R-34-8-7-05H

R7-107

TACB TESTING
OF
ASPHALTIC CONCRETE PLANT STACK EMISSIONS

WOOD MATERIAL SUPPLY INC.
CONROE, TEXAS

JULY 1987

NUS PROJECT NUMBER Y963

NUS CORPORATION
A Halliburton Company

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NUS PROJECT NUMBER Y963

Prepared By:

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NUS
CORPORATION
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HOUSTON, TEXAS 77084
713-492-1888

C-34-8-7-066H
August 27, 1987

Mr. Paul Wood
Wood Material Supply, Inc.
2338 Sleepy Hollow Road
Conroe, Texas 77358

Subject: Hot Mix Asphalt Concrete Plant
100 South Second Street, Conroe
Montgomery County, Texas
NUS Project Number: Y963

Dear Mr. Wood:

We hereby submit results of stack sampling analyses performed at your Conroe, Texas Asphaltic Concrete Facility, July 14, 1987.

Testing was performed by Mullins Environmental Testing Company, Inc. on behalf of NUS Corporation (NUS), in accordance with test procedures described in the Texas Air Control Board (TACB) Sampling Manual. Particulate results were computed in:

- Grains per dry standard cubic foot (gr/dscf) - front-half particulate catch
- Pounds per hour (lbs/hr) - total particulate catch

Sulfur dioxide (SO_2) emissions were computed in lbs/hr and parts per million (ppm).

Throughout the test period, NUS provided an on-site observer to monitor stack sampling operations and to take stack opacity readings. Test results are given below.

Particulates Average 0.0370 gs/dscf *
Average 5.2 lbs/hr

Opacity Average Reading 0-5% **

Sulfur Dioxides Average 6.6 ppm
Average 1.03 lbs/hr

* Allowable front-half catch - 40CFR 60.90 - Subpart I - Standards of Performance for Hot Mix Asphalt Plants - 0.04 g/dscf.
** Opacity visible emission readings by NUS on-site observer.

Copies of test results should be furnished to the Texas Air Control Board.

Please contact me at (713) 492-1888 if you have any questions concerning test results or if you require any further assistance on this project.

Very truly yours,

William J. Cole, P.E.
Senior Project Manager

WJC/pl

NUS CORPORATION
16360 PARK TEN PLACE, SUITE 300
HOUSTON, TEXAS 77084
713-492-1888

This report contains results of testing
performed on behalf of NUS Corporation
by Mullins Environmental Testing, Inc. (METCO)
at: Wood Materials Supply Inc.
Conroe, Texas
July 1987

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SOURCE EMISSIONS SURVEY
WOOD MATERIAL SUPPLY, INC.
CONROE, TEXAS
FOR
NUS CORPORATION
FILE NUMBER 87-88

INTRODUCTION

Mullins Environmental Testing Co., Inc., Dallas, Texas, conducted a source emissions survey of the Wood Material Supply, Inc. located in Conroe, Texas, on July 13 and 14, 1987. The purpose of this survey was to determine the emissions of particulate matter and sulfur dioxide from the Scrubber Exhaust Stack of the asphaltic concrete plant.

The sampling followed the procedures set forth in the Appendix to the Code of Federal Regulations, Title 40, Chapter I, Part 60, and in the "Sampling Procedures Manual, Texas Air Control Board, January 1983."

SUMMARY OF RESULTS

The principal conclusions are as follows:

5.2 - ok

1. The emissions of particulate matter from the stack were ~~4.9~~ pounds per hour (0.0370 grains per dry standard cubic foot), based on averaging the three tests using only the "front-half" collections of the EPA-type sampling train. The allowable particulate emission rate is 0.04 grains per dry standard cubic foot, as stated in the new source performance standards for asphalt concrete plants outlined in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Subpart I. The actual emissions were 92.6 percent of the permitted emissions.

2. The emissions of particulate matter from the stack were 5.2 pounds per hour, based on averaging the three tests using both the "front-half" and "back-half" collections of the EPA-type sampling train. The allowable particulate emission rate, as calculated from Table I of Regulation I of the Texas Air Control Board Regulations, is equal to 28.7 pounds per hour. The actual emissions were 18.3 percent of the permitted emissions.

3. The emissions of sulfur dioxide from the stack were 1.03 pounds per hour (6.6 parts per million), based on averaging the three tests.

SUMMARY OF RESULTS

Scrubber Exhaust Stack

Run Number	1	2	3
Stack Flow Rate - ACFM	30,180	31,120	28,854
Stack Flow Rate - DSCFM*	15,694	15,578	14,732
% Water Vapor - % Vol.	38.40	41.08	39.48
% CO_2 - % Vol.	7.4	7.2	8.2
% O_2 - % Vol.	10.8	10.8	9.6
% Excess Air @ Sampling Point	99	99	79
Particulates Probe, Cyclone & Filter Catch grains/dscf*	0.0317	0.0441	0.0353
grains/cf @ Stack Conditions	0.0165	0.0220	0.0180
lbs/hr	4.27	5.89	4.46
Total Catch grains/dscf*	0.0344	0.0464	0.0389
grains/cf @ Stack Conditions	0.0178	0.0231	0.0198
lbs/hr	4.63	6.19	4.92
Allowable Emission Rate EPA - 40 CFR 60 - grains/dscf	0.04	0.04	0.04
Allowable Emission Rate TACB - Reg. I - lbs/hr	28.8	29.3	28.0
Sulfur Dioxide Concentration - ppm	7.8	4.9	7.2
Sulfur Dioxide Emissions - lbs/hr	1.2	0.8	1.1

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

DISCUSSION OF RESULTS

The three tests for particulate matter taken on the Scrubber Exhaust Stack appeared to be valid representations of the actual emissions during the tests. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 3.6 percent of the mean value. The measured flow rates (Q_s) for the tests were within 3.9 percent of the mean value. The rates of sampling for the three tests were well within the specified limits, the greatest deviation being 6.2 percent.

The calculated emissions (grains per dry standard cubic foot) of particulate matter for the three tests showed a range of -14.4 percent to +19.1 percent variation from the mean value.

Sulfur dioxide was determined simultaneously during each test for particulate matter. The calculated emissions (pounds per hour) of sulfur dioxide showed a range of -22.6 percent to +16.1 percent variation from the mean value.

DESCRIPTION OF SAMPLING LOCATION

The sampling ports are located approximately 23 feet above the ground. The sampling ports are located 8 feet 4 inches (2.44 stack diameters) downstream from the inlet to the stack and 3 feet 6 inches (1.02 stack diameters) upstream from the outlet of the stack.

SAMPLING AND ANALYTICAL PROCEDURES

The sampling followed the procedures outlined in the Appendix to the Code of Federal Regulations, Title 40, Chapter I, Part 60, and in the "Sampling Procedures Manual, Texas Air Control Board, January 1983."

A preliminary velocity traverse was made at each of the ports on the stack, in order to determine the uniformity and magnitude of the flow prior to testing. All points were checked for cyclonic flow and the average angle of cyclonic flow was equal to 9.5 degrees. Twelve traverse points were sampled from each of the two ports for a total of twenty-four traverse points on the Scrubber Exhaust Stack. Samples of three-minute duration were taken isokinetically at each of the twenty-four traverse points using an EPA-type, heated, glass-lined probe.

On all tests, the sampling train was leak-checked at the nozzle at 15 inches of mercury vacuum before each test, and leak-checked at the nozzle after each test at the highest vacuum reading recorded during the tests. This was done to predetermine the possibility of a diluted sample.

Also before and after each test, the pitot tube lines were checked for leaks under both a vacuum and a pressure. The lines were also checked for clearance and the manometer was zeroed before each test.

Particulate emissions were calculated from gravimetric analysis using both the "front-half" and "back-half" collections from the EPA-type sampling train. The "back-half" of the sampling train contained an 80-percent isopropyl alcohol solution to absorb sulfur trioxide, a six-percent hydrogen peroxide solution to absorb sulfur dioxide, and silica gel to absorb moisture. The isopropyl alcohol solution was checked for hydrogen peroxide contamination and none was found.

At the conclusion of each test, the sampling train was purged for fifteen minutes with ambient air at the same rate at which the sample was taken.

A grab orsat sample was taken during each test.

DESCRIPTION OF TESTS

Personnel from Mullins Environmental Testing Co., Inc. arrived at the plant at 5:30 p.m. on Monday, July 13, 1987. Arrangements were made for installation of monorail brackets on the stack. After the brackets were installed, equipment was moved onto the stack and secured for the night by 7:30 p.m.

On Tuesday, July 14, work began at 5:45 a.m. The equipment was prepared for testing, but testing was delayed because the plant was not operating due to rain. The preliminary data was collected beginning at 7:00 a.m. The first test for particulate matter and sulfur dioxide began at 8:05 a.m. Testing continued until completion of the test at 9:22 a.m. The second test began at 10:21 a.m. Testing continued until 10:30 a.m. when testing was stopped due to a temporary plant upset. Testing was resumed at 10:40 a.m. and continued until completion of the second test at 11:47 a.m. The third test began at 12:47 p.m. and was completed at 2:02 p.m.

The equipment was moved off of the stack and loaded into the sampling van. The samples were recovered and transported to Mullins Environmental Testing Co.'s laboratory in Dallas, Texas, for analysis and evaluation.

Operations at Wood Material Supply, Inc. in Conroe, Texas, were completed at 3:30 p.m. on Tuesday, July 14, 1987.

Billy J. Mullins, Jr.

Billy J. Mullins, Jr., P.E.
President

APPENDICES

A. Location of Sampling Points

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APPENDIX A

Location of Sampling Points
Scrubber Exhaust Stack

The sampling ports are located 8 feet 4 inches (2.44 stack diameters) downstream from the inlet to the stack and 3 feet 6 inches (1.02 stack diameters) upstream from the outlet of the stack. The locations of the sampling points were calculated as follows:

Port and Wall Thickness = 2 3/4 inches

Inside Stack Diameter = 41 inches

Point Number	Percent of Diameter From Wall	Distance From Wall
1	2.1	1 "
2	6.7	2 3/4 "
3	11.8	4 13/16"
4	17.7	7 1/4 "
5	25.0	10 1/4 "
6	35.6	14 9/16"
7	64.4	26 7/16"
8	75.0	30 3/4 "
9	82.3	33 3/4 "
10	88.2	36 3/16"
11	93.3	38 1/4 "
12	97.9	40 "

APPENDIX B

Nomenclature and Equations
for
Calculation of Source Emissions

METCO

Nomenclature for Particulate Calculations

Symbol	English Units	Metric Units	Description
A_s	in.^{2}	m^2	Stack Area
C_{an}	gr/dscf*	g/dscm*	Particulate - probe, cyclone and filter
C_{ao}	gr/dscf*	g/dscm*	Particulate - total
C_{at}	gr/CF @ stack conditions	g/m^3	Particulate - probe, cyclone and filter
C_{au}	gr/CF @ stack conditions	g/m^3	Particulate - total
C_{aw}	lbs/hr	kg/hr	Particulate - probe, cyclone and filter
C_{ax}	lbs/hr	kg/hr	Particulate - total
C_p			Pitot Tube Calibration Factor
D_n	in.	m	Sampling Nozzle Diameter
%EA			Percent Excess Air at sampling point
g	32.2 ft/sec^2		Acceleration of gravity
%I			Percent isokinetic
%M			Percent moisture in the stack gas by volume
M_d			Mole fraction of dry gas
m_f	mg	mg	Particulate - probe, cyclone and filter
M_{H_2O}	18 lb/lb-mole		Molecular Weight of Water
m_t	mg	mg	Particulate - total

* 29.92 "Hg, 528°R (760 mm Hg, 20°C)

METCO

Symbol	English Units	Metric Units	Description
MW	lb/lb-mole	g/g-mole	Molecular Weight of stack gas
MW_{air}	28.95 lb/ lb-mole		Molecular Weight of air
MW_d	lb/lb-mole	g/g-mole	Molecular Weight of dry stack gas
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H_2O	mm H_2O	Orifice Pressure drop
P_s	"Hg Absolute	mm Hg	Stack Pressure
ΔP	"H_2O	mm H_2O	Velocity Head of stack gas
P_{std}	29.92 "Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m^3/hr	Stack Gas Volume at Actual Stack Conditions
Q_s	DSCFM*	dscm/hr*	Stack Gas Volume at 29.92 "Hg, 528°R, dry
R	21.83 "Hg-ft^3/lb-mole°R		Universal Gas Constant
T_m	°F	°C	Average Gas Meter Temperature
T_t	min	min	Net time of test
T_s	°F	°C	Stack Temperature
T_{std}	528°R	293°K	Standard Temperature
V_m	ft^3	m^3	Volume of dry gas sampled at meter conditions
$V_{m_{std}}$	dscf*	dscm*	Volume of dry gas sampled @ standard conditions
V_s	fpm	m/sec	Stack velocity @ stack conditions
V_w	ml	ml	Total Water Collected in Impingers and Silica Gel

* 29.92 "Hg, 528°R (760 mm Hg, 20°C)

METCO

Symbol	English Units	Metric Units	Description
$V_{w_{gas}}$	scf*	scm*	Volume of Water Vapor Collected @ standard conditions
ρ_{air}	0.0748 lbs/ft^3		Density of Air
ρ_{H_2O}	1 g/ml		Density of Water
ρ_{man}	51.63 lbs/ft^3		Density of Manometer Oil

Standard Conditions: 29.92 "Hg, 68°F (760 mm Hg, 20°C)

* 29.92 "Hg, 528°R (760 mm Hg, 20°C)

Example Particulate Calculations

1. Volume of dry gas sampled at standard conditions.*

$$V_{m_{std}} = V_m \left(\frac{T_{std}}{T_m + 460}\right) \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}}\right]$$

$$V_{m_{std}} = 17.65\ V_m \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = \text{dscf}$$

$$V_{m_{std}} = \text{dscf} \times 0.028317 = \text{dscm}$$

2. Volume of water vapor collected at standard conditions.*

$$V_{w_{gas}} = \frac{(V_w - \text{gms } SO_2 - \text{gms } H_2S)\ \rho_{H_2O}\ R\ T_{std}}{P_{std}\ M_{H_2O}\ 453.6}$$

$$V_{w_{gas}} = 0.0472\ (V_w - \text{gms } SO_2 - \text{gms } H_2S) = \text{scf}$$

$$V_{w_{gas}} = \text{scf} \times 0.028317 = \text{scm}$$

3. Percent moisture in stack gas.

$$\%M = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \%$$

* 29.92 "Hg, 528°R (760 mm Hg, 20°C)

4. Mole fraction of dry gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average molecular weight of dry stack gas.

$$MW_d = \left[\%CO_2 \times \frac{44}{100}\right] + \left[\%O_2 \times \frac{32}{100}\right] + \left[\%N_2 \times \frac{28}{100}\right] + \left[\%CO \times \frac{28}{100}\right] = \text{lb/lb-mole} = \text{g/g-mole}$$

6. Molecular weight of stack gas.

$$MW = MW_d \times M_d + 18\ (1-M_d) = \frac{\text{lb}}{\text{lb-mole}} = \text{g/g-mole}$$

7. Percent excess air at sampling point.

$$\%EA = \frac{100\ (\%O_2 - 0.5\%\ CO)}{0.265\ (\%N_2) - (\%O_2) + 0.5\ (\%CO)}$$

8. Stack Pressure.

$$P_s = P_b + \frac{\text{stack pressure "}H_2O}{13.6} = \text{"Hg Absolute}$$

$$P_s = \text{"Hg Abs.} \times 25.4 = \text{mm Hg}$$

* 29.92 "Hg, 528°R (760 mm Hg, 20°C)

9. Stack velocity at stack conditions.

$$V_s = C_p\, 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460) \times \Delta P_s}{12 \times \rho_{air} \times P_s \times MW \times T_{std}} \right]^{1/2}$$

$$V_s = 5123.8\, C_p \left[\frac{(T_s + 460) \times \Delta P_s}{P_s \times MW} \right]^{1/2} = \text{fpm}$$

$$V_s = \text{fpm} \times 0.00508 = \text{m/sec}$$

10. Dry stack gas volume at standard conditions.*

$$Q_s = \frac{1}{144} V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

$$Q_s = \frac{0.123\, V_s \times A_s \times M_d \times P_s}{T_s + 460} = \text{DSCFM}$$

$$Q_s = \text{DSCFM} \times 1.6990 = \text{dscm/hr}$$

11. Actual stack gas volume at stack conditions.

$$Q_a = \frac{V_s \times A_s}{144} = \text{ACFM}$$

$$Q_a = \text{ACFM} \times 1.6990 = \text{m}^3\text{/hr}$$

* 29.92 "Hg, 528°R (760 mm Hg, 20°C)

12. Percent isokinetic.

$$\%I = \frac{V_{m_{std}} \times (T_s + 460) \times P_{std} \times 100 \times 144}{M_d \times T_{std} \times P_s \times T_t \times V_s \times \frac{\pi D_n^2}{4}}$$

$$\%I = \frac{1039\ V_{m_{std}} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s \times D_n^2}$$

13. Particulate - probe, cyclone and filter.

$$C_{an} = \frac{m_f}{V_{m_{std}}} \times \frac{1\ gr}{64.8\ mg}$$

$$C_{an} = 0.0154\ \frac{m_f}{V_{m_{std}}} = gr/dscf^*$$

$$C_{an} = gr/dscf \times 2.290 = g/dscm^*$$

14. Particulate total.

$$C_{ao} = 0.0154 \times \frac{m_t}{V_{m_{std}}} = gr/dscf^*$$

$$C_{ao} = gr/dscf \times 2.290 = g/dscm^*$$

* 29.92 "Hg, 528°R (760 mm Hg, 20°C)

15. Particulate - probe, cyclone and filter at stack conditions.

$$C_{at} = C_{an} \times \frac{P_s}{P_{std}} \times \frac{(T_{std})}{(T_s + 460)} \times M_d$$

$$C_{at} = \frac{17.65 \times C_{an} \times P_s \times M_d}{T_s + 460} = gr/CF$$

$$C_{at} = gr/CF \times 2.290 = g/m^3$$

16. Particulate - total, at stack conditions.

$$C_{au} = \frac{17.65 \times C_{ao} \times P_s \times M_d}{T_s + 460} = gr/CF$$

$$C_{au} = gr/CF \times 2.290 = g/m^3$$

17. Particulate - probe, cyclone and filter.

$$C_{aw} = C_{an} \times Q_s \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ lb}}{7000 \text{ gr}}$$

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = lbs/hr$$

$$C_{aw} = lbs/hr \times 0.4536 = kg/hr$$

18. Particulate - total.

$$C_{ax} = 0.00857 \times C_{ao} \times Q_s = lbs/hr$$

$$C_{ax} = lbs/hr \times 0.4536 = kg/hr$$

* 29.92 "Hg, 528°R (760 mm Hg, 20°C)

METCO

SOURCE EMISSION SURVEY

JOB NUMBER: 87-88
JOB NAME: WOOD MATERIALS SUPPLY, INC.
LOCATION: CONROE, TX
UNIT TESTED: SCRUBBER STACK

SOURCE EMISSION CALCULATIONS

SYMBOL	DESCRIPTION	UNITS			
RUN #			1	2	3
DATE			7/14/87	7/14/87	7/14/87
BEGIN TIME			805	1021	1247
END TIME			922	1147	1402
P(b)	BAROMETRIC PRESSURE	"Hg Abs. (mm Hg)	29.90 (759)	29.95 (761)	29.93 (760)
P(m)	ORIFICE PRESSURE DROP	"H2O (mm H2O)	1.043 (26.5)	1.211 (30.8)	1.015 (25.8)
V(m)	VOLUME DRY GAS SAMPLED @ METER CONDITIONS	ft.^3 (m^3)	39.458 (1.117)	42.638 (1.207)	39.181 (1.109)
T(m)	AVERAGE GAS METER TEMPERATURE	DEG.F (DEG.C)	76 (24)	78 (26)	82 (28)
V(m[std])	VOLUME DRY GAS SAMPLED @ STANDARD CONDITIONS*	DSCF (DSCM)	38.949 (1.103)	42.019 (1.190)	38.283 (1.084)
V(w)	TOTAL WATER COLLECTED, IMPINGERS & SILICA GEL	ml	514.3	620.8	529.2
V(w[gas])	VOLUME WATER VAPOR COLLECTED @ STANDARD CONDITIONS*	SCF (SCM)	24.275 (0.687)	29.302 (0.830)	24.978 (0.707)
%M	MOISTURE IN STACK GAS BY VOLUME	%	38.40	41.08	39.48

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

METCO

SOURCE EMISSION CALCULATIONS

WOOD MATERIALS SUPPLY, INC.
CONROE, TX
SCRUBBER STACK

SYMBOL	DESCRIPTION	UNITS			
Md	MOL FRACTION OF DRY GAS		0.6160	0.5892	0.6052
CO2		%	7.4	7.2	8.2
O2		%	10.8	10.8	9.6
CO		%	0.0	0.0	0.0
N2		%	81.8	82.0	82.2
%EA	EXCESS AIR @ SAMPLING POINT	%	99.3	98.8	78.8
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	29.62 (29.62)	29.58 (29.58)	29.70 (29.70)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	25.16 (25.16)	24.83 (24.83)	25.08 (25.08)
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H2O)	0.802 (20.4)	0.850 (21.6)	0.738 (18.7)
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	166 (74)	164 (73)	168 (76)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg)	29.84 (758)	29.93 (760)	29.91 (760)
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	3,292 (16.72)	3,395 (17.25)	3,148 (15.99)
As	STACK AREA	(SQ. INCHES) (SQ. METERS)	1,320 (0.85)	1,320 (0.85)	1,320 (0.85)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR)	15,694 (26,664)	15,578 (26,467)	14,732 (25,030)
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	30,180 (51,276)	31,120 (52,873)	28,854 (49,023)

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

METCO

SOURCE EMISSION CALCULATIONS

WOOD MATERIALS SUPPLY, INC.
CONROE, TX
SCRUBBER STACK

SYMBOL	DESCRIPTION	UNITS			
Tt	NET TIME OF TEST	MINUTES	72	72	72
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.249 (0.006)	0.249 (0.006)	0.249 (0.006)
%I	PERCENT ISOKINETIC	%	93.8	101.9	98.2
Mf	PARTICULATE - PROBE, CYCLONE AND FILTER	mg	80.3	120.4	87.8
Mt	PARTICULATE - TOTAL	mg	87.0	126.6	96.8
Can	PARTICULATE - PROBE, CYCLONE AND FILTER	gr/DSCF* (g/DSCM)	0.0317 (0.0727)	0.0441 (0.1011)	0.0353 (0.0809)
Cao	PARTICULATE - TOTAL	gr/DSCF* (g/DSCM)	0.0344 (0.0788)	0.0464 (0.1063)	0.0389 (0.0892)
Cat	PARTIC.-PROBE, CYCLONE AND FILTER @ STACK COND.	gr/CF (g/m3)	0.0165 (0.0377)	0.0220 (0.0504)	0.0180 (0.0411)
Cau	PARTICULATE - TOTAL @ STACK CONDITIONS	gr/CF (g/m3)	0.0178 (0.0408)	0.0231 (0.0529)	0.0198 (0.0453)
Caw	PARTICULATE - PROBE, CYCLONE AND FILTER	LBS/HR (Kg/HR)	4.27 (1.94)	5.89 (2.67)	4.46 (2.02)
Cax	PARTICULATE - TOTAL	LBS/HR (Kg/HR)	4.63 (2.10)	6.19 (2.81)	4.92 (2.23)

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SULFUR DIOXIDE EMISSION DATA

JOB NUMBER: 87-88
JOB NAME: WOOD MATERIALS SUPPLY, INC.
LOCATION: CONROE, TX
UNIT TESTED: SCRUBBER STACK

RUN NUMBER	1	2	3
DATE	7/14/87	7/14/87	7/14/87
START TIME	805	1021	1247
END TIME	922	1147	1402
N - NORMALITY OF Ba(ClO4)2	0.0100	0.0100	0.0100
ML(I)- ml IN IMPINGER 2	413	436	369
ML(I)- ml IN IMPINGER 3	522	392	492
ML(A)- ml IN ALIQUOT #2	10.00	10.00	10.00
ML(A)- ml IN ALIQUOT #3	10.00	10.00	10.00
ML(B) - ml OF Ba(ClO4)2 TO TITRATE #2	1.18	1.10	1.27
ML(B) - ml OF Ba(ClO4)2 TO TITRATE #3	0.52	0.12	0.45
ML(BB) - ml OF Ba(ClO4)2 TO TITRATE BLANK	0.05	0.05	0.05
Tm - AVERAGE GAS METER TEMPERATURE, DEG.F	76	78	82
Vm - VOLUME OF DRY GAS SAMPLED @ METER CONDITIONS, FT^3	39.458	42.638	39.181
Pb - BAROMETRIC PRESSURE, "Hg Abs.	29.90	29.95	29.93
Qs - STACK GAS VOLUME DRY @ STANDARD CONDITIONS, *SCFM	15,694	15,578	14,732
C(I) - SO2 IN IMPINGER #2 IN mgs	14.93	14.65	14.41
C(I) - SO2 IN IMPINGER #3 IN mgs	7.85	0.88	6.30
C(T) - TOTAL SO2 IN IMPINGERS, IN mgs	22.8	15.5	20.7
ppm SO2	7.8	4.9	7.2
C(SO2) - EMISSION RATE OF SO2, lbs/day	29.2	18.3	25.3
C(SO2) - EMISSION RATE OF SO2, lbs/hr	1.2	0.8	1.1
Cs - EMISSION RATE OF SULFUR, lbs/day	14.6	9.2	12.7

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

C(I) = ML(I) * [ML(B) - ML(BB)] * N * 32 / ML(A)
C(T) = C(I) #2 + C(I) #3
ppm SO2 = 0.7513 * C(T) * [Tm + 460] / Vm * Pb
C(SO2) = ppm SO2 * Qs * 0.0002392

SULFUR TRIOXIDE EMISSION DATA

JOB NUMBER: 87-88
JOB NAME: WOOD MATERIALS SUPPLY, INC.
LOCATION: CONROE, TX
UNIT TESTED: SCRUBBER STACK

RUN NUMBER	1	2	3
DATE	7/14/87	7/14/87	7/14/87
START TIME	805	1021	1247
END TIME	922	1147	1402
N - NORMALITY OF Ba(ClO4)2	0.0100	0.0100	0.0100
ML(I) - ml IN IMPINGER	405	400	426
ML(A) - ml IN ALIQUOT	10.00	10.00	10.00
ML(B) - ml OF Ba(ClO4)2 TO TITRATE	0.30	0.30	0.25
ML(BB) - ml OF Ba(ClO4)2 TO TITRATE BLANK	0.05	0.05	0.05
Tm - AVERAGE GAS METER TEMPERATURE, DEG.F	76	78	82
Vm - VOLUME OF DRY GAS SAMPLED @ METER CONDITIONS, FT^3	39.458	42.638	39.181
Pb - BAROMETRIC PRESSURE, "Hg Abs.	29.90	29.95	29.93
Qs - STACK GAS VOLUME DRY @ STANDARD CONDITIONS, *SCFM	15,694	15,578	14,732
C(I) - SO3 IN IMPINGERS IN mgs	4.1	4.0	3.4
ppm SO3	1.1	1.0	0.9
C(SO3) - EMISSION RATE OF SO3, lbs/day	5.2	4.7	4.2
Cs - EMISSION RATE OF SULFUR, lbs/day	2.1	1.9	1.7

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

C(I) = ML(I) * [ML(B) - ML(BB)] * N * 40 / ML(A)
ppm SO3 = 0.6021 * C(I) * [Tm + 460] / Vm * Pb
C(SO3) = ppm SO3 * Qs * 0.0002991
Cs = C(SO3) / 2.5

APPENDIX C

Calibration Data

Equipment	Calibration Factor	Calibration Date
Pitot Tube #12	0.807	3/ 9/87
Probe Tip #II-4	0.249	5/18/87
Dry Gas Meter #6	1.008	4/ 1/87
Stack Unit Orifice #6		4/ 2/87
Digital Temperature Indicator #6		4/ 2/87
Barometer #1		5/15/87

PITOT TUBE CALIBRATION

Date: 3-9-87

Pitot No. 12

Time: 1035

P_b: 29.70 "Hg

P_s: – "H_2O

T_s: 74 °F

C_{pstd}: 0.99

Motor Setting	fps mark	CALIBRATOR STANDARD START	CALIBRATOR STANDARD END	$\sqrt{\text{STANDARD AVERAGE}}$	HIGH	$\sqrt{\text{HIGH}}$	CAL. FACTOR	LOW	$\sqrt{\text{LOW}}$	CAL. FACTOR
39	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
48	30	0.20	0.20	0.447	0.30	0.548	0.808	0.30	0.548	0.808
55	40	0.35	0.34	0.587	0.52	0.721	0.806	0.52	0.721	0.806
63	50	0.60	0.60	0.775	0.90	0.949	0.808	0.89	0.943	0.813
70	60	0.85	0.85	0.922	1.30	1.140	0.801	1.30	1.140	0.801
76	70	1.00	1.00	1.00	1.50	1.225	0.808	1.50	1.225	0.808
84	80	1.40	1.40	1.183	2.10	1.449	0.808	2.10	1.449	0.808
100	90	1.60	1.60	1.265	2.40	1.549	0.808	2.40	1.549	0.808
63	50	0.60	0.60	0.775	0.90	0.949	0.808	0.90	0.949	0.808
63	50	0.60	0.60	0.775	0.90	0.949	0.808	0.90	0.949	0.808
Average							0.807			0.808

Summary of Results:

Normal high side calibration factor 0.807

variation +0.12% -0.74%

Normal low side calibration factor 0.808

variation +0.62% -0.87%

Signature of Calibrator

METCO

NOZZLE CALIBRATION

Nozzle Set No. II

Date 18 May 1987 Calibrator: Chuck Thompson

	1	2	3	4	5	6
Reading 1	0.188	0.130	0.253	0.250	0.319	0.338
Reading 2	0.186	0.129	0.253	0.248	0.319	0.337
Reading 3	0.187	0.131	0.252	0.249	0.318	0.339
Reading 4	0.187	0.130	0.253	0.249	0.317	0.338
Reading 5	0.186	0.130	0.251	0.249	0.318	0.338
Reading 6	0.188	0.130	0.252	0.250	0.318	0.337
Reading 7	0.187	0.131	0.252	0.250	0.318	0.338
Reading 8	0.187	0.130	0.251	0.249	0.318	0.338
Reading 9	0.187	0.130	0.251	0.250	0.318	0.338
Reading 10	0.186	0.131	0.253	0.248	0.318	0.337
Average	0.187	0.130	0.252	0.249	0.318	0.338

	7	8	9	10	11
Reading 1	0.357	0.426	0.504	0.504	0.189
Reading 2	0.358	0.425	0.504	0.503	0.190
Reading 3	0.356	0.425	0.504	0.504	0.190
Reading 4	0.357	0.424	0.504	0.504	0.190
Reading 5	0.357	0.426	0.504	0.503	0.190
Reading 6	0.357	0.424	0.504	0.504	0.191
Reading 7	0.357	0.424	0.502	0.503	0.190
Reading 8	0.356	0.424	0.503	0.504	0.189
Reading 9	0.356	0.424	0.505	0.504	0.190
Reading 10	0.357	0.426	0.504	0.504	0.191
Average	0.357	0.425	0.504	0.504	0.190

METCO

Dry Gas Meter Calibration

Dry Gas Meter Number 6

Date: 1 APRIL 1987

ΔH ("H_2O)	C_{DG}
0.5	1.006
1.0	1.003
1.5	1.007
2.0	1.010
3.0	1.011
4.0	1.008
Average	1.008

Variation: + 0.30%

\- 0.50%

Calibrator: John R. Smith

Checked by: DA

C_{DG} @ 2 liters/min. = 1.017 4/2/87

METCO

DRY GAS METER CALIBRATION

Meter Number: 6

Date: 1 APRIL 1987

Calibrator: John R. Smith

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 1 @ 0.50

P_b: 29.26 "Hg

Control Module Vacuum 5.1 "Hg

WET TEST METER (No. 2) | DRY GAS METER

	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1447.09	5.001 cf	74 °F	-1.25 "H_2O	262.577 cf	71 °F	67 °F	0.50 "H_2O
Start	1435	0.000 cf	74 °F	-1.25 "H_2O	257.700 cf	69 °F	65 °F	0.50 "H_2O
	12.09	5.001 cf	74 °F	-1.25 "H_2O	4.877 cf	70 °F	66 °F	0.50 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 5.001 \left(\frac{29.26 + \frac{(-1.25)}{13.6}}{74 + 460} \right) \times \underset{(C_f)}{0.997} = 4.807 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 4.877 \left(\frac{29.26 + \frac{0.50}{13.6}}{68 + 460} \right) = 4.776 \text{ dscf}$$

$$C_{DG} = \frac{4.807}{4.776} = \boxed{1.006}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 6

Calibrator: John R. Smith

Date: 1 APRIL 1987

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 1 @ 1.00

P_b: 29.26 "Hg

Control Module Vacuum 5.0 "Hg

WET TEST METER (No. 2) — DRY GAS METER

	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1458.65	5.000 cf	74 °F	-1.70 "H_2O	268.000 cf	73 °F	68 °F	1.00 "H_2O
Start	1450	0.000 cf	74 °F	-1.70 "H_2O	263.101 cf	71 °F	67 °F	1.00 "H_2O
	8.65	5.000 cf	74 °F	-1.70 "H_2O	4.899 cf	72 °F	68 °F	1.00 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 5.000 \left(\frac{29.26 + \frac{(-1.70)}{13.6}}{74 + 460} \right) \times \underset{(C_f)}{0.997} = 4.800 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 4.899 \left(\frac{29.26 + \frac{1.00}{13.6}}{70 + 460} \right) = 4.786 \text{ dscf}$$

$$C_{DG} = \frac{4.800}{4.786} = \boxed{1.003}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 6 Calibrator: John R. Smith

Date: 1 APRIL, 1987

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 1 @ 1.50

P_b: 29.25 "Hg

Control Module Vacuum 5.1 "Hg

WET TEST METER (No. 2). DRY GAS METER

	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1515.17	10.000 cf	74 °F	-2.15 "H_2O	278.155 cf	77 °F	71 °F	1.50 "H_2O
Start	1501	0.000 cf	74 °F	-2.15 "H_2O	268.358 cf	73 °F	69 °F	1.50 "H_2O
	14.17	10.000 cf	74 °F	-2.15 "H_2O	9.797 cf	75 °F	70 °F	1.50 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.000 \left(\frac{29.25 + \frac{(-2.15)}{13.6}}{74 + 460} \right) \times \underset{(C_f)}{0.997} = 9.587 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 9.797 \left(\frac{29.25 + \frac{1.50}{13.6}}{73 + 460} \right) = 9.525 \text{ dscf}$$

$$C_{DG} = \frac{9.587}{9.525} = \boxed{1.007}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 6

Date: 1 APRIL, 1987

Calibrator: John R. Smith

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 1 @ 2.00

P_b: 29.24 "Hg

Control Module Vacuum 5.1 "Hg

WET TEST METER (No. 2) — DRY GAS METER

	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1555.34	10.000 cf	74 °F	-2.60 "H_2O	308.827 cf	82 °F	74 °F	2.00 "H_2O
Start	1543	0.000 cf	74 °F	-2.60 "H_2O	299.000 cf	81 °F	73 °F	2.00 "H_2O
	12.34	10.000 cf	74 °F	-2.60 "H_2O	9.827 cf	82 °F	74 °F	"H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.000 \left(\frac{29.24 + \frac{(-2.60)}{13.6}}{74 + 460} \right) \times \underset{(C_f)}{0.997} = 9.573 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 9.827 \left(\frac{29.24 + \frac{2.00}{13.6}}{78 + 460} \right) = 9.474 \text{ dscf}$$

$$C_{DG} = \frac{9.573}{9.474} = \boxed{1.010}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 6 Calibrator: John R. Smith

Date: 1 APRIL, 1987

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 1@ 3.00

P_b: 29.24 "Hg

Control Module Vacuum 5.0 "Hg

	WET TEST METER (No. 2)				DRY GAS METER			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1541.10	10.001 cf	74 °F	-3.45 "H_2O	298.662 cf	83 °F	73 °F	3.00 "H_2O
Start	1531	0.000 cf	74 °F	-3.45 "H_2O	288.904 cf	79 °F	72 °F	3.00 "H_2O
	10.10	10.001 cf	74 °F	-3.45 "H_2O	9.758 cf	81 °F	73 °F	3.00 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.001 \left(\frac{29.24 + \frac{(-3.45)}{13.6}}{74 + 460} \right) \times \underset{(C_f)}{0.997} = 9.553 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 9.758 \left(\frac{29.24 + \frac{3.00}{13.6}}{77 + 460} \right) = 9.449 \text{ dscf}$$

$$C_{DG} = \frac{9.553}{9.449} = \boxed{1.011}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 6

Date: 1 APRIL, 1987

Calibrator: John R. Smith

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 1@ 4.00

P_b: 29.24 "Hg

Control Module Vacuum 5.0 "Hg

WET TEST METER (No. 2) — DRY GAS METER

	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1606.82	10.003 cf	74 °F	-4.30 "H_2O	319.065 cf	84 °F	74 °F	4.00 "H_2O
Start	1558	0.000 cf	74 °F	-4.30 "H_2O	309.300 cf	80 °F	74 °F	4.00 "H_2O
	8.82	10.003 cf	74 °F	-4.30 "H_2O	9.765 cf	82 °F	74 °F	4.00 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.003 \left(\frac{29.24 + \frac{(-4.30)}{13.6}}{74 + 460} \right) \times \underset{(C_f)}{0.997} = 9.534 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 9.765 \left(\frac{29.24 + \frac{4.00}{13.6}}{78 + 460} \right) = 9.461 \text{ dscf}$$

$$C_{DG} = \frac{9.534}{9.461} = \boxed{1.008}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 6

Date: 2 APRIL, 1987

Calibrator: John R. Smith

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 1@ 2 l/m

P_b: 29.55 "Hg

Control Module Vacuum 0.5 "Hg

	WET TEST METER (No. 1)				DRY GAS METER			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	0858.84	2.000 cf	71 °F	-0.50 "H_2O	331.861 cf	71 °F	69 °F	0.00 "H_2O
Start	0831	0.000 cf	71 °F	-0.50 "H_2O	329.900 cf	69 °F	67 °F	0.00 "H_2O
	27.84	2.000 cf	71 °F	-0.50 "H_2O	1.961 cf	70 °F	68 °F	0.00 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 2.000 \left(\frac{29.55 + \frac{(-0.50)}{13.6}}{71 + 460} \right) \times \underset{(C_f)}{1.002} = 1.966 \text{ dscf}$$

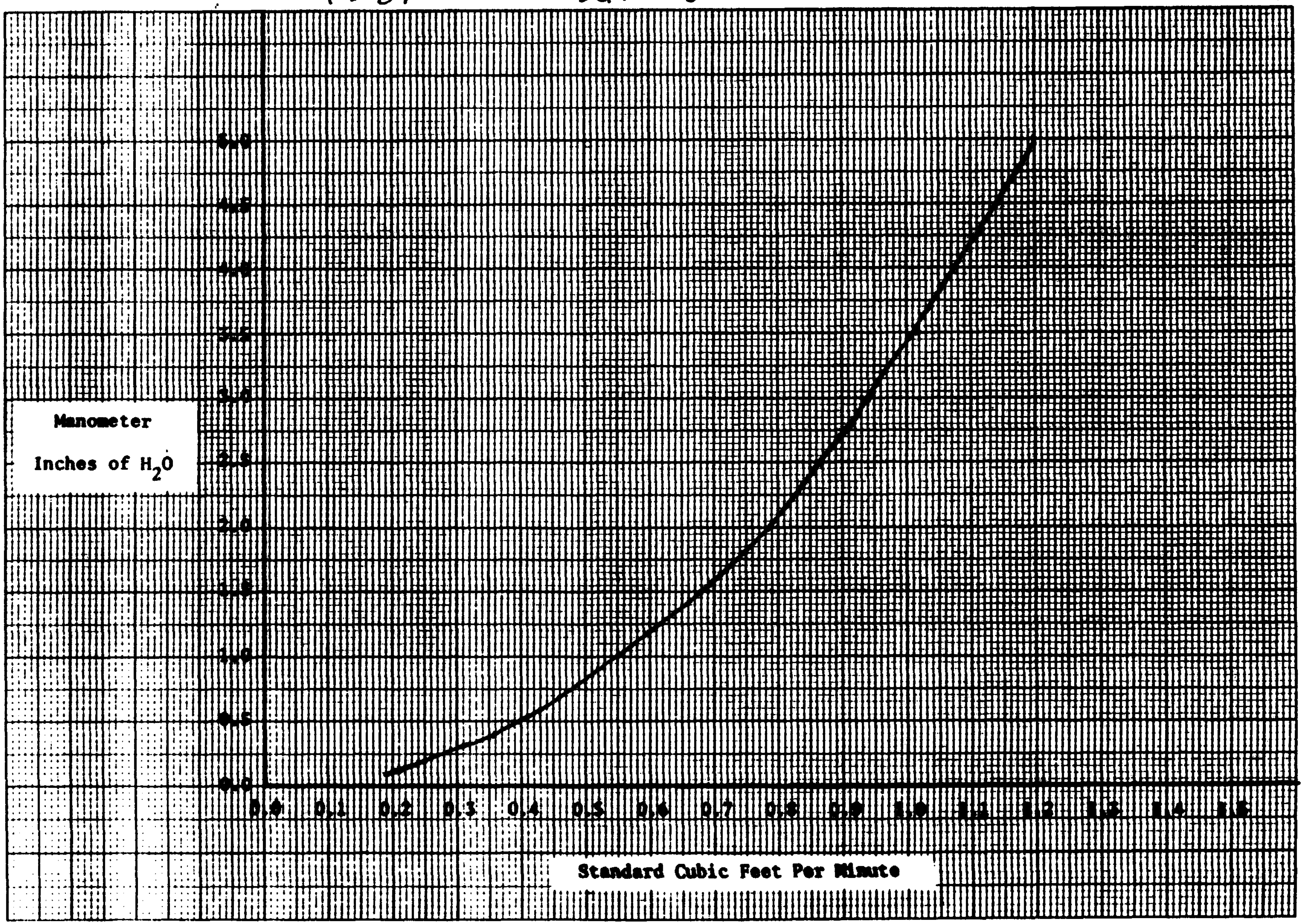
$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 1.961 \left(\frac{29.55 + \frac{0.00}{13.6}}{69 + 460} \right) = 1.933 \text{ dscf}$$

$$C_{DG} = \frac{1.966}{1.933} = \boxed{1.017}$$

(2.000 lpm)

MULLINS ENVIRONMENTAL TESTING CO., INC.

4-2-87 DGM#6 R. Irwin



METCO

DIGITAL TEMPERATURE INDICATOR NO. 6

CALIBRATION DATA

Date: 4-2-87

Media	Time	Mercury Thermometer (°F)	DTI (°F)
Ice Bath	1025	32	32
Ambient Air	1028	69	68
Boiling Water	1032	212	212
Oven	1041	148	150
Oven	1101	276	275
Oven	1115	353	350
Oven	1126	404	400

Meter Adjusted? Yes_____ No ✓

Signature of Calibrator

METCO

BAROMETER CALIBRATION

Barometer No. 1

Date: 5/15/87

Time: 0820

Barometric Pressure @ Addison Field @ 719 ft.	=	30.11
	-	0.719
Absolute Pressure at Addison Field	=	29.391
	+	0.083
Absolute Pressure @ METCO @ 636 ft.	=	29.47
Barometer Reading	=	29.42
Variation	=	-0.05

Barometer Adjusted? Yes ✓ No

Signature of Calibrator

METCO

APPENDIX D

Field Testing Data

MULLINS ENVIRONMENTAL TESTING CO., INC.

Job No. 87-88

Job Name Wood Materials Supply

Run No. 1

Location Scrubber Stack

Date 14 July 1987

Operator Alexander, Orr

Sample Box No. 3 Meter Box No. 6

PART., SO2 FIELD DATA

Read and record at the start of each test point.

Purge to: 818.433

Purge time: 0926 - 0941

Ambient Temp. °F 76

Assumed Moisture % 33

Probe Length 3'

C Factor - 13.7 to reference

Initial Leak @ 16.0 "Hg = 0.008 cfm

Final Leak @ 11.0 "Hg = 0.006 cfm

Point	Clock Time	Dry Gas Meter, CF	ΔP_s Pitot in. H_2O	P_m Orifice ΔH in. H_2O Desired	Actual	Pump Vacuum In. Hg Gauge	T_s Stack Temp. °F	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	T_m Dry Gas Temp. °F Inlet	Outlet	Remarks
A 12	0805	772.700	1.00	1.40	1.40	4.5	163	232	228	75	74	75	
11	0808	774.65	1.10	1.50	1.50	6.5	163	236	232	70	75	75	
10	0811	776.47	1.30	1.70	1.70	8.3	164	238	237	63	75	75	
9	0814	778.57	1.35	1.80	1.80	9.2	165	251	242	63	75	75	ret. change
8	0817	780.78	1.15	1.50	1.50	7.0	166	270	247	66	76	75	
7	0820	782.79	0.87	1.15	1.15	5.2	165	273	250	72	76	75	
6	0823	784.63	0.40	0.53	0.53	3.0	166	269	252	73	77	74	
5	0826	785.90	0.32	0.42	0.42	2.5	166	267	258	70	76	75	orsat
4	0829	786.98	0.30	0.40	0.40	2.5	165	268	263	71	76	74	
3	0832	788.04	0.30	0.40	0.40	2.3	165	268	263	72	76	75	
2	0835	789.10	0.26	0.35	0.35	2.0	165	270	269	74	77	75	
1	0838	790.08	0.26	0.35	0.35	2.0	166	270	272	76	77	75	
END	0841	791.051	—	—	—	—	—	—	—	—	—	—	
B 12	0846	791.051	1.00	1.40	1.40	5.0	168	267	270	80	76	74	
11	0849	792.92	1.00	1.40	1.40	5.3	168	254	262	65	77	75	ref. change 12.0
10	0852	794.75	1.10	1.35	1.35	5.5	168	259	264	62	79	75	
9	0855	796.70	1.05	1.30	1.30	5.3	166	260	260	63	80	74	ret. to 12.5
8	0858	798.59	0.92	1.15	1.15	5.0	168	261	260	66	80	75	

Pitot Tube Calibration Factor C_p 0.807

Volume Collected V_m 39.458 145 ft^3

Water Collected V_w 514.3 ml

Time of Test T_t 72 min.

Stack Pressure P_s - 0.80 "H_2O

Baro. Press. P_b 29.90 "Hg

Probe Tip Dia. D_n 0.249 in.

% CO_2 7.4 % CO 0.0

% O_2 10.8 % N_2 81.8

Area Stack A_s 1320 in^2

Pitot Tube No. 12 Barometer No. 1

Probe Tip No. II-4

V_m = Dry Gas Meter Calibration Factor 1.008 X 39.145

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)]

M_F = ________ M_T = ________

Impinger Box No. 3

Impinger 1	Final Weight	841.5	**Water Weight Gain**	Impinger 1 188.0
	Initial Weight	653.5		Impinger 2 192.3
	Increase	188.0		Impinger 3 78.8
Impinger 2	Final Weight	878.6		Impinger 4 8.4
	Initial Weight	686.3	V_w =	Impinger 5 46.8
	Increase	192.3	g SO_2 = -	Impinger 6
Impinger 3	Final Weight	763.9	V_w =	Total 514.3 = V_w
	Initial Weight	685.1		
	Increase	78.8		
Impinger 4	Final Weight	498.1		
	Initial Weight	489.7		
	Increase	8.4		
Impinger 5	Final Weight	872.8		
	Initial Weight	826.0		
	Increase	46.8		
Impinger 6	Final Weight			
	Initial Weight			
	Increase			

Filter # ____ Final Weight ____ Initial Weight ____ Increase ____

P_b = 29.90		$\%CO_2$ = 7.4	
V_m = 39.458		$\%O_2$ = 10.8	
V_w = 514.3		%CO = 0.0	
P_m = 1.043		$\%N_2$ = 81.8	
Avg ΔP = 0.802		A_s = 1320	
Avg $\sqrt{\Delta P}$ = 0.872		D_n = 0.249	
C_p = 0.807		T_t = 72	
P_s = -0.80 "H_2O	29.84 "Hg		
T_m = 76 °F	536 °R		
T_s = 166 °F	626 °R		

Moisture Content: %M = 38.40 M_d = 0.6160 MW_d = 29.616 MW = 25.16

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 39.458 \left(\frac{29.90 + \frac{1.043}{13.6}}{76 + 460}\right) = 38.949 \text{ sft}^3$$

0.541 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 514.3 = 24.275 \text{ sft}^3$$

$$\%\ \text{Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{24.275}{38.949 + 24.275} \times 100 = 38.40\ \%$$

$$V_s = 5123.8 \times 0.807 \sqrt{\frac{626}{29.84 \times 25.16}} \times 0.872 = 3292 \text{ fpm}$$

ACFM: 30180 ~~30194~~

SCFM: 15680

%EA: 99.3

$$\%I = \frac{1039 \times 626 \times 38.949}{29.84 \times 0.6160 \times 3292 \times 72 \times (0.249)^2} = 73.8\ \%$$

41.479

0.576

Run No. 1

PARTICULATE FIELD DATA

Location Scrubber Stack

Date 14 July 1987

			ΔP_s	P_m			T_s				T_m		
Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O	Orifice ΔH in. H_2O		Pump Vacuum In. Hg Gauge	Stack Temp. °F	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F		Remarks
				Desired	Actual						Inlet	Outlet	
7	0901	800.34	0.68	0.86	0.86	4.0	167	262	258	69	80	75	
6	0904	801.90	0.60	0.76	0.76	3.8	167	264	258	71	80	75	
5	0907	803.32	0.72	0.91	0.91	4.2	167	266	259	74	80	75	
4	0910	804.86	0.86	1.10	1.10	5.0	165	265	258	75	81	75	
3	0913	806.60	0.90	1.10	1.10	5.0	166	260	250	77	81	75	
2	0916	808.35	0.90	1.10	1.10	5.0	167	262	255	79	82	75	
1	0919	810.10	0.90	1.10	1.10	5.0	167	262	256	80	82	75	
END	0922	811.845	—	—	—	—	—	—	—	—	—	—	
AH													

MULLINS ENVIRONMENTAL TESTING CO., INC.

Job No. 87- 88
Job Name Wood Materials
Run No. 2
Location Scrubber Stack
Date 14 July 1987
Operator Alexander, Orr
Sample Box No. 11 Meter Box No. 6

PART., SO_2 FIELD DATA

Read and record at the start of each test point.

Purge to: 868.900
Purge time: 1158 - 1208

Ambient Temp. °F 84
Assumed Moisture % 38
Probe Length 3'
C Factor - 14 to reference
Initial Leak @ 15.0 "Hg = 0.000 cfm
Final Leak @ 19.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	ΔP_s Pitot in. H_2O	P_m Orifice ΔH in. H_2O Desired	Actual	Pump Vacuum In. Hg Gauge	T_s Stack Temp. °F	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	T_m Dry Gas Temp. °F Inlet	Outlet	Remarks
B 8 12	1021	818.600	1.05	1.50	1.50	10.8	170	270	237	83	76	76	
7 11	1024	820.40	1.05	1.50	1.50	11.2	172	252	236	66	77	76	
6 10	1027	822.41	1.10	1.50	1.50	11.6	171	251	244	64	78	76	plant down - off
5 9	1030	824.40	1.50	2.10	2.10	14.3	163	270	254	88	77	76	1030 restart
4 8	1033	826.83	0.87	1.25	1.25	10.3	164	253	256	69	78	76	1040
3 7	1046	828.70	0.72	1.05	1.05	8.5	163	239	257	70	78	76	
2 6	1049	830.48	0.65	0.93	0.93	7.5	163	238	255	73	78	76	
1 5	1052	832.12	0.75	1.10	1.10	8.5	165	239	259	75	79	76	
END 4	1055	833.80	0.86	1.20	1.20	9.2	162	237	258	76	80	76	orsat
3	1058	835.50	0.87	1.25	1.25	10.0	161	236	263	80	80	76	
2	1103	837.40	0.89	1.30	1.30	10.8	165	235	265	83	80	76	
1	1104	839.27	0.80	1.15	1.15	10.3	166	228	261	86	81	76	
END	1107	841.032	—	—	—	—	—	—	—	—	—		
A 12	1111	841.032	1.10	1.55	1.55	12.2	163	274	272	97	80	76	
11	1114	843.02	1.20	1.70	1.70	13.5	160	256	265	86	81	77	
10	1117	845.15	1.45	2.10	2.10	17.0	160	251	260	84	82	77	
9	1120	847.45	1.40	2.00	2.00	17.0	165	241	247	81	82	77	
8	1123	849.74	1.20	1.70	1.70	15.0	162	242	250	74	83	77	

Pitot Tube Calibration Factor C_p 0.807
Volume Collected V_m 42.638 ft^3
Water Collected V_w 620.8 ml
Time of Test T_t 72 min.
Stack Pressure P_s -0.30 "H_2O

Baro. Press. P_b 29.95 "Hg
Probe Tip Dia. D_n 0.249 in.
% CO_2 7.2 % CO 0.0
% O_2 10.8 % N_2 82.0
Area Stack A_s 1320 in^2

Pitot Tube No. 12 Barometer No. 1
Probe Tip No. II -4

V_m = Dry Gas Meter Calibration Factor 1.008 X 42.300

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)]

M_F = ____ M_T = ____

Impinger Box No. 11

Impinger 1	Final Weight	864.2	
	Initial Weight	666.4	
	Increase	197.8	✓
Impinger 2	Final Weight	834.7	
	Initial Weight	672.2	
	Increase	162.5	✓
Impinger 3	Final Weight	856.2	
	Initial Weight	679.9	
	Increase	176.3	✓
Impinger 4	Final Weight	536.8	
	Initial Weight	492.8	
	Increase	44.0	✓
Impinger 5	Final Weight	843.6	
	Initial Weight	803.4	
	Increase	40.2	✓
Impinger 6	Final Weight		
	Initial Weight		
	Increase		

Filter # ____ Final Weight ____ Initial Weight ____ Increase ____

Water Weight Gain

V_w =

g SO_2 = - ____

V_w =

Impinger 1	197.8 ✓
Impinger 2	162.5 ✓
Impinger 3	176.3 ✓
Impinger 4	44.0 ✓
Impinger 5	40.2 ✓
Impinger 6	
Total	620.8 ✓ = V_w

P_b = 29.95 ✓		$\%CO_2$ = 7.2 ✓	
V_m = 42.638 ✓		$\%O_2$ = 10.8 ✓	
V_w = 620.8 ✓		$\%CO$ = 0.0	
P_m = 1.211 ✓		$\%N_2$ = 82.0 ✓	
Avg ΔP = 0.850 ✓		A_s = 1320 ✓	
Avg $\sqrt{\Delta P}$ = 0.896 ✓		D_n = 0.249 ✓	
C_p = 0.807 ✓		T_t = 872 ✓	
P_s = -0.30 ✓ "H_2O		29.93 ✓ "Hg	
T_m = 78 ✓ °F		538 ✓ °R	
T_s = 164 ✓ °F		624 ✓ °R	

Moisture Content: %M = 41.08 ✓ M_d = 0.5892 ✓ MW_d = 29.584 ✓ MW = 24.83 ✓

$$V_{m_{std}} = 17.65\, V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 42.638 \left(\frac{29.95 + \frac{1.211}{13.6}}{78 + 460}\right) = 42.019 \text{ sft}^3$$

0.584 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 620.8 = 29.302 \text{ sft}^3$$

$$\%\text{ Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{29.302}{42.019 + 29.302} \times 100 = 41.08\ \%$$

$$V_s = 5123.8 \times 0.807 \sqrt{\frac{624}{29.93 \times 24.83} \times } \ 0.896 = 3395 \text{ fpm}$$

$$\%I = \frac{1039 \times 624 \times 42.019}{29.93 \times 0.5892 \times \frac{31120}{3395} \times 72 \times (0.249)^2} = 101.9\ \%$$

ACFM: 31,120 ✓

SCFM: 15578 ✓

%EA: 98.8 ✓

Run No. 2

PARTICULATE FIELD DATA

Location Scrubber Stack

Date 14 July 1987

			ΔP_s	P_m			T_s				T_m		
Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O	Orifice ΔH in. H_2O		Pump Vacuum In. Hg Gauge	Stack Temp. °F	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F		Remarks
				Desired	Actual						Inlet	Outlet	
7	1126	851.96	0.95	1.35	1.35	11.3	157	238	243	73	82	77	
6	1129	853.90	0.43	0.61	0.61	5.8	161	240	246	72	82	77	
5	1132	855.29	0.32	0.46	0.46	4.6	165	252	244	70	81	77	
4	1135	856.43	0.30	0.43	0.43	4.5	167	259	239	71	81	77	
3	1138	857.54	0.33	0.48	0.48	5.0	166	258	240	70	81	77	
2	1141	858.68	0.30	0.43	0.43	4.5	165	263	260	67	81	78	
1	1144	859.79	0.30	0.43	0.43	4.5	158	266	268	66	81	78	
END	1147	860.900	—	—	—	—	—	—	—	—	—	—	

MULLINS ENVIRONMENTAL TESTING CO., INC.

Job No. 87-88

PART., SO_2 FIELD DATA

Job Name Wood Materials Supply

Run No. 3

Location Scrubber Stack

Date 14 July 1987

Operator Alexander, Orr

Sample Box No. 12 Meter Box No. 6

Read and record at the start of each test point.

Purge to: 916.100

Purge time: 1402-1417

Ambient Temp. °F 94

Assumed Moisture % 38

Probe Length 3'

C Factor 13.5 to reference

Initial Leak @ 16.8 "Hg = 0.000 cfm

Final Leak @ 14.6 "Hg = 0.002 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (ΔP_s)	Orifice ΔH in. H_2O (P_m) Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp. °F (T_s)	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F (T_m) Inlet	Dry Gas Temp. °F Outlet	Remarks
A 12	1247	869.100	1.30	1.80	1.80	6.5	166	265	255	87	80	79	
11	1250	871.30	1.20	1.70	1.70	6.8	164	272	260	72	81	79	
10	1253	873.45	1.40	2.00	2.00	7.2	164	260	265	67	82	79	
9	1256	875.80	1.30	1.80	1.80	7.0	164	245	269	62	83	79	
8	1259	877.97	0.94	1.30	1.30	6.5	163	235	273	60	84	79	
7	1302	879.87	0.94	1.30	1.30	5.5	162	235	272	62	84	79	
6	1305	881.80	0.38	0.52	0.52	2.5	164	232	273	63	85	80	
5	1308	883.29	0.24	0.33	0.33	2.0	170	231	273	66	84	80	
4	1311	884.20	0.20	0.27	0.27	2.0	172	234	275	68	83	80	
3	1314	885.10	0.26	0.36	0.36	2.2	172	231	274	68	83	80	
2	1317	886.10	0.28	0.38	0.38	2.2	170	240	273	69	83	80	
1	1320	887.26	0.26	0.36	0.36	2.2	171	247	270	67	83	80	Orsat
END	1323	888.153	—	—	—	—	—	—	—	—	—	—	
B 12	1326	888.153	0.90	1.20	1.20	5.0	170	257	271	72	83	80	
11	1329	889.85	0.85	1.15	1.15	4.8	169	243	270	61	85	80	
10	1332	891.66	0.91	1.20	1.20	5.0	169	241	264	60	85	80	
9	1335	893.43	0.87	1.20	1.20	5.0	169	242	260	59	86	80	
8	1338	895.22	0.68	0.94	0.94	4.3	173	240	258	60	87	80	

Pitot Tube Calibration Factor C_p 0.807

Volume Collected V_m 39.181 ft^3

Water Collected V_w 529.2 ml

Time of Test T_t 72 min.

Stack Pressure P_s -0.33 "H_2O

Baro. Press. P_b 29.93 "Hg

Probe Tip Dia. D_n 0.249 in.

% CO_2 8.2 % CO 0.0

% O_2 9.6 % N_2 82.2

Area Stack A_s 1320 in^2

Pitot Tube No. 12 Barometer No. 1

Probe Tip No. II-4

V_m = Dry Gas Meter Calibration Factor 1.008 X 38.870

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)]

M_F = ____ M_T = ____

Impinger Box No. 12

Impinger 1	Final Weight	847.2	
	Initial Weight	647.9	
	Increase	199.3	
Impinger 2	Final Weight	800.5	
	Initial Weight	689.3	
	Increase	111.2	
Impinger 3	Final Weight	825.8	
	Initial Weight	690.9	
	Increase	134.9	
Impinger 4	Final Weight	553.8	
	Initial Weight	496.2	
	Increase	57.6	
Impinger 5	Final Weight	858.7	
	Initial Weight	832.5	
	Increase	26.2	
Impinger 6	Final Weight		
	Initial Weight		
	Increase		

Filter # ____ Final Weight ____ Initial Weight ____ Increase ____

Water Weight Gain

Impinger 1	199.3
Impinger 2	111.2
Impinger 3	134.9
Impinger 4	57.6
Impinger 5	26.2
Impinger 6	
Total	529.2 = V_w

V_w =

g SO_2 = - ____

V_w =

P_b = 29.93		$\%CO_2$ = 8.2	
V_m = 39.181		$\%O_2$ = 9.6	
V_w = 529.2		$\%CO$ = 0.0	
P_m = 1.015		$\%N_2$ = 82.2	
Avg ΔP = 0.738		A_s = 1320	
Avg $\sqrt{\Delta P}$ = 0.826		D_n = 0.249	
C_p = 0.807		T_t = 72	
P_s = -0.37 "H_2O		29.91 "Hg	
T_m = 82 °F		542 °R	
T_s = 168 °F		628 °R	

Moisture Content: %M = 39.48 M_d = 0.6052 MW_d = 29.696 MW = 25.08

$$V_{m_{std}} = 17.65\, V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right) = 17.65 \times 39.181 \left(\frac{29.93 + \frac{1.015}{13.6}}{82 + 460} \right) = 38.283 \text{ sft}^3$$

0.532 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 529.2 = 24.978 \text{ sft}^3$$

$$\%\ \text{Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{24.978}{38.283 + 24.978} \times 100 = 39.48\ \%$$

$$V_s = 5123.8 \times 0.807 \sqrt{\frac{628}{\cancel{25.08} \times 29.91}} \times \frac{\cancel{0.826}\ 0.832}{\cancel{0.682}} = \cancel{3125}\ 3148 \text{ fpm}$$

$$\%I = \frac{1039 \times 628 \times 38.283}{29.91 \times 0.6052 \times 31\cancel{25}48 \times 72 \times (0.\cancel{249})^2} = 98.\cancel{4}2\ \%$$

ACFM: ~~28646~~ 854

SCFM: ~~14628~~ 832

%EA: 78.8

Run No. 3

PARTICULATE FIELD DATA

Location Scrubber Stack

Date 14 July 1981

Point	Clock Time	Dry Gas Meter, CF	ΔP_s Pitot in. H_2O	P_m Orifice ΔH in. H_2O Desired	P_m Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	T_s Stack Temp. °F	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	T_m Dry Gas Temp. °F Inlet	T_m Dry Gas Temp. °F Outlet	Remarks
7	1341	896.83	0.56	0.76	0.76	4.0	174	239	254	62	86	81	
6	1344	898.28	0.50	0.68	0.68	3.6	171	240	249	66	86	81	
5	1347	899.63	0.67	0.92	0.92	4.3	169	235	245	70	86	81	
4	1350	901.19	0.78	1.05	1.05	4.9	168	236	240	72	87	81	
3	1353	902.88	0.82	1.10	1.10	5.0	168	234	234	73	88	81	
2	1356	904.65	0.80	1.10	1.10	5.2	167	236	241	73	88	81	
1	1359	906.40	0.68	0.93	0.93	4.5	167	239	244	73	88	81	
END	1402	907.970	–	–	–	–	–	–	–	–	–	–	

METCO

APPENDIX E

Analytical Data

Mullins Environmental Testing Co., Inc.

Particulate Analysis Summary

Job Number 87 88 Date Analysis Completed 7-21-87

Job Name Wood Materials Supply Inc Unit Tested Scrubber Stack

Location Conroe, Tx.

Run No.	1	2	3		
Particulate on Filter (mg)	31.7	61.5	34.7		
Particulate in Front Wash (mg)*	48.6	58.9	53.1		
MF (mg)	80.3	120.4	87.8		
Particulate in Impinger #1 (mg)**	6.7	6.2	9.0		
MT (mg)	87.0	126.6	96.8		

FPB

Mary Gantie

Analyst

* Less Acetone Residue

** Less Ammonium Sulfate

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

Stack Filters

Job Number 87-88 Location Conroe, Texas

Job Name Wood Materials Supply Unit Tested Scrubber Stack

Desiccator Time In	7/14 2030	16 59 7/15			
Desiccator Time Out	7/15 16 52	0819 7/16			

Run No. 1	Filter No. T-72				
Filter & Particulate + Tare Weight (g)	2.5546	2.5549			
Tare Weight (g)	1.8796	1.8794	✓		
Filter & Particulate (g)	0.6750	0.6755	✓		

Filter & Particulate Average (g) 0.6753 ✓
Initial Filter Weight (g) 0.6436 ✓
Total Particulate (mg) 31.7 ✓

Run No. 2	Filter No. T-73				
Filter & Particulate + Tare Weight (g)	2.5811	2.5811			
Tare Weight (g)	1.8795	1.8794	✓		
Filter & Particulate (g)	0.7016	0.7017	✓		

Filter & Particulate Average (g) 0.7017 ✓
Initial Filter Weight (g) 0.6402 ✓
Total Particulate (mg) 61.5 ✓

Run No. 3	Filter No. T-74				
Filter & Particulate + Tare Weight (g)	2.5561	2.5563			
Tare Weight (g)	1.8792	1.8794			
Filter & Particulate (g)	0.6769	0.6769	✓		

Filter & Particulate Average (g) 0.6769 ✓
Initial Filter Weight (g) 0.6422 ✓
Total Particulate (mg) 34.7 ✓

M. Ganter

Analyst

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

Front Wash

Job Number 87-88 Location Conroe, Tx

Job Name Wood Material Supply Inc. Unit Tested " Stack

Desiccator Time In	11⁴⁵ 7/15/87	8" 7/16			
Desiccator Time Out	808 7/16	8⁴⁵ 7/17			

Run No. 1	Volume (ml) 432				
Final Weight (g)	154.1788	154.1791			
Initial Weight (g)	154.1272	154.1272	✓		
Particulate Weight (g)	0.0516	0.0519	✓		

Particulate Average (mg) 51.8 ✓
Less Acetone Blank (mg) 3.2 ✓
Total Particulate (mg) 48.6 ✓

Run No. 2	Volume (ml) 329				
Final Weight (g)	176.9460	176.9459			
Initial Weight (g)	176.8846	176.8846	✓		
Particulate Weight (g)	0.0614	0.0613	✓		

Particulate Average (mg) 61.4 ✓
Less Acetone Blank (mg) 2.5 ✓
Total Particulate (mg) 58.9 ✓

Run No. 3	Volume (ml) 425				
Final Weight (g)	146.1715	146.1720			
Initial Weight (g)	146.1155	146.1155	✓		
Particulate Weight (g)	0.0560	0.0565	✓		

Particulate Average (mg) 56.3 ✓
Less Acetone Blank (mg) 3.2 ✓
Total Particulate (mg) 53.1 ✓

Acetone Blank	Volume (ml) 365				
Final Weight (g)	127.9254	127.9259			
Initial Weight (g)	127.9229	127.9229	✓		
Difference (g)	0.0025	0.0030	✓		

Average (mg) 2.75
* mg/l 7.5

* Note: If greater than 7.9 mg/l, use 7.9 mg/l.

M. G.

Analyst

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

SO_3 Back Half Analysis

Job Number 87-8?

Job Name Wood Mat. Supply

Location Conyse, Ky.

Unit Tested Scrubber Stack

Desiccator Time In	9⁰⁰ 7/16/87	16³⁰ 7/.	16³⁰ 7/17		
Desiccator Time Out	1631 7/16	1633 7/17	7/21		

Run No. 1	Volume (ml) 375 (405)				
Final Weight (g)	158.8317	158.8301	158.8296		
Initial Weight (g)	158.8165	158.8165	158.8165	✓	
Particulate Weight (g)	0.0152	0.0136	0.0131		

Particulate Average (mg) 13.4

Less Ammonium Sulfate (mg) 6.7

Total Particulate (mg) 6.7

Run No. 2	Volume (ml) 370 (400)				
Final Weight (g)	177.2229	177.2203	177.2200		
Initial Weight (g)	177.2074	177.2074	177.2074	✓	
Particulate Weight (g)	0.0155	0.0129	0.0126		

Particulate Average (mg) 12.8

Less Ammonium Sulfate (mg) 6.6

Total Particulate (mg) 6.2

Run No. 3	Volume (ml) 396 (426)				
Final Weight (g)	184.3000	184.2990	184.2986		
Initial Weight (g)	184.2842	184.2842	184.2842	✓	
Particulate Weight (g)	0.0158	0.0148	0.0144		

Particulate Average (mg) 14.6

Less Ammonium Sulfate (mg) 5.6

Total Particulate (mg) 9.0

M. Banter

Analyst

SO_2 EMISSION DATA

Job Number 87-88 Location Conroe, Tex.

Job Name Wood Materials Supply Unit Tested Scrubber Stack

Run Number	1	2	3			
$\underline{N}$ - normality of $BaCl_2$	0.0100	0.0100	0.0100			
ML_I - ml in impinger #2	413	436	369			
ML_I - ml in impinger #3	522	392	492			
ML_A - ml in aliquot #2	10	10	10			
ML_A - ml in aliquot #3	10	10	10			
ML_B - ml of $BaCl_2$ to titrate #2	1.15 1.20 1.20	1.10 1.10 1.10	1.25 1.25 1.30			
Average ML_B - ml of $BaCl_2$	1.18	1.10	1.27			
ML_B - ml of $BaCl_2$ to titrate #3	0.50 0.50 0.55	0.10 0.10 0.15	0.45 0.45 0.45			
Average ML_B - ml of $BaCl_2$	0.52	0.12	0.45			
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05			
T_m - average gas meter temp., °F						
V_m - volume of dry gas sampled @ meter conditions, ft.^{3}						
P_b - barometric pressure, "Hg Abs.						
Q_s - stack gas volume dry @ standard conditions, *SCFM						
C_I - SO_2 in impinger #2, mgs	14.9	14.6	14.4			
C_I - SO_2 in impinger #3, mgs	7.9	0.9	6.3			
C_T - total SO_2 in impingers, mgs	22.8	15.5	20.7			
ppm SO_2						
C_{SO_2} - emission rate of SO_2, lbs/day						
C_{SO_2} - emission rate of SO_2, lbs/hr						
C_s - emission rate of S, lbs/day						

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

$$C_I = \frac{ML_I \times (ML_B - ML_{BB}) \times \underline{N} \times 32}{ML_A}$$

$$\text{ppm } SO_2 = \frac{0.7513 \times C_T \times (T_m + 460)}{V_m \; P_b}$$

$$C_{SO_2} = \text{ppm } SO_2 \times Q_s \times 239.2 \times 10^{-6}$$

$$C_T = C_I \, \#2 + C_I \, \#3$$

$$C_s = \frac{C_{SO_2}}{2}$$

METCO

SULFUR TRIOXIDE EMISSION DATA

Job Number 77-88 Location Conroe, Tx

Job Name Wood Materials Unit Tested Scrubber

Run Number	1	2	3	
Date				
Time				
$\underline{N}$ - normality of $BaCl_2$	0.0100	0.0100	0.0100	
ML_I - ml in impinger	405	400	426	
ML_A - ml in aliquot	10	10	10	
ML_B - ml of $BaCl_2$ to titrate	0.30	0.30	0.25	
	0.30	0.30	0.25	
	0.30	0.30	0.25	
Average ML_B - ml of $BaCl_2$ to titrate	0.30	0.30	0.25	
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.15	0.15	0.15	
T_m - average gas meter temp., °F				
V_m - volume of dry gas sampled @ meter conditions, ft.^{3}				
P_b - barometric pressure, "Hg Abs.				
Q_s - stack gas volume dry @ standard conditions, *SCFM				
C_I - SO_3 in impinger, mgs	4.0	4.0	3.4	
ppm SO_3				
C_{SO_3} - emission rate of SO_3, lbs/day				
C_S - emission rate of S, lbs/day				

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

$$\text{ppm } SO_3 = \frac{0.6021 \times C_I \times (T_m + 460)}{V_m P_b}$$

$$C_I = \frac{ML_I \times (ML_B - ML_{BB}) \times \underline{N} \times 40}{ML_A}$$

$$C_{SO_3} = \text{ppm } SO_3 \times Q_s \times 299.1 \times 10^{-6}$$

$$C_S = \frac{C_{SO_3}}{2.5}$$

APPENDIX F

Plant Operational Data

7/~~13~~14/87

Run No.	Time	Feed Rate instant	Feed Rate Totalizer	Burner Position	Water Pump
1	0803	204	618164	7	77
2	8:15	203	618207	7	
3	8:30	204	618263	7½	
4	8:45	205	618315	7½	
5	9:00	203	618369	7½	
6	9:15	202	618430	6	
17	9:22 9:30	204	618450	5 ½	77

7/14/87 II	10:20	202	618657	7	77
2	/ ~~[illegible]~~ 11:47	~~202~~	618937	4	77

down 5 minutes

7/14/87 III. 3	12:45	171	619114	4	77
	1:10	200	619192	5	
	1:25	201	619246	6⅛	
	1:40	204	619300	6½	
	1:55	203	619351	6½	
	2:05	197	619379	7	77

ASPHALTIC CONCRETE CENTRIFUGE EXTRACTION WORK SHEET

County *Montgomery* Highway ________ Project *Pct 1,2,3,4* Control ________

Date *1-14-87* Time ________ Station ________ Sampled By ________

Spec. Item ________ Type *340 D Mod* Design No. ________

Total Sample = *800* gm. (A)		Total Solvent = *1620* ml. (2)	
Final Filter = *27.6* gm. (a)		Total Ash = $\frac{1 \times 2}{100}$ = *4.86* gm. (D)	
Original Filter = *25.2* gm. (b)		Fines + Aggr. + Ash = B + C + D = *765.26* gm. (E)	
Fines in Filter = a − b = *2.4* gm. (B)		Total Loss = A − E = *34.74* gm. (F)	
Pan + Extr. Aggr = *2012* gm. (c)		Total Loss = $\frac{F}{A}$ × 100 = *4.3* % (G)	
Pan = *1254* gm. (d)		Moisture Content = *–* % (H)	
Extr. Aggr = c − d = *758* gm. (C)		Hydrocarbon Volatiles Content = *–* % (I)	
Dish + Ash per 100 ml = *138.9* gm. (e)		Retention Factor = *–* % (R)	
Dish = *138.6* gm. (f)		Residual Bitumen = G − H − I + R = *4.3* % (J)	
Ash per 100 ml = e − f = *.3* gm. (1)			

	Percent of Total Mixture
Fines + Aggr. + Ash = ($\frac{E}{A}$ × 100) − R =	*95.7*
Moisture = H =	*–*
Hydrocarbon Volatiles = I =	*–*
Residual Bitumen = J =	*4.3*
Total =	100.0%

SIEVE ANALYSIS

Sieve Size	Grams	Percent
1-3/4" − 7/8"		
7/8" − 3/8"		
5/8" − 3/8"		
1/2" − 3/8"		
3/8" − 4	*231*	*30.5*
1/4" − 10		
4 − 10	*216*	*28.5*
+10		*59.0*
10 − 40	*95*	*12.5*
40 − 80	*139*	*18.3*
80 − 200	*38*	*5.0*
Pass 200	*32+2.4+4.86=39.26*	*5.2*
Total	*758.26*	100.0%

Moisture
5.5%

A.C.
4.3%

Charles J. Hood
Inspector

METCO

APPENDIX G

Chain of Custody

MULLINS ENVIRONMENTAL TESTING CO., INC.

Chain of Custody

Job Number 87-88

Job Name WOOD MATERIALS SUPPLY

Location S CONROE, TEXAS

Unit Tested Scrubber Stack

Date(s) Sampled 7/14/87

Number of Tests 111

Date Results Required

SOURCE SAMPLES

	Number of Containers	Particulate	SO_2	SO_3	H_2S	Cl_2	H_2SO_4	Metals	Other
Filter Container	111	✓							
Front Wash	111	✓							
Back Wash									
Impinger No. 1	111	✓		✓					
Impinger No. 2	111		✓						
Impinger No. 3	111		✓						
Impinger No. 4									
Acetone Blank	1	✓							
NO_x									

Special Instructions

Outside Analysis

Firm: Date Taken:

Analysis for:

Sample No. 1 Recovered by: Don C. Alexander Date: 7/14/87 Time: 1030 Location: VAN

Sample No. 2 Recovered by: Don C Alexander Date: 7/14/87 Time: 1330 Location: VAN

Sample No. 3 Recovered by: Don C Alexander Date: 7/14/87 Time: 1440 Location: VAN

Samples Received by: Don C Alexander for Transport Date: 7/14/87 Time: 1530

Samples Received at Lab by: Don C Alexander Date: 7/14/87 Time: 2030

Samples Analyzed by: Mary Santee Date: 7/21/87 Time: 0845

METCO

APPENDIX H

Resumes of Test Personnel

BILLY J. MULLINS, JR., President

Education	Post Graduate Study in Environmental Engineering at Southern Methodist University, Dallas, Texas, 1970.
	M.S. 1969, New York University, New York, New York, in Civil Engineering (Air Resources).
	B.S. 1968, Texas Tech University, Lubbock, Texas, in Civil Engineering (Water Resources).
	Studies in Engineering at U.S. Naval Academy, Annapolis, Maryland, 1963-1964.
Professional Training Courses	Attended Short Course on Air Pollution Engineering at the University of Texas at Austin, February 1970.
	Attended four-week management course presented by the American Management Association, 1976.
Certification	Registered Professional Engineer Certified Visible Emissions Evaluator Certified Fallout Shelter Analyst Licensed Private Pilot (Multi-Engine-Land, Instrument) Diplomat in the American Academy of Environmental Engineers
Professional Memberships	Air Pollution Control Association - Past Chairman, Southwest Section; Chairman - Consultants Committee Source Evaluation Society - Past President Texas Society of Professional Engineers National Society of Professional Engineers American Management Association

MULLINS

Technical Experience

Directed and performed stack sampling on over 1200 sources of which over 150 were sampled simultaneously using more than one sampling train at several points in the flue gas stream. 1972-present.

Directed and performed over 150 short-term ambient air studies using mobile sampling vans and various ambient air sampling equipment. 1972-present.

Designed, directed and operated over 20 permanent ambient air networks of various size and duration for a variety of parameters. 1972-present.

Designed surface and underground drainage systems for residential subdivisions, public works projects, and shopping centers. 1969-1972.

Designed several residential subdivisions including lot layout, street design, drainage design, and utility design. 1969-1972.

Research Projects

Supervised and conducted a study made by the Hawaiian Sugar Planters' Association to characterize the emissions for several bagasse-fired boilers. April-May 1976.

Supervised and conducted a study made by the Rio Grande Valley Sugar Growers, Inc. to determine the area affected by the burning of sugarcane fields prior to harvesting. November 1974-April 1975.

Supervised and conducted a study by a lightweight aggregate manufacturer to develop a material balance around the process through sampling and analysis of several parameters. November 1973.

Conducted a study in New York City to attempt to develop a correlation in the ambient air between carbon dioxide and sulfur dioxide to provide a tool for predicting air pollution episodes. January-May 1969.

<u>Publications</u>

Co-authored "Sulfur Compound Emissions of the Petroleum Production Industry," December 1974.

Co-authored "Field Procedure for Stabilizing Hydrogen Sulfide Samples to be Analyzed Using Modified Methylene Blue Technique," presented at the Conference on Ambient Air Quality Measurements, Austin, Texas, March 1975.

Co-authored "Atmospheric Emissions Survey of the Sour Gas Industry," October 1975.

Co-authored "Technique for Insuring the Validity of Samples for High Concentrations of Sulfur Dioxide Using the EPA Method 5 Sampling Train," presented at the Third National Conference on Energy and the Environment, College Corner, Ohio, September 1975.

<u>Teaching Experience</u>

Served as a lecturer in the Environmental Protection Agency's training course number 450, "Source Sampling for Particulate Pollutants" for two years from January 1974 to October 1975.

Conducted a two-day training course entitled "Technical Assistance in Source Sampling" at Iowa State University, Ames, Iowa, for the Environmental Protection Agency, October 1974.

Conducted EPA's training course number 450, "Source Sampling for Particulate Pollutants" for the EPA at Research Triangle Park, North Carolina, September 1975.

Conducted a two-day short course entitled "Performing and Observing Source Sampling" at Dallas, Texas, July 1976, May 1977, October 1977; at Lake Charles, Louisiana, May 1977; and at Casper, Wyoming, May 1977.

Served as a lecturer in the Environmental Protection Agency's two-day seminar entitled "Asphalt Industry Environmental Solutions," presented in Dallas, Texas, on March 21 and 22, 1979.

Conducted a two-day short course entitled "Performing and Observing Source Sampling" in Lincoln, Nebraska, in March 1980 for the State of Nebraska, Air Quality Control Division.

MULLINS ENVIRONMENTAL TESTING CO., INC.
P.O. Box 596
Addison, Tx 75001
(214) 931-7127

METCO

DON C. ALEXANDER, Manager, Field Services

Education	B.S. 1978, Angelo State University, San Angelo, Texas, in Biology with a minor in Chemistry.
Professional Training Courses	Two-day short course, "Performing and Observing Source Sampling," Dallas, Texas, March 1982.
Certification	Certified Visible Emissions Evaluator
Professional Membership	Source Evaluation Society
Technical Experience	Participated in the sampling of over 1000 sources, including several of which were sampled simultaneously, using more than one sampling train and has supervised the sampling of over 850 sources. 1979-present.

Thoroughly trained in the calibration techniques for all field testing equipment and has supervised the calibration of all field testing equipment.

Thoroughly trained and familiar with the operation of MSA LIRA Model 202S Infrared CO Analyzer, Thermo Electron Model 48 Gas Correlation CO Analyzer, Thermo Electron Model 10AR Chemiluminescent NO_x Analyzer, Teledyne Oxygen Monitor, and Shimadzu GC-Mini 2 Gas Chromatograph.

Has performed on-site gravimetric particulate analysis, SO_2 analysis, and H_2S fuel gas analysis.

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P.O. Box 598
Addison, Tx 75001
(214) 931-7127

METCO

GREGGORY M. ORR, Environmental Field Technician

Education	B.S. 1985, Louisiana Tech University, Ruston, Louisiana, in Geology.
Technical Experience	Participated in the sampling of over 25 sources, including several which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures. 1986-present.

APPENDIX I

RESUMES OF NUS PERSONNEL

WILLIAM J. COLE, P.E.

SENIOR PROJECT MANAGER

EDUCATION

Graduate Work - Mechanics of Fluids and Industrial Administration - Warrington Technical College, England - 1964

Higher National Certificate - Mechanical Engineering -- Warrington Technical College, England - 1960

ADDITIONAL EDUCATION

Hazardous Waste Management Safety Practices -- 1985
GRCDA -- Hazardous Waste Management -- 1981
Institute for Boiler Improvement -- Boiler Efficiency -- 1978
Fundamentals of Industrial Hygiene -- 1977
AICHE -- Primer on Environmental Impact Statements -- 1975
AICHE -- Introduction to Pollution Control -- 1975

Additional Short Courses in:
Hazardous Waste Management 1981 - 1985
Water and Wastewater Management
Air Pollution Control
Professional Management

EXPERIENCE

NUS CORPORATION, 1987-Present
WILLIAM J. COLE & ASSOCIATES, 1984-1987
Southwestern Laboratories, Inc., 1975-1984
Langford Engineering, Inc., 1972-1975
Turner, Collie and Braden, Inc., 1964-1972

As a Senior Project manager and Environmental Management Consultant, is responsible for technical administrative aspects of environmental projects involving: environmental compliance, site remediation, wastewater treatment, groundwater monitoring, hazardous waste management, air pollution evaluaton and emissions control. Areas of expertise include:

- Technical lead in the development and management of, waste materials testing, groundwater monitoring, and air emissions compliance testing.

- Development and management of ambient air testing programs to assess the effects of dry vs wet sand blasting operations and personnel exposure to wind borne respirable dust particles from such operations.

- Preparation of permit applications for Part A and Part B hazardous wastes, air emissions, and wastewater discharge.

- Development and management of health and safety programs, remedial site investigations, feasibility and treatability studies, closure plans, trial burns and air testing programs for major industrial clients.

- Development of innovative and cost-effective solutions for difficult to handle wastes and environmental control problems.

- Management of environmental compliance audits and corrective action programs.

- Effective interaction with regulatory agency personnel at all levels.

Manages and directs testing programs for: personnel exposure from air borne pollutants, ambient air and source emissions, pollution control system performance and hazardous waste materials, for major industrial clients. Client programs include RCRA remediation projects, which require major interaction between NUS, the Client, local, state, and Federal agencies to assure compliance with applicable regulations.

Was responsible for the lead in preparation of Part B Permits, Closure Plans, and Environmental Exposure Assessments for surface impoundments operated by the U.S. Navy, San Diego, California. Performed remedial investigations and prepared closure plans for contaminated waste sites in Texas, Louisiana, and California, under the auspices of state regulatory agencies.

Developed testing programs for Superfund Projects to provide: Waste materials evaluations, groundwater monitoring, air emissions testing. Also developed waste cleanup and site closure programs for: Petroleum, wood preserving, iron and steel production, and metals finishing facilities.

Supervised the investigation of a surface impoundment liner failure in a brine holding pond, for a major natural gas storage and terminalling facility.

Developed personnel exposure monitoring programs for waste management sites and industrial manufacturing processes.

Designed and supervised procedures for field sampling, ambient air testing, laboratory analyses and clean up of: PCB spills, leaking underground storage facilities, surface impoundments, refining wastes, and agricultural chemical wastes.

Directed groundwater monitoring activities at an agricultural chemicals manufacturing facility waste landfill site. Prepared monthly, quarterly, and annual reports for submittal to regulatory agencies.

Performed environmental audits for NASA Dryden facility, Edwards, California.

Coordinated and made presentation before regulatory agencies in Texas, Louisiana, Ohio, and California on Hazardous Waste Management projects.

Was principal of the Environmental Engineering Management firm of William J. Cole & Associates (Cole Assoc.) which was formed to provide specialized consulting services in: permitting, evaluation and management of: Indoor air pollution and work place safety, industrial air and water pollutants, wastewater, solid and hazardous wastes. Cole Assoc. provided environmental consulting services to clients through the Contintental United States.

Was Manager of Environmental Engineering Services and responsible for marketing and directing, environmental engineering and testing services to clients throughout the southern United States. Services included engineering and analytical evaluation of: Industrial and indoor air pollutants, potable water and wastewater systems for industrial and municipal clients, health and safety programs, solid and hazardous wastes. This position entailed effective interaction between client and regulatory agencies in the permitting of industrial and municipal pollution control facilities.

Was Project Manager responsible for permitting, engineering design, and project management for new and upgraded municipal and industrial, water collection, treatment and distribution systems, and wastewater collection and treatment facilities in the State of Texas.

MEMBERSHIPS

PROFESSIONAL ENGINEER REGISTRATION - Texas

PROFESSIONAL AFFILIATION:
- Air Pollution Control Association
- Water Pollution Control Federation
- Institute of Mechanical Engineers
- National Society of Professional Engineers
- Texas Society of Professional Engineers
- American Society of Mechanical Engineers

MARK A. LESTER

EQUIPMENT TECHNICIAN

EDUCATION

H.S. Carrick High School, 1977 (electronics specialization)
Connelley Skills Learning Center, 1978 (electronics)
2nd Class FCC License (with radar endorsement)
Monitor Lab's Technical Training Course, 1978
(sulfur dioxide, nitrogen oxides, ozone,
data aquisition systems)
Thermo Electron Technical Training Course, 1981
(sulfur dioxide, nitrogen oxide)

EXPERIENCE

NUS CORPORATION, Houston, Texas, February 1987-Present
Energy Impact Associates, Inc., E.I.A., Inc.,
Pittsburgh, Pennsylvania, Technician, 1978 to 1982

NUS Corporation - Air Quality Equipment Technician, responsible for performing and documenting accurate and defensible calibration of instruments and equipment used in Environmental Protection Agency (EPA) and state compliance and prevention of significant deterioration (PSD) sampling. Set-up, maintain and calibrate continuous emissions monitor systems for nitrogen oxides, sulfur dioxides, oxygen, carbon monoxide and hydrocarbons at stationary sources for compliance sampling.

E.I.A., Inc. - Air Quality Technician, responsible for installation, operation and maintenance of air quality/meteorological monitoring networks for the utility and steel industry and procesing and validating data. Speicifc projects included:

- Installation and maintenance of an air quality/meteorological system for Niagara-Mohawk Power Company to investigate the affects of air pollutants on agricultural products (1978 - 1981). Equipment included: SO_2 analyzers and O_3 analyzers, wind speed and direction, delta temperature, dew point temperature, soil moisture gauges, electronic precipitation gauges, associated calibration devices, strip chart recorders and computer data loggers with magnetic tapes.

- Conducted performance audits on air quality networks with sulfur dioxide analyzers and high volume particulate samplers (hi-vol) using Thermo Electron Corporation, Monitor Labs, Analytical Instrument Development (AID) and Bendix calibrators for SO_2 and a standard reference flow device for hi-vols.

- Conducted field tests with isokinetic sampler to assess fugitive emissions from road surfaces and material storage piles in integrated steel mills.

- Trained and supervised a staff of twelve E.I.A. personnel in strip chart recorder data reduction,a nd reviewed and analyzed data to insure precision, reliability and validity of strip chart and computer logged data.

CERTIFICATIONS

NUS Corporation Superfund Division Certification for Performance of Remedial Response Activities at Uncontrolled Hazardous Substance Facilities

Visible Emissions Evaluator, Texas Air Control Board

Sample Packaging, Preservation and Documentation Program for Uncontrolled Hazardous Substances Facilities - NUS Corporation

H05147

APPENDIX J

FIELD OPACITY DATA

NUS CORPORATION
A Halliburton Company

VISIBLE EMISSION
OBSERVATION FORM
Test #1, MAC

Prepared by: ________
Checked by: ________
Approved by: ________
Date: ________

Source Name: scrubber stack Observer: Mark Lester Date Certified: ________

Plant: Barbel Date: 7-14-87

Stack Distance From: 400 Height: 25 Wind Speed: 0-3 Direction: from North

% Cloud Cover: 85 Background Used: sky Temp Dry Bulb 85 Wet Bulb ___

Relative Humidity: 95% Observer Signature: Mark Lester

Test #1

TIME	00	15	30	45	COMMENT	TIME	00	15	30	45	COMMENT
0931	0	0	0	0	stack						
0932	0	5	0	5	Pen. Shadow						
0933	0	5	0	0							
0934	0	0	0	0	note						
0935	0	5	5	0	ATTach ~~steam~~	Attached Steam Plume 300'					
0936	0	0	0	5	Plume 300'						M 8.12.87
					*						
					N →						
~~1029~~	0	0									
~~1030~~											

Test #2

NUS CORPORATION
A Halliburton Company

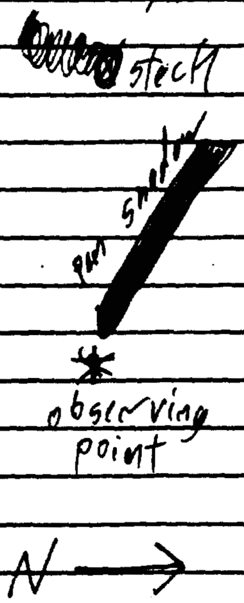
VISIBLE EMISSION OBSERVATION FORM

Test #2

Prepared by: MAL
Checked by: ____
Approved by: ____
Date: 7-14-87

Source Name: scrubber stack Observer: Mark Lester Date Certified: ____
Plant: (Barber) wood supplie Date: 7-14-87
Stack Distance From: 300 Height: 25 Wind Speed: 3-5 Direction: North
% Cloud Cover: 80 Background Used: sky Temp Dry Bulb 89 Wet Bulb ____
Relative Humidity: 95% Observer Signature: Mark A Lester

TIME	00	15	30	45	COMMENT	TIME	00	15	30	45	COMMENT
~~1028~~	~~0~~	~~0~~	~~0~~	~~0~~ MAL	steam plume 500'						
1042	0	0	0	0							
1043	0	0	0	0							
1044	0	5	10	0							
1045	0	0	0	0							
1046	0	5	5	5							
1047	0	0	0	0							
1048	5	10	5	0							
1049	0	0	0	0							
1050	0	5	5	5							
1051	10	0	0	0							
1052	0	0	5	0							
1053	10	5	10	5							
1054	10	5	5	5							
1055	0	0	0	0							
1056	0	5	0	0							
1057	0	5	0	5							
1058	0	0	0	0							
1059	5	0	0	0							
1100	5	0	5	5							



NUS CORPORATION
A Halliburton Company

VISIBLE EMISSION
OBSERVATION FORM

Test #3

Prepared by: ________
Checked by: ________
Approved by: ________
Date: ________

Source Name: scrubber stack Observer: Mark A Leste Date Certified: 3-31
Plant: Barber wood products Date: ~~3-31~~ 7-14-87
Stack Distance From: 250 Height: 25 Wind Speed: 1-3 Direction: west
% Cloud Cover: 75 Background Used: sky Temp Dry Bulb 91 Wet Bulb ____
Relative Humidity: 90% Observer Signature: Mark A Lester

TIME	00	15	30	45	COMMENT	TIME	00	15	30	45	COMMENT
1259	0	0	0	5							
1300	0	0	0	0							
1301	0	0	0	0							
1302	5	0	5	0							
1303	0	0	0	0							
1304	0	5	0	0							
1305	0	0	0	0							
1306	0	5	0	0							
1307	5	5	0	5							
1308	5	0	0	0							
1309	5	5	5	5							
1310	5	0	5	5							
1311	0	0	0	0							
1312	0	5	0	5							
1313	0	0	0	0							
1314	5	5	0	0							
1315	0	0	0	0							
1316	5	5	0	5