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Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

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SOURCE EMISSIONS SURVEY
OF
F. R. LEWIS CONSTRUCTION CO., INC.
ASPHALT CONCRETE DRUM-MIX PLANT
NACOGDOCHES, TEXAS

NOVEMBER 1984

FILE NUMBER 84-124

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Review #0849

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C. Calibration Data

D. Field Testing Data

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SOURCE EMISSIONS SURVEY
F. R. LEWIS CONSTRUCTION CO., INC.
ASPHALT CONCRETE DRUM-MIX PLANT
NACOGDOCHES, TEXAS
FILE NUMBER 84-124

INTRODUCTION

Mullins Environmental Testing Co., Inc., Dallas, Texas, conducted a source emissions survey at the F. R. Lewis Construction Co., Inc. asphalt concrete drum-mix plant located in Nacogdoches, Texas, on November 8, 9, 12, 13, and 15, 1984. The purpose of this survey was to determine emissions of particulate matter and sulfur dioxide from the exhaust stack of the rotary drying kiln.

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

SUMMARY OF RESULTS

The principal conclusions are as follows:

1. The emissions of particulate matter from the stack were 5.3 pounds per hour (0.0338 grains per dry standard cubic foot), based on averaging the three valid 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 84.6 percent of the permitted emissions.

2. The emissions of particulate matter from the stack were 5.9 pounds per hour, based on averaging the three valid 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 27.6 pounds per hour. The actual emissions were 21.5 percent of the permitted emissions.

3. The emissions of sulfur dioxide from the stack were equal to 3.8 parts per million (0.7 pounds per hour), based on averaging the three valid tests.

SUMMARY OF RESULTS

Scrubber Stack

Run Number	1	3	4
Stack Flow Rate - ACFM	29,349	28,669	26,616
Stack Flow Rate - DSCFM*	18,626	18,251	17,694
% Water Vapor - % Vol.	25.58	25.58	23.90
% CO_2 - % Vol.	4.6	5.2	4.0
% O_2 - % Vol.	14.0	13.8	15.2
% Excess Air @ Sampling Point	185	180	245
Particulates Probe, Cyclone & Filter Catch grains/dscf*	0.0475	0.0282	0.0258
grains/cf @ Stack Conditions	0.0301	0.0179	0.0171
lbs/hr	7.6	4.4	3.9
Total Catch grains/dscf*	0.0529	0.0321	0.0293
grains/cf @ Stack Conditions	0.0335	0.0203	0.0194
lbs/hr	8.4	5.0	4.4
Allowable Emission Rate EPA - 40 CFR 60 - grains/dscf	0.04	0.04	0.04
Allowable Emission Rate TACB - Reg. I - lbs/hr	28.3	27.9	26.6
Plant Production Rate - tons/hr	152.9	150.4	138.1
Sulfur Dioxide Emissions - lbs/hr	0.7	0.7	0.7

*29.92 "Hg, 68°F (760 mm Hg, 20°C)

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SUMMARY OF RESULTS

Scrubber Stack

Run Number	2		
Stack Flow Rate - ACFM	27,735		
Stack Flow Rate - DSCFM*	19,867		
% Water Vapor - % Vol.	16.95		
% CO_2 - % Vol.	5.2		
% O_2 - % Vol.	12.8		
% Excess Air @ Sampling Point	143		
Particulates Probe, Cyclone & Filter Catch grains/dscf*	0.0297		
grains/cf @ Stack Conditions	0.0212		
lbs/hr	5.1		
Total Catch grains/dscf*	0.0324		
grains/cf @ Stack Conditions	0.0231		
lbs/hr	5.5		
Allowable Emission Rate EPA - 40 CFR 60 - grains/dscf	0.04		
Allowable Emission Rate TACB - Reg. I - lbs/hr	27.3		
Plant Production Rate - tons/hr	148.7		
Sulfur Dioxide Emissions - lbs/hr	0.4		

*29.92 "Hg, 68°F (760 mm Hg, 20°C)

DISCUSSION OF RESULTS

The second test had a lower moisture content than the other two tests although the leak checks were satisfactory. Therefore, an additional test was taken. The three valid tests for particulate matter and sulfur dioxide 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 4.5 percent of the mean value. The measured flow rates (Q_s) for the tests were within 2.7 percent of the mean value. The rates of sampling for the three tests were well within the specified limits, the greatest deviation being 5.0 percent.

The calculated emissions (grains per dry standard cubic foot) of particulate matter for the three tests showed a range of -23.7 percent to +40.4 percent variation from the mean value.

Sulfur dioxide was determined simultaneously with the particulate runs. The indicative parameters all indicate that the results were valid. The collection efficiencies between the two sulfur dioxide impingers in these tests were very good, indicating that little, if any, sulfur dioxide was bypassed.

The efficiences were as follows:

	Run #1	Run #3	Run #4
Impinger #2	96.2	95.5	95.5
Impinger #3	3.8	4.5	4.5

Collection of 90 percent or more of the sampled sulfur dioxide in the first sulfur dioxide impingers is a verification of a representative sample.

The calculated emissions (pounds per hour) of sulfur dioxide for the three valid tests were the same for each test.

DESCRIPTION OF PROCESS OPERATION

The F. R. Lewis Construction Co., Inc. asphalt concrete drum-mix plant is a Barber Green Model DM-60 plant with a venturi scrubber.

In an asphalt concrete drum-mix plant, sand, gravel, and coarse aggregate are conveyed into a rotary drying kiln. The kiln is heated by an oil-fired continuous flame. Asphalt is added in the rotary kiln where it is mixed with the hot, dry aggregate. Any dust and fine particles that are not entrained in the asphalt mix are channeled along with the dryer exhaust by an induced draft fan through a wet venturi scrubber. After passing through the wet venturi scrubber, the exhaust is emitted to the atmosphere via a stack.

During the testing, the plant operated at an average production rate of 147.1 tons per hour containing approximately 5.8 percent asphalt. The venturi scrubber operated at an average pressure drop of 17.3 inches of water with a water pump pressure of 50 psi.

DESCRIPTION OF SAMPLING LOCATION

The sampling ports are located on the scrubber exhaust stack approximately 18 feet above the ground. The sampling was done from six ports on the rectangular stack located 10 feet 2 inches (4.22 equivalent stack diameters) downstream from the inlet to the stack and 4 feet (1.66 equivalent stack diameters) upstream from a flair in 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 six ports on the stack in order to determine the uniformity and magnitude of the flow prior to testing. Several traverse points were checked for cyclonic flow and none was found to be present. Four traverse points were sampled from each of the six ports for a total of twenty-four traverse points. 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 pressure. The lines were also checked for clearance and the manometer 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 impinger of 80 percent solution of isopropyl alcohol, which had been checked for peroxide contamination, to absorb sulfur trioxide, two impingers of six percent solution of hydrogen peroxide to absorb sulfur dioxide, a dry impinger and a silica gel impinger to absorb moisture.

At the conclusion of each test, the sampling train was purged with two cubic feet of ambient air at the same rate as that used during the sampling.

DESCRIPTION OF TESTS

Personnel from Mullins Environmental Testing Co., Inc., arrived at the plant at 5:30 p.m. on Thursday, November 8, 1984. After meeting with plant personnel, the sampling location was surveyed and all work was completed by 6:00 p.m.

On Friday, November 9, work began at 6:00 a.m. The equipment was prepared for testing and the scrubber stack was measured. Due to wet conditions at the laydown site resulting from precipitation, the plant could not operate. The equipment was loaded into the van and any testing was delayed until more favorable weather conditions permitted. Operations at the plant were completed by 9:15 a.m.

Personnel arrived back at the plant at 11:30 a.m. on Monday, November 12, 1984. The equipment was unloaded and set up at the exhaust stack of the scrubber. The preliminary data were collected and the first particulate test began at 2:32 p.m. Testing continued without difficulty until completion of the test at 3:49 p.m. The sample was recovered and the equipment was secured for the night by 5:00 p.m.

On Tuesday, November 13, work began at 6:30 a.m. The equipment was prepared for testing, but testing was delayed until the temperature had risen to above 40 degrees. The second test for particulates began at 9:15 a.m. Testing continued until 9:53 a.m. when it was delayed while the sampling probe heating element was repaired. Testing resumed at 10:30 a.m. and continued until completion of the test at 11:08 a.m. The equipment was prepared for the next test, but testing was delayed to wait for trucks. The third test began at 12:50 p.m. and continued until its completion at 2:07 p.m. Due to a leak during the second test, a fourth test was necessary. The test was scheduled for Thursday, November 15, due to the plant not operating on Wednesday, November 14. The equipment was loaded into the sampling van and the samples were recovered. All work for the day at the plant was completed by 3:30 p.m.

Personnel arrived back at the plant at 6:00 a.m. on Thursday, November 15. The equipment was set up and prepared for testing. The fourth test began at 8:07 a.m. Testing continued without difficulty until completion of the test at 9:24 a.m.

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

Operations at the F. R. Lewis Construction Co., asphaltic concrete plant located in Nacogdoches, Texas, were completed at 11:30 a.m. on Thursday, November 15, 1984.

Billy J. Mullins Jr.

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

APPENDICES

A. Location of Sampling Points

B. Source Emissions Calculations

C. Calibration Data

D. Field Testing Data

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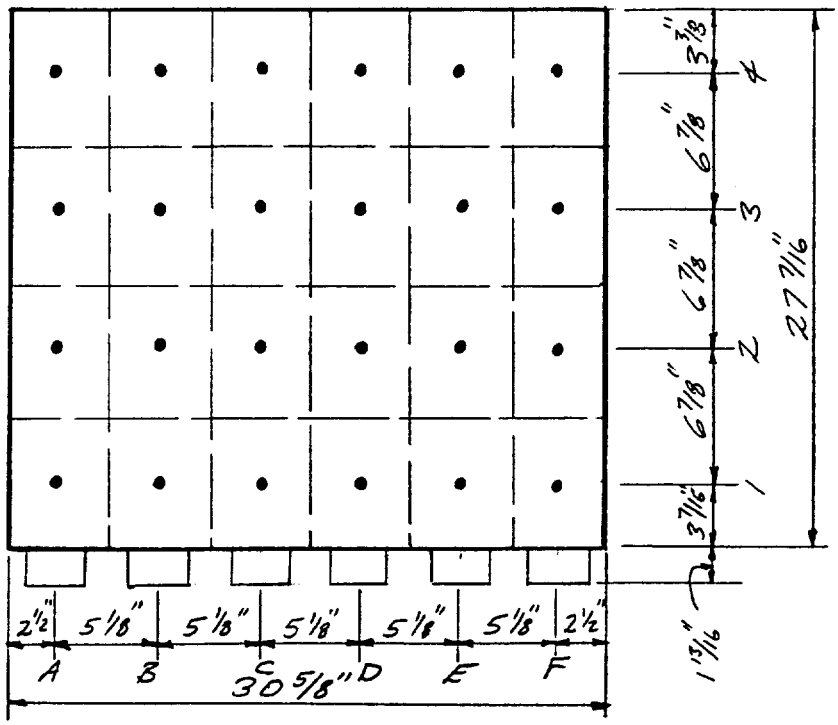
APPENDIX A

Location of Sampling Points

The sampling ports were located 10 feet 2 inches (4.22 equivalent stack diameters) downstream from the inlet to the stack and 4 feet (1.66 equivalent stack diameters) upstream from a flair in the stack. The locations of the sampling points were calculated as indicated below:



APPENDIX B

Nomenclature and Equations for Calculation of Source Emissions

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)

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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)

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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.

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

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

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

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.

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

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

* 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.

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

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

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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.

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

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

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SOURCE EMISSIONS SURVEY
F. R. LEWIS CONSTRUCTION CO., INC.
ASPHALT CONCRETE DRUM-MIX PLANT
NACOGDOCHES, TEXAS
FILE NUMBER 84-124

SOURCE EMISSIONS CALCULATIONS

Scrubber Stack

Symbol	Description	Units			
Run No.			1	3	4
Date			11/12/84	11/13/84	11/15/84
Begin			1432	1250	0807
End			1549	1407	0924
P_b	barometric pressure	"Hg Abs. (mm Hg)	29.82 (757)	29.85 (758)	29.81 (757)
P_m	orifice pressure drop	"H_2O (mm H_2O)	0.805 (20.4)	0.887 (22.5)	0.833 (21.2)
V_m	volume dry gas sampled @ meter conditions	ft^3 (m^3)	38.187 (1.081)	39.787 (1.127)	39.005 (1.105)
T_m	average gas meter temp.	°F (°C)	79 (26)	78 (26)	73 (23)
$V_{m_{std}}$	volume dry gas sampled @ standard conditions*	dscf (dscm)	37.363 (1.058)	39.048 (1.106)	38.583 (1.093)
V_w	total H_2O collected, impingers & silica gel	ml	272.1	284.3	256.7
$V_{w_{gas}}$	volume water vapor collected @ standard conditions*	scf (scm)	12.843 (0.364)	13.419 (0.380)	12.116 (0.343)
%M	moisture in stack gas by volume	%	25.58	25.58	23.90

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

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Source Emissions Calculations
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File Number 84-124

Symbol	Description	Units			
M_d	mol fraction of dry gas	----	0.7442	0.7442	0.7610
CO_2		%	4.6	5.2	4.0
O_2		%	14.0	13.8	15.2
N_2		%	81.4	81.0	80.8
%EA	excess air @ sampling point	%	184.9	180.0	244.7
MW_d	molecular weight of dry stack gas	lb/lb-mole (g/g-mole)	29.30 (29.30)	29.38 (29.38)	29.25 (29.25)
MW	molecular weight of stack gas	lb/lb-mole (g/g-mole)	26.41 (26.41)	26.47 (26.47)	26.56 (26.56)
ΔP	velocity head of stack gas	"H_2O (mm H_2O)	1.865 (47.4)	1.785 (45.3)	1.595 (40.5)
T_s	stack temperature	°F (°C)	156 (69)	155 (68)	142 (61)
P_s	stack pressure	"Hg Abs. (mm Hg)	29.66 (753)	29.70 (754)	29.69 (754)
V_s	stack velocity @ stack conditions	fpm (m/sec)	5,031 (25.56)	4,915 (24.97)	4,563 (23.18)
A_s	stack area	$in.^2$ (m^2)	840 (0.54)	840 (0.54)	840 (0.54)
Q_s	dry stack gas volume @ standard conditions*	DSCFM (dscm/hr)	18,626 (31,646)	18,251 (31,008)	17,694 (30,062)
Q_a	actual stack gas volume @ stack conditions	ACFM (m^3/hr)	29,349 (49,864)	28,669 (48,709)	26,616 (45,221)

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

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Source Emissions Calculations
F. R. Lewis Construction Co., Inc.
File Number 84-124

Symbol	Description	Units			
T_t	net time of test	min.	72	72	72
D_n	sampling nozzle diameter	in. (m)	0.176 (0.004)	0.176 (0.004)	0.176 (0.004)
%I	percent isokinetic	%	96.6	103.0	105.0
m_f	particulate - probe, cyclone and filter	mg	115.3	71.6	64.6
m_t	particulate - total	mg	128.4	81.3	73.4
C_{an}	particulate - probe, cyclone and filter	gr/dscf* (g/dscm)	0.0475 (0.1088)	0.0282 (0.0647)	0.0258 (0.0590)
C_{ao}	particulate - total	gr/dscf* (g/dscm)	0.0529 (0.1212)	0.0321 (0.0734)	0.0293 (0.0671)
C_{at}	particulate - probe, cyclone and filter @ stack conditions	gr/cf (g/m^3)	0.0301 (0.0688)	0.0179 (0.0410)	0.0171 (0.0391)
C_{au}	particulate total @ stack conditions	gr/cf (g/m^3)	0.0335 (0.0766)	0.0203 (0.0466)	0.0194 (0.0444)
C_{aw}	particulate - probe, cyclone and filter	lbs/hr (kg/hr)	7.6 (3.4)	4.4 (2.0)	3.9 (1.8)
C_{ax}	particulate - total	lbs/hr (kg/hr)	8.4 (3.8)	5.0 (2.3)	4.4 (2.0)

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

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SOURCE EMISSIONS SURVEY
F. R. LEWIS CONSTRUCTION CO., INC.
ASPHALT CONCRETE DRUM-MIX PLANT
NACOGDOCHES, TEXAS
FILE NUMBER 84-124

SOURCE EMISSIONS CALCULATIONS

Scrubber Stack

Symbol	Description	Units	
Run No.			2
Date			11/13/84
Begin			0915
End			1108
P_b	barometric pressure	"Hg Abs. (mm Hg)	29.96 (761)
P_m	orifice pressure drop	"H_2O (mm H_2O)	0.861 (21.9)
V_m	volume dry gas sampled @ meter conditions	$ft.^3$ (m^3)	38.789 (1.098)
T_m	average gas meter temp.	°F (°C)	59 (15)
$V_{m_{std}}$	volume dry gas sampled @ standard conditions*	dscf (dscm)	39.604 (1.121)
V_w	total H_2O collected, impingers & silica gel	ml	171.3
$V_{w_{gas}}$	volume water vapor collected @ standard conditions*	scf (scm)	8.085 (0.229)
%M	moisture in stack gas by volume	%	16.95

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

METCO

Source Emissions Calculations
F. R. Lewis Construction Co., Inc.
File Number 84-124

Symbol	Description	Units	
M_d	mol fraction of dry gas	----	0.8305
CO_2		%	5.2
O_2		%	12.8
N_2		%	82.0
%EA	excess air @ sampling point	%	143.3
MW_d	molecular weight of dry stack gas	lb/lb-mole (g/g-mole)	29.34 (29.34)
MW	molecular weight of stack gas	lb/lb-mole (g/g-mole)	27.42 (27.42)
ΔP	velocity head of stack gas	"H_2O (mm H_2O)	1.748 (44.4)
T_s	stack temperature	°F (°C)	152 (67)
P_s	stack pressure	"Hg Abs. (mm Hg)	29.80 (757)
V_s	stack velocity @ stack conditions	fpm (m/sec)	4,755 (24.16)
A_s	stack area	$in.^2$ (m^2)	840 (0.54)
Q_s	dry stack gas volume @ standard conditions*	DSCFM (dscm/hr)	19,867 (33,754)
Q_a	actual stack gas volume @ stack conditions	ACFM (m^3/hr)	27,735 (47,122)

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

METCO

Source Emissions Calculations
F. R. Lewis Construction Co., Inc.
File Number 84-124

Symbol	Description	Units	
T_t	net time of test	min.	72
D_n	sampling nozzle diameter	in. (m)	0.176 (0.004)
%I	percent isokinetic	%	95.9
m_f	particulate - probe, cyclone and filter	mg	76.4
m_t	particulate - total	mg	83.3
C_{an}	particulate - probe, cyclone and filter	gr/dscf* (g/dscm)	0.0297 (0.0680)
C_{ao}	particulate - total	gr/dscf* (g/dscm)	0.0324 (0.0742)
C_{at}	particulate - probe, cyclone and filter @ stack conditions	gr/cf (g/m^3)	0.0212 (0.0486)
C_{au}	particulate total @ stack conditions	gr/cf (g/m^3)	0.0231 (0.0529)
C_{aw}	particulate - probe, cyclone and filter	lbs/hr (kg/hr)	5.1 (2.3)
C_{ax}	particulate - total	lbs/hr (kg/hr)	5.5 (2.5)

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SO_2 EMISSION DATA

Job Number 84-124 Location Nacogdoches, Texas

Job Name F. R. Lewis Construction Co., Inc. Unit Tested Scrubber Stack

Run Number	1	2	3	4	
Date	11/12/84	11/13/84	11/13/84	11/15/84	
Time	1432-1549	0915-1108	1250-1407	0807-0924	
$\underline{N}$ - normality of $BaCl_2$	0.0099	0.0099	0.0099	0.0099	
ML_I - ml in impinger #2	430	348	337	371	
ML_I - ml in impinger #3 & 4	257	299	285	321	
ML_A - ml in aliquot #2	10	10	10	10	
ML_A - ml in aliquot #3 & 4	10	10	10	10	
ML_B - ml of $BaCl_2$ to titrate #2	0.80	0.55	1.05	0.95	
ML_B - ml of $BaCl_2$ to titrate #3 & 4	0.10	0.10	0.10	0.10	
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05	0.05	
T_m - average gas meter temp., °F	79	59	78	73	
V_m - volume of dry gas sampled @ meter conditions, $ft.^3$	38.187	38.789	39.787	39.005	
P_b - barometric pressure, "Hg Abs.	29.82	29.96	29.85	29.81	
Q_s - Stack gas volume dry @ standard conditions, *SCFM	18,626	19,867	18,251	17,694	
C_I - SO_2 in impinger #2, mgs	10.2	5.5	10.7	10.6	
C_I - SO_2 in impinger #3 & 4, mgs	0.4	0.5	0.5	0.5	
C_T - total SO_2 in impingers, mgs	10.6	6.0	11.2	11.1	
ppm SO_2	3.8	2.0	3.8	3.8	
C_{SO_2} - emission rate of SO_2, lbs/day	16.8	9.5	16.5	16.2	
C_{SO_2} - emission rate of SO_2, lbs/hr	0.7	0.4	0.7	0.7	
C_s - emission rate of S, lbs/day	8.4	4.8	8.3	8.1	

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

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

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

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

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

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

METCO

SULFUR TRIOXIDE EMISSION DATA

Job Number 84-124 Location Nacogdoches, Texas

Job Name F. R. Lewis Construction Co. Unit Tested Scrubber Stack

Run Number	1	2	3	4
Date	11/12/84	11/13/84	11/13/84	11/15/84
Time	1432-1549	0915-1108	1250-1407	0807-0924
N - normality of $BaCl_2$	0.0099	0.0099	0.0099	0.0099
ML_I - ml in impinger	310	305	346	335
ML_A - ml in aliquot	10	10	10	10
ML_B - ml of $BaCl_2$ to titrate	0.40	0.15	0.20	0.15
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05	0.05
T_m - average gas meter temp., °F	79	59	78	73
V_m - volume of dry gas sampled @ meter conditions, $ft.^3$	38.187	38.789	39.787	39.005
P_b - barometric pressure, "Hg Abs.	29.82	29.96	29.85	29.81
Q_s - stack gas volume dry @ standard conditions, *SCFM	18,626	19,867	18,251	17,694
C_I - SO_3 in impinger, mgs	4.3	1.2	2.1	1.3
ppm SO_3	1.2	0.3	0.6	0.4
C_{SO_3} - emission rate of SO_3, lbs/day	6.8	1.9	3.1	1.9
C_S - emission rate of S, lbs/day	2.7	0.8	1.2	0.8

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

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

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

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

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

APPENDIX C

Calibration Data

Equipment	Calibration Factor	Calibration Date
Pitot Tube #4	0.816	9/10/84
Probe Tip #III-2	0.176	9/18/84
Dry Gas Meter #1	1.041	9/ 6/84
Stack Unit Orifice #1		9/ 7/84
Digital Temperature Indicator #1		10/ 5/84
Barometer #12		10/25/84

PITOT TUBE CALIBRATION

Date: Sept. 10, 1984

Time: 0840

Pitot No. 4 (3')

P_b: 29.25 "Hg P_s: _____ "H_2O

T_s: 77 °F C_{pstd}: 0.99

Motor Setting	fps mark	CALIBRATOR STANDARD START	END	$\sqrt{\text{STANDARD AVERAGE}}$	HIGH	$\sqrt{\text{HIGH}}$	CAL. FACTOR	LOW	$\sqrt{\text{LOW}}$	CAL. FACTOR
39	20	0.110	0.110	0.332	0.160	0.400	0.822	0.160	0.400	0.822
48	30	0.240	0.240	0.490	0.355	0.596	0.814	0.355	0.596	0.814
55	40	0.375	0.380	0.614	0.560	0.748	0.813	0.555	0.745	0.816
63	50	0.595	0.595	0.771	0.875	0.935	0.816	0.875	0.935	0.816
70	60	0.825	0.825	0.908	1.20	1.095	0.821	1.20	1.095	0.821
76	70	1.05	1.05	1.025	1.55	1.245	0.815	1.55	1.245	0.815
84	80	1.40	1.40	1.183	2.05	1.432	0.818	2.05	1.432	0.818
100	90	1.55	1.55	1.245	2.30	1.517	0.812	2.30	1.517	0.812
55	40	0.385	0.385	0.620	0.565	0.752	0.816	0.560	0.748	0.821
55	40	0.385	0.385	0.620	0.565	0.752	0.816	0.560	0.748	0.821
Average							0.816			0.817

Summary of Results:

Normal high side calibration factor 0.816

variation -0.49, +0.74

Normal low side calibration factor 0.817

variation -0.61, +0.69

Kevin D. Overton

Signature of Calibrator

METCO

NOZZLE CALIBRATION

Nozzle Set No. III

Date: September 18, 1984 Calibrator: L. Williams

	1	2	3	4	5
Reading 1	0.112	0.176	0.250	0.304	0.363
Reading 2	0.112	0.176	0.250	0.302	0.364
Reading 3	0.113	0.175	0.251	0.303	0.366
Reading 4	0.110	0.175	0.249	0.304	0.365
Reading 5	0.112	0.178	0.250	0.304	0.366
Reading 6	0.111	0.178	0.249	0.303	0.365
Reading 7	0.112	0.175	0.250	0.305	0.364
Reading 8	0.111	0.176	0.250	0.303	0.366
Reading 9	0.113	0.177	0.251	0.305	0.365
Reading 10	0.112	0.174	0.250	0.304	0.366
Average	0.112	0.176	0.250	0.304	0.365

	6	7	8	9	10
Reading 1	0.432	0.481	0.601	0.724	0.971
Reading 2	0.431	0.480	0.601	0.722	0.971
Reading 3	0.429	0.482	0.601	0.723	0.973
Reading 4	0.430	0.481	0.602	0.722	0.970
Reading 5	0.429	0.481	0.602	0.724	0.971
Reading 6	0.430	0.482	0.600	0.722	0.969
Reading 7	0.429	0.482	0.600	0.724	0.971
Reading 8	0.429	0.482	0.600	0.722	0.970
Reading 9	0.432	0.481	0.601	0.725	0.969
Reading 10	0.431	0.480	0.602	0.722	0.973
Average	0.430	0.481	0.601	0.723	0.971

METCO

Dry Gas Meter Calibration

Dry Gas Meter Number 1

Date: 9/6/84

ΔH ("H_2O)	C_{DG}
0.5	1.051
1.0	1.048
1.5	1.044
2.0	1.043
3.0	1.035
4.0	1.025
Average	1.041

Variation: + 1.0

- 1.5

Calibrator: Don C Alexander

Checked by: Don C Alexander

METCO

DRY GAS METER CALIBRATION

Meter Number: 1

Calibrator: Don C Alexander

Date: 9/6/84

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

Run No.: 12

P_b: 29.52 "Hg

Control Module Vacuum 5.7 "Hg

	WET TEST METER				DRY GAS METER			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1248	5.500 cf	76 °F	-2.30 "H_2O	510.747 cf	86 °F	84 °F	0.50 "H_2O
Start	1235	0.000 cf	76 °F	-2.30 "H_2O	505.300 cf	87 °F	84 °F	0.50 "H_2O
	13	5.500 cf	°F	-2.30 "H_2O	5.447 cf	85 °F	°F	0.50 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 5.500 \left(\frac{29.52 + \frac{-2.30}{13.6}}{76 + 460} \right) \times \underset{(C_f)}{1.031} = 5.481 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 5.447 \left(\frac{29.52 + \frac{0.50}{13.6}}{85 + 460} \right) = 5.214 \text{ dscf}$$

$$C_{DG} = \frac{5.481}{5.214} = \boxed{1.051}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1

Date: 9/6/84

Calibrator: Don C Alexander

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

Run No.: 11

P_b: 29.52 "Hg

Control Module Vacuum 5.1 "Hg

	WET TEST METER				DRY GAS METER			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1234	5.502 cf	76 °F	-3.10 "H_2O	504.856 cf	89 °F	84 °F	1.00 "H_2O
Start	1224	0.000 cf	76 °F	-3.10 "H_2O	499.400 cf	89 °F	84 °F	1.00 "H_2O
		5.502 cf	76 °F	-3.10 "H_2O	5.456 cf	89 °F	84 °F	1.00 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 5.502 \left(\frac{29.52 + \frac{-3.10}{13.6}}{76 + 460} \right) \times \underset{(C_f)}{1.031} = 5.472 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 5.456 \left(\frac{29.52 + \frac{1.00}{13.6}}{86 + 460} \right) = 5.219 \text{ dscf}$$

$$C_{DG} = \frac{5.472}{5.219} = \boxed{1.048}$$ ✓

METCO

DRY GAS METER CALIBRATION

Meter Number: 1

Date: 9/6/84

Calibrator: Don C Albright

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

Run No.: 10

P_b: 29.53 "Hg

Control Module Vacuum 4.3 "Hg

	WET TEST METER				DRY GAS METER			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1223	10.252 cf	76 °F	-4.00 "H_2O	499.170 cf	90 °F	84 °F	1.50 "H_2O
Start	1208 / 15	0.000 cf	76 °F	-4.00 "H_2O	499.000 cf	87 °F	83 °F	1.50 "H_2O
		10.252 cf	76 °F	-4.00 "H_2O	10.170 cf	86 °F	°F	1.50 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.252 \left(\frac{29.53 + \frac{-4.00}{13.6}}{76 + 460} \right) \times \underset{(C_f)}{1.031} = 10.176 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 10.170 \left(\frac{29.53 + \frac{1.50}{13.6}}{86 + 460} \right) = 9.744 \text{ dscf}$$

$$C_{DG} = \frac{10.176}{9.744} = \boxed{1.044}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1

Date: 9/6/84

Calibrator: Don C Alexander

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

Run No.: 9

P_b: 29.53 "Hg

Control Module Vacuum 5.20 "Hg

	WET TEST METER				DRY GAS METER			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	12	10,259 cf	76 °F	-4.65 "H_2O	488.678 cf	91 °F	84 °F	2.00 "H_2O
Start	1150	0.000 cf	76 °F	-4.65 "H_2O	478.500 cf	89 °F	83 °F	2.00 "H_2O
		10,259 cf	76 °F	-4.65 "H_2O	10,176 cf	87 °F	°F	2.00 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10{,}259 \left(\frac{29.53 + \frac{-4.65}{13.6}}{76 + 460} \right) \times \underset{(C_f)}{1.031} = 10{,}166 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 10{,}176 \left(\frac{29.53 + \frac{2.00}{13.6}}{87 + 460} \right) = 9{,}744 \text{ dscf}$$

$$C_{DG} = \frac{10{,}166}{9{,}744} = \boxed{1.043}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1

Date: 9/6/84

Calibrator: Don C Alexander

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

Run No.: 8

P_b: 29.53 "Hg

Control Module Vacuum 6.0 "Hg

	WET TEST METER				DRY GAS METER			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1130	10.250 cf	76 °F	-6.40 "H_2O	467.141 cf	91 °F	82 °F	3.00 "H_2O
Start	1120	0.000 cf	76 °F	-6.40 "H_2O	457.000 cf	86 °F	82 °F	3.00 "H_2O
		10.250 cf	76 °F	-6.40 "H_2O	10.141 cf	88.5 °F	82 °F	3.00 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.250 \left(\frac{29.53 + \frac{-6.40}{13.6}}{76 + 460} \right) \times \underset{(C_f)}{1.031} = 10.112 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 10.141 \left(\frac{29.53 + \frac{3.00}{13.6}}{85 + 460} \right) = 9.771 \text{ dscf}$$

$$C_{DG} = \frac{10.112}{9.771} = \boxed{1.035}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1

Date: 9/5/84

Calibrator: Don C Alexander

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

Run No.: 7

P_b: 29.53 "Hg

Control Module Vacuum 4.2 "Hg

	WET TEST METER				DRY GAS METER			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1150	10.260 cf	76 °F	-7.60 "H_2O	477.920 cf	92 °F	83 °F	4.00 "H_2O
Start	1140	0.000 cf	76 °F	7.60 "H_2O	467.703 cf	88 °F	82 °F	4.00 "H_2O
		10.250 cf	76 °F	-7.60 "H_2O	10.217 cf	86 °F		4.00 "H_2O

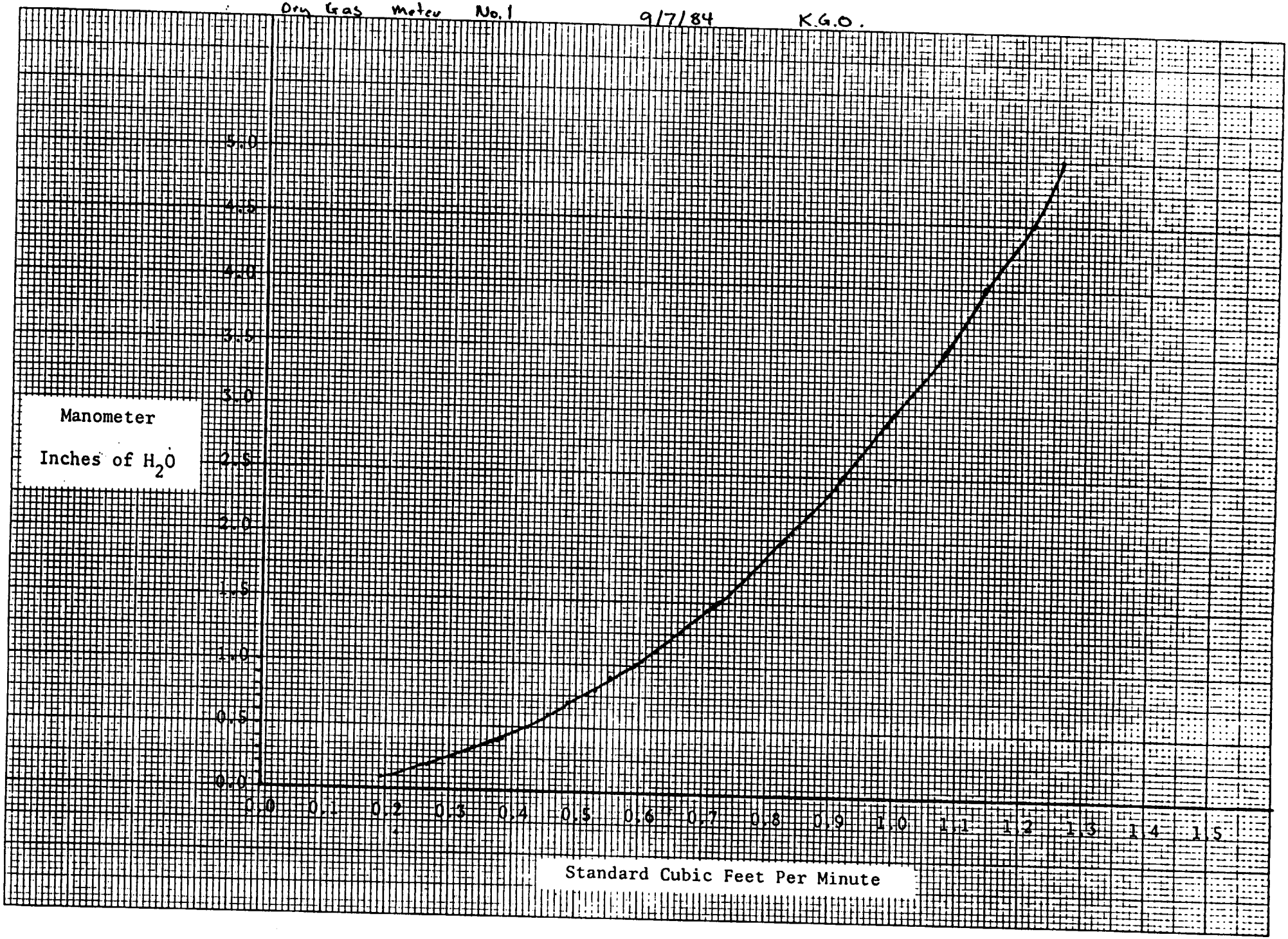
$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.\cancel{250}\,262 \left(\frac{29.53 + \overset{-7.60}{13.6}}{76 + 460} \right) \times \underset{(C_f)}{1.031} = 10.093 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 10.217 \left(\frac{29.53 + \overset{4.00}{13.6}}{86 + 460} \right) = 9.850 \text{ dscf}$$

$$C_{DG} = \frac{10.093}{9.850} = \boxed{1.025}$$

K+E KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1320

Dry Gas Meter No. 1 9/7/84 K.G.O.



METCO

DIGITAL TEMPERATURE INDICATOR NO. 1

CALIBRATION DATA

Date: October 5, 1984

Media	Time	Mercury Thermometer (°F)	DTI (°F)
Ice Bath	1634	35	35
Ambient Air	1605	80	80
Boiling Water	1637	212	214
Oven	1609	148	148
Oven	1701	406	406
Oven	1705	376	376
Oven	1720	298	298

Meter Adjusted? Yes____ No —

Kevin S. Overton
Signature of Calibrator

METCO

BAROMETER CALIBRATION

Barometer No. 12

Date: 10-25-84

Time: 1600

Barometric Pressure @ Addison Field @ 719 ft.	=	30.14
	-	0.719
Absolute Pressure at Addison Field	=	29.421
	+	0.076
Absolute Pressure @ METCO @ 643 ft.	=	29.497
Barometer Reading	=	29.360
Variation	=	- .137

Barometer Adjusted? Yes ✓ No ____

D Mull
Signature of Calibrator

APPENDIX D

Field Testing Data

MULLINS ENVIRONMENTAL TESTING CO., INC.

Job No. 84-124

Job Name FR Lewis

Run No. 1

Location Scrubber Stack

Date 12 November 1984

Operator Alexander, Patterson

Sample Box No. 4 Meter Box No. 1

Particulate FIELD DATA

Read and record at the start of each test point.

Purge to: 479.832

Purge time: 1552-1607

Ambient Temp. °F 76

Assumed Moisture % 30

Probe Length 3'

C Factor — — to reference

Initial Leak @ 15.0 "Hg = 0.000 cfm

Final Leak @ 5.0 "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 (P_m) 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 (T_m) Outlet	Remarks
A 4	1432	435.303	1.00	0.40	0.40	2.1	154	270	265	95	76	74	
3	1435	436.410	1.10	0.45	0.45	2.1	156	267	258	77	77	74	
2	1438	437.65	1.30	0.55	0.55	2.3	156	267	261	67	77	75	
1	1441	438.92	1.10	0.45	0.45	2.1	153	265	268	76	78	75	
END	1444	440.040	—	—	—	—	—	—	—	—	—	—	
B 4	1445	440.040	1.90	0.83	0.83	3.2	156	259	266	76	78	75	
3	1448	441.55	2.10	0.90	0.90	3.5	156	255	261	71	79	75	
2	1451	443.20	1.90	0.83	0.83	3.3	156	256	259	71	80	75	
1	1454	444.71	1.50	0.65	0.65	3.0	152	261	260	71	81	76	
END	1457	446.125	—	—	—	—	—	—	—	—	—	—	
C 4	1458	446.125	2.00	0.86	0.86	3.2	155	267	261	83	80	76	
3	1501	447.72	2.20	0.95	0.95	3.5	156	261	259	77	82	76	
2	1504	449.42	1.90	0.83	0.83	3.2	157	266	259	77	82	76	
1	1507	450.97	1.60	0.70	0.70	3.0	155	265	265	78	83	77	orsat
END	1510	452.382	—	—	—	—	—	—	—	—	—	—	
D 4	1511	452.382	2.10	0.90	0.90	3.3	156	265	257	84	83	77	
3	1514	454.03	2.20	0.95	0.95	3.6	156	245	258	82	83	77	
2	1517	455.56	2.05	0.88	0.88	3.3	157	250	256	75	84	77	

Pitot Tube Calibration Factor C_p 0.816

Volume Collected V_m 38.187 ft^3

Water Collected V_w 272.1 ml

Time of Test T_t 72 min.

Stack Pressure P_s -2.15 "H_2O

Baro. Press. P_b 29.82 "Hg

Probe Tip Dia. D_n 0.176 in.

% CO_2 4.6 % CO 0.0

% O_2 14.0 % N_2 81.4

Area Stack A_s 840 in^2

Pitot Tube No. 4 Barometer No. 12

Probe Tip No. III-2

V_m = Dry Gas Meter Calibration Factor 1.041 X 36.683

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

M_F = ____ M_T = ____

Impinger Box No. 4

Impinger 1	Final Weight	745.4	
	Initial Weight	635.7	
	Increase	109.7	
Impinger 2	Final Weight	874.1	
	Initial Weight	714.7	
	Increase	159.4	
Impinger 3	Final Weight	641.7	
	Initial Weight	662.7	
	Increase	~~-22.0~~ -21.0	
Impinger 4	Final Weight	474.9	
	Initial Weight	472.8	
	Increase	2.1	
Impinger 5	Final Weight	785.8	
	Initial Weight	763.9	
	Increase	21.9	
Impinger 6	Final Weight		
	Initial Weight		
	Increase		

Filter # _____ Final Weight _____ Initial Weight _____ Increase _____

Water Weight Gain

Impinger 1	~~110.7~~ 109.7
Impinger 2	159.4
Impinger 3	-21.0
Impinger 4	2.1
Impinger 5	21.9
Impinger 6	
Total	272.1 = V_w

V_w =

g SO_2 = -

V_w =

P_b =	29.82	$\%CO_2$ =	4.6
V_m =	38.187	$\%O_2$ =	14.0
V_w =	272.1	%CO =	0.0
P_m =	0.805	$\%N_2$ =	81.4
Avg ΔP =	1.865	A_s =	840
Avg $\sqrt{\Delta P}$ =	1.357	D_n =	0.176
C_p =	0.816	T_t =	72
P_s =	-2.15 $"H_2O$		29.66 "Hg
T_m =	79 °F		539 °R
T_s =	156 °F		616 °R

Moisture Content: %M = ~~25.65~~ 25.58 M_d = ~~0.7435~~ 0.7442 MW_d = 29.296 MW = 26.401

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right) = 17.65 \times 38.187 \left(\frac{29.82 + \frac{0.805}{13.6}}{79 + 460} \right) = 37.363\ sft^3$$

0.519 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 272.1 = \cancel{12.890}\ 12.843\ sft^3$$

$$\%\ Moisture = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{\cancel{12.890}\ 12.843}{37.363 + \cancel{12.890}\ 12.843} \times 100 = \cancel{25.65}\ 25.58\ \%$$

$$V_s = 5123.8 \times 0.816 \sqrt{\frac{616}{29.66 \times 26.401}} \times 1.357 = \cancel{5038}\ 5031\ fpm$$

ACFM: ~~29355~~ 29349

SCFM: 18626

%EA: 184.9

$$\%I = \frac{1039 \times 616 \times 37.363}{0.7442 \times 29.66 \times 5031 \times 72 \times (0.176)^2} = 96.6\ \%$$

Run No. 1

PARTICULATE FIELD DATA

Location Scrubber Stack

Date 12 November 1984

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
1	1520	457.31	1.70	0.75	0.75	3.1	157	254	258	76	84	78	
END	1523	458.772	—	—	—	—	—	—	—	—	—	—	
F 4	1524	458.772	2.30	1.00	1.00	3.8	157	261	249	80	84	78	
3	1527	460.50	2.30	1.00	1.00	3.8	158	251	251	74	85	78	
2	1530	462.21	2.10	0.90	0.90	3.5	159	251	250	76	85	78	
1	1533	463.82	1.90	0.83	0.83	3.2	157	249	248	76	86	78	
END	1536	465.385	—	—	—	—	—	—	—	—	—	—	
F 4	1537	465.385	2.10	0.90	0.90	3.5	157	261	247	78	85	78	
3	1540	467.05	2.40	1.05	1.05	3.9	155	241	247	74	86	79	
2	1543	468.83	2.30	1.00	1.00	3.7	157	242	246	74	86	79	
1	1546	470.50	1.70	0.75	0.75	3.2	156	247	246	75	86	79	
END	1549	471.986	—	—	—	—	—	—	—	—	—	—	
All													

MULLINS ENVIRONMENTAL TESTING CO., INC.

Job No. 84-124

Job Name F R Lewis

Run No. 2

Location Scrubber Stack

Date 13 November 1984

Operator Alexander, Patterson

Sample Box No. 5 Meter Box No. 1

Particulate FIELD DATA

Read and record at the start of each test point.

Purge to: 521.025

Purge time: 1111 - 1126

Ambient Temp. °F 64

Assumed Moisture % 26

Probe Length 3'

C Factor — to reference

Initial Leak @ 15.0 "Hg = 0.002 cfm

Final Leak @ 6.5 "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 (P_m) 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 (T_m) Outlet	Remarks
A4	0915	481.204	1.20	0.55	0.55	3.0	147	270	268	84	49	47	
3	0918	482.50	1.30	0.65	0.65	3.5	147	254	270	64	51	47	
2	0921	483.78	1.20	0.57	0.57	3.2	147	249	274	63	52	47	
1	0924	485.10	1.00	0.48	0.48	2.8	142	250	274	65	53	48	
END	0927	486.230	—	—	—	—	—	—	—	—	—	—	
B4	0928	486.230	1.60	0.78	0.78	3.9	149	249	261	69	54	49	
3	0930	487.65	1.70	0.83	0.83	4.2	149	239	256	62	56	49	
2	0934	489.21	1.50	0.70	0.70	3.8	151	228	254	61	58	50	
1	0937	490.60	1.20	0.55	0.55	3.2	149	252	256	63	59	50	
END	0940	491.883	—	—		—	—	—	—	—			
C4	0941	491.883	1.80	0.90	0.90	4.4	152	265	259	68	59	51	orsat
3	0944	493.41	1.95	0.97	0.97	4.8	154	256	270	64	61	51	
2	0947	495.10	1.80	0.90	0.90	4.6	153	236	268	63	63	52	Halt testing
1	0950	496.65	1.60	0.83	0.83	4.2	150	226	265	65	64	53	repair probe heat
END	0953	498.355 ~~498.742~~		—	—	—	—	—	—	—			
D4	~~1034~~ 1030	498.742	2.10	1.05	1.05	4.8	151		259	75	61	57	restart
3	1033	500.46	2.10	1.05	1.05	4.8	155		262	61	64	57	1030
2	~~1040~~ 1036	502.11	2.00	1.00	1.00	4.8	155		265	61	66	58	

Pitot Tube Calibration Factor C_p 0.816

Volume Collected V_m ~~39.192~~ 38.789 ft^3

Water Collected V_w 171.3 ml

Time of Test T_t 72 min.

Stack Pressure P_s -2.20 "H_2O

Baro. Press. P_b 29.96 "Hg

Probe Tip Dia. D_n 0.176 in.

% CO_2 5.2 % CO 0.0

% O_2 12.8 % N_2 82.0

Area Stack A_s 840 in^2

Pitot Tube No. 4

Barometer No. 12

Probe Tip No. III-2

37.648 - 0.387

V_m = Dry Gas Meter Calibration Factor 1.041 X ~~37.448~~ 37.261

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

M_F = ____ M_T = ____

Impinger Box No. 5

Impinger 1	Final Weight	715.6
	Initial Weight	650.4
	Increase	65.2
Impinger 2	Final Weight	757.8
	Initial Weight	683.8
	Increase	74.0
Impinger 3	Final Weight	702.5
	Initial Weight	682.9
	Increase	~~20.6~~ 19.6
Impinger 4	Final Weight	480.4
	Initial Weight	480.1
	Increase	0.3
Impinger 5	Final Weight	759.8
	Initial Weight	747.6
	Increase	12.2
Impinger 6	Final Weight	
	Initial Weight	
	Increase	

Filter # _____ Final Weight _____ Initial Weight _____ Increase _____

Water Weight Gain

Impinger 1	65.2
Impinger 2	74.0
Impinger 3	~~20.6~~ 19.6
Impinger 4	0.3
Impinger 5	12.2
Impinger 6	
Total	171.3 = V_w

V_w =

g SO_2 = -

V_w =

P_b =	29.96	$\%CO_2$ =	5.2
V_m =	~~39.192~~ 38.789	$\%O_2$ =	12.8
V_w =	171.3	$\%CO$ =	0.0
P_m =	0.861	$\%N_2$ =	82.0
Avg ΔP =	1.748	A_s =	840
Avg $\sqrt{\Delta P}$ =	1.314	D_n =	0.176
C_p =	0.816	T_t =	72
P_s =	-2.20 "H_2O		29.80 "Hg
T_m =	59 °F		519 °R
T_s =	152 °F		612 °R

Moisture Content: %M = ~~16.84~~ 16.95 M_d = ~~0.834~~ 0.805 MW_d = 29.344 MW = ~~27.43~~ 27.2

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times \cancel{39.192}\ 38.789 \left(\frac{29.96 + \frac{0.861}{13.6}}{59 + 460}\right) = \cancel{40.016}\ 39.604\ sft^3$$

0.550 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times \cancel{172.3}\ 171.3 = \cancel{8.133}\ 8.085\ sft^3$$

$$\%\ Moisture = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{\cancel{8.133}\ 8.085}{\cancel{8.133}\ 8.085 + \cancel{40.016}\ 39.604} \times 100 = \cancel{16.89}\ 16.95\ \%$$

$$V_s = 5123.8 \times \underline{0.816} \sqrt{\frac{612}{\cancel{29.80}\ 27.2} \times 1.314} = \cancel{4754}\ 4755\ fpm$$

ACFM: 27735

SCFM: 19867

$$\%I = \frac{1039 \times \cancel{40.016}\ 39.604 \times 612}{\cancel{0.834}\ 0.805 \times 29.80 \times \cancel{4754}\ 4755 \times 72 \times (0.176)^2} = \cancel{96.9}\ 95.9\ \%$$

%EA: 143.3

Run No. 2

PARTICULATE FIELD DATA

Location Scrubber stack

Date 13 November 1984

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
1	1043	503.82	1.60	0.83	0.83	4.2	155		271	62	67	58	1039
END	1046	505.450	—	—	—	—	—	—	—	—	—	—	1042
E 4	1043	505.450	2.20	1.05	1.05	5.0	155	—	270	68	68	59	
3	1046	507.28	2.20	1.05	1.05	5.0	153		271	63	70	60	
2	1049	509.00	2.00	1.00	1.00	5.0	153		270	66	72	60	
1	1052	510.55	1.90	0.95	0.95	4.8	154		268	67	73	61	
END	1055	512.229	—	—	—	—	—	—	—	—	—	—	
F 4	1056	512.229	2.10	1.05	1.05	4.8	154		271	70	72	62	
3	1059	513.88	2.20	1.05	1.05	5.0	154		274	63	74	62	
2	1102	515.58	2.10	1.05	1.05	5.0	154		261	63	75	63	
1	1105	517.30	1.60	0.83	0.83	4.5	154		255	65	76	64	
END	1108	518.852	—	—	—	—	—	—	—	—	—	—	
All													

MULLINS ENVIRONMENTAL TESTING CO., INC.

Job No. 84-124

Job Name FR Lewis

Run No. 3

Location Scrubber Stack

Date 11/13/84

Operator Alexander, Patterson

Sample Box No. 6 Meter Box No. 1

Particulate FIELD DATA

Read and record at the start of each test point.

Purge to: 564.187

Purge time: 1408-1420

Ambient Temp. °F 76

Assumed Moisture % 20

Probe Length Ø 3'

C Factor — to reference

Initial Leak @ 15.0 "Hg = 0.004 cfm

Final Leak @ 8.0 "Hg = 0.004 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 (P_m) 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 (T_m) Outlet	Remarks
A 4	1250	521.280	1.50	0.78	0.70	3.5	151	236	270	83	73	71	
3	1253	522.70	1.50	0.78	0.70	3.4	152	248	269	74	74	71	
2	1256	524.15	1.30	0.70	0.70	3.4	152	248	252	72	76	71	
1	1259	525.60	1.00	0.55	0.55	3.0	152	268	252	72	76	72	
END	1302	526.822	—	—	—	—	—	—	—	—	—	—	
B 4	1303	526.822	1.70	0.86	0.86	4.0	154	268	262	77	77	72	
3	1306	528.40	1.90	0.95	0.95	4.1	154	270	267	73	79	72	
2	1309	530.05	1.70	0.86	0.86	4.0	152	264	260	72	80	73	
1	1312	531.60	1.10	0.60	0.60	3.2	153	271	246	72	80	73	
END	1315	532.933	—	—	—	—	—	—	—	—	—	—	
C 4	1316	532.933	1.80	0.90	0.90	4.0	154	257	265	78	80	73	
3	1319	534.50	2.00	1.00	1.00	4.8	153	253	262	75	82	74	
2	1322	536.20	1.85	0.93	0.93	4.7	154	259	262	72	83	74	
1	1325	537.86	1.30	0.70	0.70	3.8	154	258	273	74	83	74	orsat
END	1328	539.291	—	—	—	—	—	—	—	—	—	—	
D 4	1329	539.291	2.00	1.00	1.00	4.8	155	256	271	80	83	75	
3	1332	540.98	2.10	1.00	1.00	4.9	156	263	266	73	84	75	
2	1335	542.64	2.00	1.00	1.00	4.9	155	266	274	74	85	75	

Pitot Tube Calibration Factor C_p 0.816

Volume Collected V_m 39.787 ft^3

Water Collected V_w 284.3 ml

Time of Test T_t 72 min.

Stack Pressure P_s -2.05 "H_2O

Baro. Press. P_b 29.85 "Hg

Probe Tip Dia. D_n 0.176 in.

% CO_2 5.2 % CO 0.0

% O_2 13.8 % N_2 81.0

Area Stack A_s 840 in^2

Pitot Tube No. 4

Barometer No. 12

Probe Tip No. III-2

V_m = Dry Gas Meter Calibration Factor 1.041 x 38.220

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

M_F = ____ M_T = ____

Impinger Box No. 6

Impinger 1	Final Weight	788.7
	Initial Weight	643.0
	Increase	145.7
Impinger 2	Final Weight	791.5
	Initial Weight	697.2
	Increase	94.3
Impinger 3	Final Weight	724.1
	Initial Weight	696.4
	Increase	27.7
Impinger 4	Final Weight	475.6
	Initial Weight	474.2
	Increase	1.4
Impinger 5	Final Weight	785.7
	Initial Weight	770.5
	Increase	15.2
Impinger 6	Final Weight	
	Initial Weight	
	Increase	

Filter # _____ Final Weight _____ Initial Weight _____ Increase _____

Water Weight Gain

Impinger 1	145.7
Impinger 2	94.3
Impinger 3	27.7
Impinger 4	1.4
Impinger 5	15.2
Impinger 6	
Total	284.3 = V_w

V_w =
g SO_2 = -
V_w =

P_b =	29.85	$\%CO_2$ =	5.2
V_m =	39.787	$\%O_2$ =	13.8
V_w =	284.3	%CO =	0.0
P_m =	0.887	$\%N_2$ =	81.0
Avg ΔP =	1.785	A_s =	840
Avg $\sqrt{\Delta P}$ =	1.329	D_n =	0.176
C_p =	0.86	T_t =	72
P_s =	-2.05 "H_2O		29.70 "Hg
T_m =	78 °F		538 °R
T_s =	155 °F		615 °R

Moisture Content: %M = 25.58 M_d = 0.7442 MW_d = 29.384 MW = 26.47

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 39.787 \left(\frac{29.85 + \frac{0.887}{13.6}}{78 + 460}\right) = 39.048\ sft^3$$

0.542 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 284.3 = 13.419\ sft^3$$

$$\%\ Moisture = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{13.419}{39.048 + 13.419} \times 100 = 25.58\%$$

$$V_s = 5123.8 \times 0.86 \sqrt{\frac{615}{29.70 \times 26.47} \times 1.329} = 4915\ fpm$$

ACFM: 28669

SCFM: 18,251

$$\%I = \frac{1039 \times 615 \times 39.048}{0.7442 \times 29.70 \times 4915 \times 72 \times (0.176)^2} = 103.0\%$$

%EA: 180.0

Run No. 3

PARTICULATE FIELD DATA

Location Scrubber Stack

Date 13 November 1984

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
1	1238	544.33	1.60	0.83	0.83	4.2	156	267	271	74	86	76	
END	1241	545.917	—	—	—	—	—	—	—	—	—	—	
E 4	1242	545.917	2.20	1.05	1.05	5.0	156	253	274	79	85	76	
3	1245	547.63	2.10	1.00	1.00	5.0	156	261	270	73	86	77	
2	1248	549.35	2.00	1.00	1.00	5.0	157	263	270	75	87	77	
1	1251	551.05	1.70	0.86	0.86	4.7	157	265	271	75	88	77	
END	1254	552.590	—	—	—	—	—	—	—	—	—	—	
F 4	1255	552.590	2.20	1.05	1.05	5.0	158	271	270	85	86	78	
3	1258	554.32	2.20	1.05	1.05	5.0	158	271	274	80	87	78	
2	1301	556.05	2.20	1.05	1.05	5.0	158	272	271	79	88	78	
1	1304	557.78	1.90	0.95	0.95	5.0	157	269	272	79	88	79	
END	1307	559.500	—	—	—	—	—	—	—	—	—	—	1407
All													

MULLINS ENVIRONMENTAL TESTING CO., INC.

Job No. 84-124

Job Name F.R. Lewis

Run No. 4

Location Scrubber Stack

Date 15 November 1984

Operator Alexander, Patterson

Sample Box No. 4 Meter Box No. 1

Particulate FIELD DATA

Read and record at the start of each test point.

Purge to: _____

Purge time: _____

Ambient Temp. °F 72

Assumed Moisture % 25

Probe Length 3'

C Factor — _____ to reference

Initial Leak @ 15.0 "Hg = 0.000 cfm

Final Leak @ 7.0 "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 (P_m) 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 (T_m) Outlet	Remarks
A 4	0807	655.476	0.72	0.35	0.35	1.8	143	250	271	100	68	67	
3	0810	656.55	0.85	0.47	0.47	2.0	143	250	273	82	69	67	
2	0813	657.74	0.90	0.50	0.50	2.2	144	243	272	73	69	67	
1	0816	658.95	0.80	0.45	0.45	2.2	143	246	271	72	70	68	
END	0819	660.090	—	—	—	—	—	—	—	—	—	—	
B 4	0820	660.090	1.50	0.78	0.78	3.2	144	249	270	76	71	68	
3	0823	661.65	1.60	0.83	0.83	3.5	146	237	272	72	72	68	
2	0826	663.15	1.50	0.78	0.78	3.2	144	238	263	72	73	68	
1	0829	664.73	1.10	0.60	0.60	2.8	142	240	268	72	74	69	
END	0832	666.182	—	—	—	—	—	—	—	—	—	—	
C 4	0833	666.182	1.60	0.83	0.83	3.3	144	236	261	76	75	69	
3	0836	667.80	1.80	0.90	0.90	3.5	145	249	259	74	76	69	
2	0839	669.50	1.70	0.87	0.87	3.5	144	262	260	73	77	70	
1	0842	671.00	1.40	0.75	0.75	3.2	144	260	263	73	77	70	
END	0845	672.453	—	—	—	—	—	—	—	—	—	—	
D 4	0846	672.453	1.70	0.87	0.87	3.6	145	265	254	76	77	70	
3	0849	673.98	1.90	0.95	0.95	3.8	145	256	243	73	79	71	
2	0852	675.61	1.90	0.95	0.95	3.8	145	241	239	73	79	71	

Pitot Tube Calibration Factor C_p 0.816

Volume Collected V_m 39.005 ft^3

Water Collected V_w 256.7 ml

Time of Test T_t 72 min.

Stack Pressure P_s − 1.60 "H_2O

Baro. Press. P_b 29.81 "Hg

Probe Tip Dia. D_n 0.176 in.

% CO_2 4.0 % CO 0.0

% O_2 15.2 % N_2 80.8

Area Stack A_s 840 in^2

Pitot Tube No. 4

Barometer No. 12

Probe Tip No. III-2

V_m = Dry Gas Meter Calibration Factor 1.041 X 37.469

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

M_F = _____ M_T = _____

Impinger Box No. 4

Impinger 1	Final Weight	754.2
	Initial Weight	637.0
	Increase	117.2
Impinger 2	Final Weight	796.0
	Initial Weight	696.3
	Increase	99.7
Impinger 3	Final Weight	685.1
	Initial Weight	661.2
	Increase	23.9
Impinger 4	Final Weight	474.2
	Initial Weight	473.4
	Increase	0.8
Impinger 5	Final Weight	781.4
	Initial Weight	766.3
	Increase	15.1
Impinger 6	Final Weight	
	Initial Weight	
	Increase	

Filter # _____ Final Weight _____ Initial Weight _____ Increase _____

Water Weight Gain

Impinger 1	117.2
Impinger 2	99.7
Impinger 3	23.9
Impinger 4	0.8
Impinger 5	15.1
Impinger 6	
Total	256.7 = V_w

V_w =
g SO_2 = -
V_w =

P_b =	29.81	$\%CO_2$ =	4.0
V_m =	39.005	$\%O_2$ =	15.2
V_w =	256.7	%CO =	0.0
P_m =	0.833	$\%N_2$ =	80.8
Avg ΔP =	1.595	A_s =	840
Avg $\sqrt{\Delta P}$ =	1.249	D_n =	0.176
C_p =	0.816	T_t =	72
P_s =	-1.60 H_2O		29.69 "Hg
T_m =	73 °F		533 °R
T_s =	142 °F		602 °R

Moisture Content: %M = 23.90 M_d = 0.7610 MW_d = 29.248 MW = 26.56

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right) = 17.65 \times 39.005 \left(\frac{29.81 + \frac{0.833}{13.6}}{73 + 460} \right) = 38.583\ sft^3$$

0.536 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 256.7 = 12.116\ sft^3$$

$$\%\ Moisture = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{12.116}{12.116 + 38.583} \times 100 = 23.90\ \%$$

$$V_s = 5123.8 \times 0.816 \sqrt{\frac{602}{26.56 \times 29.69}} \times 1.249 = 4563\ fpm$$

$$\%I = \frac{1039 \times 602 \times 38.583}{0.7610 \times 29.69 \times 4563 \times 72 \times (0.176)^2} = 105.0\ \%$$

ACFM: 26,616

SCFM: 17,694

%EA: 244.7

Run No. 4

PARTICULATE FIELD DATA

Location Scrubber Stack

Date 15 November 1984

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
1	0855	677.30	1.60	0.83	0.83	3.5	144	234	237	72	80	72	
END	0858	678.854	—	—	—	—	—	—	—	—	—	—	
E 4	0859	678.854	2.10	1.00	1.00	4.0	141	232	237	75	79	72	
3	0902	680.68	2.20	1.15	1.15	4.5	140	235	241	72	81	72	
2	0905	682.40	2.00	1.05	1.05	4.5	139	235	233	70	82	72	
1	0908	684.10	1.50	0.83	0.83	3.5	139	249	236	70	82	73	orsat
END	0911	685.937	—	—	—	—	—	—	—	—	—	—	
F 4	0912	685.937	1.80	1.00	1.00	4.0	133	272	242	74	81	73	
3	0915	687.65	2.20	1.15	1.15	4.5	136	271	243	70	82	73	
2	0918	689.45	2.10	1.10	1.10	4.5	135	265	245	70	83	74	
1	0921	691.30	1.80	1.00	1.00	4.2	135	268	247	70	83	74	
END	0924	692.945	—	—	—	—	—	—	—	—	—	—	
Alw													

APPENDIX E

Analytical Data

Mullins Environmental Testing Co., Inc.

Particulate Analysis Summary

Job Number 84-124

Job Name T.R. Lewis

Location Nacogdoches, Texas

Date Analysis Completed 11-29-84

Unit Tested Scrubber Stack

Run No.	1	2	3	4	
Particulate on Filter (mg)	22.1	13.1	19.8	18.8	
Particulate in Front Wash (mg)*	93.2	63.3	51.8	45.8	
MF (mg)	115.3	76.4	71.6	64.6	
Particulate in Impinger #1 (mg)**	13.1	6.9	9.7	8.8	
MT (mg)	128.4	83.3	81.3	73.4	

Mary Hunter
Analyst

* Less Acetone Residue

** Less Ammonium Sulfate

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

Stack Filters

Job Number 84-124 Location Nacogdoches, Tex.

Job Name F. P. Lewis Unit Tested Scrubber Stack

Desiccator Time In	16⁰⁰ 11/16/84	13³⁵ 11/19/84			
Desiccator Time Out	13²⁸ 11/19/84	9¹⁶ 11/20/84			

Run No. 1	Filter No. J11				
Filter & Particulate + Tare Weight (g)	2.4753	2.4757			
Tare Weight (g)	1.8159	1.8161	✓		
Filter & Particulate (g)	0.6594	0.6596			

Filter & Particulate Average (g) 0.6595

Initial Filter Weight (g) 0.6374

Total Particulate (mg) 22.1

Run No. 2	Filter No. G52				
Filter & Particulate + Tare Weight (g)	2.4608	2.4608			
Tare Weight (g)	1.8160	1.8160	✓		
Filter & Particulate (g)	0.6448	0.6448			

Filter & Particulate Average (g) 0.6448

Initial Filter Weight (g) 0.6317

Total Particulate (mg) 13.1

Run No. 3	Filter No. G53				
Filter & Particulate + Tare Weight (g)	2.4662	2.4664			
Tare Weight (g)	1.8160	1.8160	✓		
Filter & Particulate (g)	0.6502	0.6504			

Filter & Particulate Average (g) 0.6503

Initial Filter Weight (g) 0.6305

Total Particulate (mg) 19.8

Mary Lanton

Analyst

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

Stack Filters

Job Number 84-124-

Job Name J. R. Lewis

Location Pacagoulas, Miss.

Unit Tested Scrubber Stack

Desiccator Time In	16:00 11/14/84	13:39 11/19/84			
Desiccator Time Out	13:38 11/19/84	7:25 11/20/84			

Run No. 4	Filter No. H-90				
Filter & Particulate + Tare Weight (g)	2.4733	2.4734			
Tare Weight (g)	1.8162	1.8161	✓		
Filter & Particulate (g)	0.6571	0.6573			

Filter & Particulate Average (g) 0.6572

Initial Filter Weight (g) 0.6384

Total Particulate (mg) 18.8 ✓

Run No. _____	Filter No. _____				
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Initial Filter Weight (g) _____

Total Particulate (mg) _____

Run No. _____	Filter No. _____				
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Initial Filter Weight (g) _____

Total Particulate (mg) _____

M. Santee

Analyst

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

Front Wash

Job Number 84-134 Location [illegible]

Job Name J.R. [illegible] Unit Tested Scrubber Stack

Desiccator Time In	8:10 11/20/84	10:56 11/21/84	11:14 11/26/84	10:14 11/27/84	8:54 11/28/84
Desiccator Time Out	10:52 11/21/84	10:09 11/26/84	10:09 11/27/84	8:48 11/28/84	8:23 11/29/84

Run No. 1	Volume (ml) 450				
Final Weight (g)	132.8265	132.8276	132.8270		
Initial Weight (g)	132.7305	132.7305	132.7305	✓	
Particulate Weight (g)	0.0960	0.0971	0.0965		

Particulate Average (mg) 96.8
Less Acetone Blank (mg) 3.6
Total Particulate (mg) 93.2 ✓

Run No. 2	Volume (ml) 481				
Final Weight (g)	119.1803	119.1815	119.1808	119.1814	
Initial Weight (g)	119.1140	119.1140	119.1140	119.1140	✓
Particulate Weight (g)	0.0663	0.0675	0.0668	0.0674	

Particulate Average (mg) 67.1
Less Acetone Blank (mg) 3.8
Total Particulate (mg) 63.3 ✓

Run No. 3	Volume (ml) 428				
Final Weight (g)	125.3261	125.3274	125.3267	125.3275	125.3278
Initial Weight (g)	125.2725	125.2725	125.2725	125.2725	125.2725 ✓
Particulate Weight (g)	0.0536	0.0549	0.0542	0.0550	0.0553

Particulate Average (mg) 55.2
Less Acetone Blank (mg) 3.4
Total Particulate (mg) 51.8 ✓

Acetone Blank ✓	Volume (ml) 250				
Final Weight (g)	177.2251	177.2266	177.2257	177.2269	177.2265
Initial Weight (g)	177.2218	177.2218	177.2218	177.2218	177.2218 ✓
Difference (g)	0.0033	0.0048	0.0039	0.0051	0.0047

Average (mg) 4.9
* mg/l 19.6 ✓

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

Mary [illegible]
Analyst

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

Front Wash

Job Number 84-124 Location Nacogdoches, Texas

Job Name L.P. Lewis Unit Tested Scrubber Stack

Desiccator Time In	8:10 11/20/84	10:56 11/21/84	10:14 11/26/84	10:15 11/27/84	7:56 11/28/84
Desiccator Time Out	10:56 11/21/84	10:14 11/26/84	10:15 11/27/84	8:55 11/28/84	8:35 11/29/84

Run No. 4	Volume (ml) 132				
Final Weight (g)	118.8376	118.8389	118.8381	118.8382	118.8384
Initial Weight (g)	118.7894	118.7894	118.7894	118.7894	118.7894
Particulate Weight (g)	0.0482	0.0495	0.0487	0.0488	0.0490

Particulate Average (mg) 49.2
Less Acetone Blank (mg) 3.4
Total Particulate (mg) 45.8

Run No. _____	Volume (ml) _____				
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Particulate Average (mg) _____
Less Acetone Blank (mg) _____
Total Particulate (mg) _____

Run No. _____	Volume (ml) _____				
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Particulate Average (mg) _____
Less Acetone Blank (mg) _____
Total Particulate (mg) _____

Run No. _____	Volume (ml) _____				
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Particulate Average (mg) _____
Less Acetone Blank (mg) _____
Total Particulate (mg) _____

_____
Analyst

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

SO_3 - Back Half Analysis

Job Number 84-124 Location Nacogdoches, Texas

Job Name T.R. Lewis Unit Tested Lewis Pipe Stack

Desiccator Time In	8[10] 11/20/84	14[43] 11/20/84	8[28] 11/21/84		
Desiccator Time Out	14[40] 11/20/84	8[25] 11/21/84			

Run No. 1	Volume (ml) 310				
Final Weight (g)	127.2866	127.2861			
Initial Weight (g)	127.2662	127.2662	✓		
Particulate Weight (g)	0.0204	0.0199			

Particulate Average (mg) 20.2
Less Ammonium Sulfate (mg) 7.1
Total Particulate (mg) 13.1 ✓

Run No. 2	Volume (ml) 305				
Final Weight (g)	125.3054	125.3049			
Initial Weight (g)	125.2963	125.2963	✓		
Particulate Weight (g)	0.0091	0.0086			

Particulate Average (mg) 8.9
Less Ammonium Sulfate (mg) 2.0
Total Particulate (mg) 6.9 ✓

Run No. 3	Volume (ml) 346				
Final Weight (g)	125.0292	125.0287			
Initial Weight (g)	125.0158	125.0158	✓		
Particulate Weight (g)	0.0134	0.0129			

Particulate Average (mg) 13.2
Less Ammonium Sulfate (mg) 3.5
Total Particulate (mg) 9.7 ✓

M. Gunter
Analyst

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

Back Half Analysis

Job Number 84-124 Location Nacogdoches, Texas

Job Name L.P. Lewis Unit Tested Scrubber Stack

Desiccator Time In	8:10 11/20/84	14:44 11/20/84	8:30 11/21/84	1437 11/21/84	902 11/26/84	10:02 11/27/84
Desiccator Time Out	14:44 11/20/84	8:29 11/21/84	14:37 11/21/84	901 11/26/84	10:07 11/27/84	

Run No. 4	Volume (ml) 335				
Final Weight (g)	124.7250	124.7243	124.7253	124.7264	124.7249
Initial Weight (g)	124.7152	124.7152	124.7152	124.7152	124.7152
Particulate Weight (g)	0.0098	0.0091	0.0101	0.0112	0.0097

Particulate Average (mg) continued

Less Ammonium Sulfate (mg)

Total Particulate (mg)

Run No.	Volume (ml)				
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Particulate Average (mg)

Less Ammonium Sulfate (mg)

Total Particulate (mg)

Run No.	Volume (ml)				
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Particulate Average (mg)

Less Ammonium Sulfate (mg)

Total Particulate (mg)

Mary Hunter

Analyst

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

Back Half Analysis

Job Number [illegible]

Job Name [illegible]

Location [illegible]

Unit Tested [illegible]

Desiccator Time In	10[illegible] 11/27/84	16[05] 11/27/84			
Desiccator Time Out	16[05] 11/27/84	8[39] 11/28/84			

continuation

Run No. [illegible]	Volume (ml) [illegible]				
Final Weight (g)	124.7260	124.7262			
Initial Weight (g)	124.7152	124.7152	✓		
Particulate Weight (g)	0.0108	0.0110			

Particulate Average (mg) 10.9

Less Ammonium Sulfate (mg) 2.1

Total Particulate (mg) 8.8

Run No. _____	Volume (ml) _____				
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Particulate Average (mg) _____

Less Ammonium Sulfate (mg) _____

Total Particulate (mg) _____

Run No. _____	Volume (ml) _____				
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Particulate Average (mg) _____

Less Ammonium Sulfate (mg) _____

Total Particulate (mg) _____

Mary Ganter

Analyst

SO_2 EMISSION DATA

Job Number 84-124 Location Macoupin Ill.

Job Name J.R. Lewis Unit Tested Scrubber Stack

Run Number	1	2	3	4	
Date	11/12/84	11/13/84	11/13/84	11/15/84	
Time	1432-1549	0915-1108	1250-1407	0807-0924	
$\underline{N}$ - normality of $BaCl_2$	0.0099	0.0099	0.0099	0.0099	
ML_I - ml in impinger #2	430	348	337	371	
ML_I - ml in impinger #3 & 4	257	299	285	321	
ML_A - ml in aliquot #2	10	10	10	10	
ML_A - ml in aliquot #3 & 4	10	10	10	10	
ML_B - ml of $BaCl_2$ to titrate #2	0.80	0.55	1.05	0.95	
ML_B - ml of $BaCl_2$ to titrate #3 & 4	0.10	0.10	0.10	0.10	
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05	0.05	
T_m - average gas meter temp., °F	79	59	78	73	
V_m - volume of dry gas sampled @ meter conditions, $ft.^3$	38.187	38.789	39.787	39.005	
P_b - barometric pressure, "Hg Abs.	29.82	29.96	29.85	29.81	
Q_s - Stack gas volume dry @ standard conditions, *SCFM	18,626	19,867	18,251	17,694	
C_I - SO_2 in impinger #2, mgs	10.2	5.5	10.7	10.6	
C_I - SO_2 in impinger #3 & 4 mgs	0.4	0.5	0.5	0.5	
C_T - total SO_2 in impingers, mgs	10.6	6.0	11.2	11.1	
ppm SO_2	3.8	2.0	3.8	3.8	
C_{SO_2} - emission rate of SO_2, lbs/day	16.8	9.5	16.5	16.2	
C_{SO_2} - emission rate of SO_2, lbs/hr	0.7	0.4	0.7	0.7	
C_s - emission rate of S, lbs/day	8.4	4.8	8.3	8.1	

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

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

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

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

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

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

METCO

SULFUR TRIOXIDE EMISSION DATA

Job Number 84-12d

Job Name FR Lewis

Location Meadowlands, N.J.

Unit Tested Scrubber Stack

Run Number	1	2	3	4
Date	11/12/84	11/13/84	11/13/84	11/15/84
Time	1432-1549	0915-1108	1250-1407	0807-0924
$\underline{N}$ - normality of $BaCl_2$	0.0099	0.0099	0.0099	0.0099
ML_I - ml in impinger	310	305	346	335
ML_A - ml in aliquot	10	10	10	10
ML_B - ml of $BaCl_2$ to titrate	0.40	0.15	0.20	0.15
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05	0.05
T_m - average gas meter temp., °F	79	59	78	73
V_m - volume of dry gas sampled @ meter conditions, ft.^{3}	38.187	38.789	39.787	39.005
P_b - barometric pressure, "Hg Abs.	29.82	29.96	29.85	29.81
Q_s - stack gas volume dry @ standard conditions, *SCFM	18,626	19,867	18,251	17,694
C_I - SO_3 in impinger, mgs	4.3	1.2	2.1	1.3
ppm SO_3	1.2	0.3	0.6	0.4
C_{SO_3} - emission rate of SO_3, lbs/day	6.8	1.9	3.1	1.9
C_S - emission rate of S, lbs/day	2.7	0.8	1.2	0.8

* 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

72 min long

Production
Percent Asphalt 5.8 %
Pressure Drop Across Control Device
Water Pump Pressure
Burner Position
Sieve Analysis
Fuel Analysis

Run No. 1
11/12/84

Time	Burner Position	Production Rate (tons/hr)	Pressure Drop Across Scrubber (" H_2O)	Water Pump Pressure (psi)
1400	43	113 - 59.046	17	50
1416	40	145 -	18	50
1430	41	141 -	17	50
1445	40	145 -	17	50
1500	40	147 -	17	50
1515	41	146 -	18	50
1530	40	144 -	17	50
1545	40	145 - 58.04	17	50

AVG 152.9 tons/hr
(integrator)

2nd Test 11-13-84

	Burner	Production	PDACD	WPP
0915	49	142 38.98	18	50
0930	44	143	18	50
0945	46	144	18	50
1000	45	146	18	50
1015	37	142	18	50
1030	42	142	18	50
1045	40	140	18	50
1100	38	140	18	50
1108	42	147 - 318.78	18	50

AVG 148.7 tons/hr (integrator)

3rd Test 11-13-84

1245	42	139 - 323.27	18	50
1300	40	144	18	50
1315	42	143	18	50
1330	39	146	18	50
1345	42	142	18	50
1400	42	144	17	50
1411	40	142 - 538.89	17.5	50

Avg 150.4 tons/hr. (integrator)

4th Test
11-15-84

	Burner	Production	PDHCD	WPD
0805	44	141 - 89.12	17	50
0820	46	144	17	50
0835	44	141	17	50
0850	42	141	17	50
0905	42	142	17	50
0920	43	144	17	50
0935	40	141 - 296.32	17	50

Avg = 138.1 tons/hr
(integrator)

Texas Highway Department
Form No. 846 Rev.

TEXAS HIGHWAY DEPARTMENT
ASPHALTIC CONCRETE EXTRACTION TEST
WORK SHEET

County: Shelby | Highway: US 59 | Project: CSR 175-2-[illegible] | Control: 175-2-55 etc.
Date: 11-12-[illegible]4 | Time: 1:55 PM | Station: | Sampled By: W. E. Ford
Spec. Item: 340 | Type: D Surf | Design No.: 31-5.8

Total Sample	= 530.3 gm. (A)		Ash per 100 ml.	=e−f= —	gm
Final Filter	= 7.1 gm. (a)		Total Solvent	= —	ml
Original Filter	= 5.9 gm. (b)		Total Ash	= $\frac{1 \times 2}{100}$ = —	gm.
Fines in Filter	=a−b= 1.2 gm. (B)		Fines+Aggr.+Ash	=B+C+D= 784.7	gm
Pan + Extr. Aggr.	= 1907.8 gm. (c)		Total Loss	=A−E= 45.6	gm
Pan	= 1087.2 gm. (d)		Total Loss	= $\frac{F}{A}$ × 100 = 5.5	%
Extr. Aggr.	=c−d= 820.6-35.9=784.7 gm. (C)		Moisture Content	= 0.0	%
Dish + Ash per 100 ml.	= — gm. (e)		Hydrocarbon Volatiles Content	= 0.0	%
Dish	= — gm. (f)		Residual Bitumen	=G−H−I= 5.5	%

		Per Cent
Fines + Aggr. + Ash	= $\frac{E}{A}$ × 100 =	94.5
Moisture	=H=	0.0
Hydrocarbon Volatiles	=I=	0.0
Residual Bitumen	=J=	5.5
Total	=	100.0%

Ticket # 01565

Moisture Setting 6.5

Asph. Setting 5.8

Temp Mix 300

SIEVE ANALYSIS		
Sieve Size	Grams	Per Cent
1¾"—⅞"		
⅞"—⅜"		
½ ~~⅝"—⅜"~~	0	0
½"—⅜"	22.3	2.8
⅜"— 4	293.7	37.4
¼"—10	—	—
4—10	183.4	22.4
+10		63.6
10— 40	48.5	6.2
40—80	97.2	12.4
80—200	101.4	12.9
Pass 200	1.2+67.0−30.0 = 38.2	4.9
Total Loss	—	—
Total	784.7	100.0%

5.5 Asph.

PER CENT MOISTURE IN AGGREGATES IN HOT BINS						
Bin No.	(a) Tare Wt. (gms.)	(b) Gross Wet Wt. (gms.)	(c) Gross Dry Wt. (gms.)	(d) Wt. Moist (gms.) b-c	(e) Dry Wt. Aggr. (gms.) c-a	% Moist. $\frac{d}{e}$ x100%

William E. Ford
Inspector

Texas Highway Department
Form No. 546 Rev.

TEXAS HIGHWAY DEPARTMENT
ASPHALTIC CONCRETE EXTRACTION TEST
WORK SHEET

County: Shelby | Highway: US 59 | Project: CSR 175-2-55 Etc. | Control: 175-2-55 Etc
Date: 11-13-54 | Time: 9:29 Am | Station: | Sampled By: W. E. Ford
Spec. Item: 340 | Type: D Surf | Design No.: 31-5.8

Total Sample	= 848.7 gm. (A)	Ash per 100 ml.	= e—f = — gm
Final Filter	= 7.1 gm. (a)	Total Solvent	= — ml.
Original Filter	= 5.9 gm. (b)	Total Ash	= $\frac{1 \times 2}{100}$ = — gm.
Fines In Filter	= a—b = 1.2 gm. (B)	Fines + Aggr. + Ash	= B+C+D = 798.5 gm
Pan + Extr. Aggr.	= 1921.6 gm. (c)	Total Loss	= A—E = 50.2 gm
Pan	= 1087.2 gm. (d)	Total Loss	= $\frac{F}{A} \times 100$ = 5.9 %
Extr. Aggr.	= c—d = 834.3-35.9 = 798.5 gm. (C)	Moisture Content	= 0.0 %
Dish + Ash per 100 ml.	= — gm. (e)	Hydrocarbon Volatiles Content	= 0.0 %
Dish	= — gm. (f)	Residual Bitumen	= G—H—I = 5.9 %

		Per Cent
Fines + Aggr. + Ash	= $\frac{E}{A} \times 100$ =	94.1
Moisture	= H =	0.0
Hydrocarbon Volatiles	= I =	0.0
Residual Bitumen	= J =	5.9
Total	=	100.0%

Ticket # 01592

Moisture Setting 6.0

Asph. Setting 5.8

Temp Mix 305

SIEVE ANALYSIS

Sieve Size	Grams	Per Cent
1¾"—⅞"		
⅞"—⅜"		
½ ~~⅝"—⅜"~~	0	0
½"—⅜"	8.0	1.0
⅜"— 4	257.7	32.3
¼"—10	—	—
4—10	215.0	26.9
+10		60.2
10— 40	59.4	7.5
40—80	112.5	14.1
80—200	110.4	13.8
Pass 200	64.3+1.2-30.0 = 35.5	4.4
Total Loss	—	—
Total		100.0%

5.9 % Asph

PER CENT MOISTURE IN AGGREGATES IN HOT BINS

Bin No.	(a) Tare Wt. (gms.)	(b) Gross Wet Wt. (gms.)	(c) Gross Dry Wt. (gms.)	(d) Wt. Moist (gms.) b-c	(e) Dry Wt. Aggr. (gms.) c-a	% Moist. $\frac{d}{e}$ x100%
1	1081.0	1703.3	1703.2	0.1	622.3	0.0

William E. Ford
Inspector

Texas Highway Department
Form No. 346 Rev.

TEXAS HIGHWAY DEPARTMENT
ASPHALTIC CONCRETE EXTRACTION TEST
WORK SHEET

County Shelby Highway US 59 Project CSR 175-2-[illegible] Control 175-2-[illegible]
Date 11-19-[illegible] Time 8:30 AM Station Sampled By [illegible]
Spec. Item 340 Type D Surf Design No. 31-5.9

Total Sample	= 516.9 gm. (A)		Ash per 100 ml.	=e—f= —	gm
Final Filter	= 7.5 gm. (a)		Total Solvent	= —	ml
Original Filter	= 5.9 gm. (b)		Total Ash	= $\frac{1 \times 2}{100}$ = —	gm.
Fines in Filter	=a—b= 1.6 gm. (B)		Fines+Aggr.+Ash	=B+C+D= 515.4	gm
Pan + Extr. Aggr.	= 1938.6 gm. (c)		Total Loss	=A—E= 51.5	gm
Pan	= 1087.3 gm. (d)		Total Loss	= $\frac{F}{A}$ × 100 = 5.9	%
Extr. Aggr.	=c—d= 851.3-35.9= 815.4 gm. (C)		Moisture Content	= 0.0	%
Dish + Ash per 100 ml.	= — gm. (e)		Hydrocarbon Volatiles Content	= 0.0	%
Dish	= — gm. (f)		Residual Bitumen	=G—H—I= 5.9	%

		Per Cent
Fines + Aggr. + Ash	= $\frac{E}{A}$ × 100 =	94.1
Moisture	=H=	0.0
Hydrocarbon Volatiles	=I=	0.0
Residual Bitumen	=J=	5.9
Total	=	100.0%

Ticket # 01636

Moisture Setting 6.2

Asph. Setting 5.8

Temp Mix 305

SIEVE ANALYSIS

Sieve Size	Grams	Per Cent
1¾"—⅞"		
⅞"—⅜"		
~~½"—⅜"~~	0	0
½"—⅜"	17.8	2.2
⅜"— 4	283.7	34.8
¼"—10	—	—
4—10	203.4	24.9
+10		61.9
10— 40	47.5	5.8
40—80	117.1	14.4
80—200	109.0	13.4
Pass 200	63.5+1.6-26.0 = 36.9	4.5
Total Loss	—	—
Total		100.0%

5.9 Asph.

PER CENT MOISTURE IN AGGREGATES IN HOT BINS

Bin No.	(a) Tare Wt. (gms.)	(b) Gross Wet Wt. (gms.)	(c) Gross Dry Wt. (gms.)	(d) Wt. Moist (gms.) b-c	(e) Dry Wt. Aggr. (gms.) c-a	% Moist. $\frac{d}{e}$ x100%
1	1082.3	1473.9	1473.8	0.1	386.5	0.0

William E. Ford
Inspector

APPENDIX F

Fuel Oil Analysis Data

	As Received
Moisture - % wt.	<0.01
Ash - % wt.	<0.01
Sulfur - % wt.	0.35
Btu/lb	18,931
Carbon - % wt.	87.03
Hydrogen - % wt.	12.36
Nitrogen - % wt.	<0.01
Oxygen - % wt.	0.26

APPENDIX G

Chain of Custody

MULLINS ENVIRONMENTAL TESTING CO., INC.

Chain of Custody

Job Number 84-124

Job Name FR. Lewis

Location Nacogdoches, Tx

Unit Tested Scrubber Stack

Date(s) Sampled 11/12,13/84

Number of Tests 111

Date Results Required 11/23/84

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									
Fuel oil	1								prox.

Special Instructions

Sample No. 1 Recovered by: Don C Alexander Date: 11/12/84 Time: 1630 Location: VAN

Sample No. 2 Recovered by: Don C Alexander Date: 11/13/84 Time: 1130 Location: VAN

Sample No. 3 Recovered by: Don C Alexander Date: 11/13/84 Time: 1500 Location: VAN

Samples Received by: R. Patterson for Transport Date: 11/15/84 Time: 1130

Samples Received at Lab by: M. Gunter Date: 11/16/84 Time: 1000

Samples Analyzed by: M. Gunter Date: 11/29/84 Time: 0935

MULLINS ENVIRONMENTAL TESTING CO., INC.

Chain of Custody

Job Number 84-124

Job Name F R Lewis Const. Co.

Location Nacogdoches, Texas

Unit Tested Scrubber Stack

Date(s) Sampled 11/15/84

Number of Tests 6

Date Results Required 11/26/84

SOURCE SAMPLES

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

Special Instructions

Sample No. 4 Recovered by: Don C. Alexander Date: 11/15/84 Time: 1000 Location: VAN

Sample No. Recovered by: Date: Time: Location:

Sample No. Recovered by: Date: Time: Location:

Samples Received by: R. Patterson for Transport Date: 11/15/84 Time: 1130

Samples Received at Lab by: M. Gantes Date: 11/16/84 Time: 1000

Samples Analyzed by: Mary Ganter Date: 11/29/84 Time: 0935

APPENDIX H

Resumes of Test Personnel

MULLINS ENVIRONMENTAL TESTING CO., INC.
P.O. Box 598
Addison, Tx 75001
(214) 931-7127

METCO

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.

MULLINS

Publications

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.

Teaching Experience

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.
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Addison, Tx 75001
(214) 931-7127

METCO

DON C. ALEXANDER, Field Testing Supervisor

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
Technicial Experience	Participated in the sampling of over 350 sources, including several which were sampled simultaneously using more than one sampling train and has supervised the sampling of over 150 sources. 1979-present. Thoroughly trained in calibration techniques for all field testing equipment and all EPA testing procedures. Trained in the operation of MSA LIRA Model 202S Infrared Analyzer.

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METCO

ROBERT M. PATTERSON, Environmental Field Technician

Education	B.S. 1983, Central Michigan University, Mt. Pleasant, Michigan, in Geology and Earth Science.
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. 1983-present.