder~~:

Manufacturer SIMPSON

Model No. 463

Serial No. A15560

~~Range~~ CALIB. DATE 3/12/87

Digital Multimeter:

Manufacturer NLS

Model No. PM 450

Serial No. 193261

Calibration Date 3/30/87

Voltage Source:

Manufacturer EEC

Model No. —

Serial No. —

Calibrated By [signature]

Date 3/30/87

	VOLTAGE		RECORDER READING	
	0.000	0.007		
Test Point	SIMPSON ~~Unadjusted~~	NLS ~~Adjusted~~	% Chart Unadjusted	% Chart Adjusted
1	0.502	0.495		
2	1.000	0.993		
3	3.00	3.007		
4	3.99	3.999		
5	4.99	4.998		
6	6.00	6.005		
7	6.99	6.998		
8	8.01	8.018		
9	9.00	9.016		
10	10.01	10.020		

Environmental Engineering Consultants, Inc.

~~Recorder~~ Calibration

DVM

~~Site~~ _____ ~~Parameter~~ _____

CALIBRATED AGAINST:

~~Recorder~~:

Manufacturer SIMPSON

Model No. 463

Serial No. A15560

~~Range~~ CALIB. DATE 3/12/87

Digital Multimeter:

Manufacturer FLUKE

Model No. PM 450

Serial No. 193260

Calibration Date 3/30/87

Voltage Source:

Manufacturer EEC

Model No. —

Serial No. —

Calibrated By [signature]

Date 3/30/87

	VOLTAGE 0.000	VOLTAGE 0.001	RECORDER READING	
Test Point	SIMPSON ~~Unadjusted~~	NLS ~~Adjusted~~	% Chart Unadjusted	% Chart Adjusted
1	0.502	0.502		
2	1.005	1.005		
3	2.99	2.998		
4	4.00	4.002		
5	5.01	5.015		
6	6.00	6.002		
7	7.01	7.015		
8	7.99	7.995		
9	9.00	9.002		
10	10.01	10.008		

APPENDIX D

PROJECT PARTICIPANTS

PROJECT PARTICIPANTS

Carl F. Fink	Team Test Leader Report Preparation Field Testing
Jack Fross	Field Testing
Byron Burrows	Field Testing
James Root	Field Testing
Henry Von Demfange	Ogden Projects, Inc. Observer
Fred Hartledge	Thornton Laboratories, Inc. Supervisior