PARTICULATE EMISSION TESTING ON THE SCRUBBER EXHAUST

TRIANGLE PAVING, INC.

BURLINGTON, N.C.
NOVEMBER 14, 1990
REPORT # 5080

ANALYTICAL TESTING CONSULTANTS, INC.

506 Broad Street
Kannapolis, N. C. 28081
(704) 932-3193

P. O. Box 767190
Roswell, Georgia 30076
(404) 587-5696

Prepared by:
kp

Distribution:
Mr. Bob Watson
(5 copies)

Issue Date:
November 16, 1990

TABLE OF CONTENTS

INTRODUCTION

This report presents the results of particulate emission testing performed on the scrubber exhaust at Triangle Paving, Inc., Burlington, N. C. on November 14, 1990.

The purpose of this test was to determine compliance with applicable emission rate codes of the state of North Carolina.

The test was conducted by ANALYTICAL TESTING CONSULTANTS, INC. Kannapolis, N. C. Members of the test team were Dan McCombs, test leader, Brent Snider, senior technician, Stewart Meadows, and Todd Parker, technicians.

SOURCE DESCRIPTION

The unit tested was the system exhaust stack at Triangle Paving, Inc. in Burlington, N. C. It is a rotary drying kiln where aggregate for the production of asphalt paving material is produced. A scrubber collector is utilized to control particulate emissions.

During this sampling, the system was to be operated at approximately 150 tons/hour as measured by the production control computer.

RESULTS SUMMARY

SYSTEM TRIANGLE PAVING, INC.
BURLINGTON, N. C.

TEST DATE November 14, 1990

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE
Qs, FLOW, ACFM	28014	27745	28124	27961
Qs dry, FLOW SCFM	20193	20286	20782	20420
Vm std, CUBIC FT.	53.46	52.39	53.11	
%I	103.78	101.23	100.17	
PMR AVG, LB/HR	6.19	4.26	4.72	5.05
Cs, GR/SCF	0.035	0.024	0.026	0.029
ALLOWABLE, GR/SCF				.04
PRODUCTION, TON/HR	148	150	149	149

RESULTS, CONCLUSIONS AND COMMENTS

Results of the particulate emission testing are presented in the preceding Test Summary. Additional information may be reviewed in the Calculations and Data Sheets sections of this report.

The process rate was 149 tons/hour with H-binder being run.

SAMPLING AND ANALYTICAL PROCEDURES

Particulate testing and analysis were performed according to procedures developed by the U. S. Environmental Protection Agency (EPA) and referred to as Method 5. Sampling port locations and number of test points to be used were determined according to Method 1. Gas sampling was performed in accordance with EPA Method 3, Fyrite Analyzer method. Stack volumetric flow rates were determined utilizing EPA Method 2.

REFERENCES

1. CODE OF FEDERAL REGULATIONS, Title 40, Part 60, Appendix A, July 1, 1989.

CALCULATIONS

Particulate Emission Rate Calculation
Square Root of DP
Nomenclature
Calculation Formulae

PARTICULATE EMISSION RATE CALCULATION

DATA/CALCULATION	RUN 1	RUN 2	RUN 3	AVERAGE
DATE	11/14/90	11/14/90	11/14/90	
AVG DH (IN H2O)	1.66	1.71	1.74	
P ATM (IN HG)	29.82	29.82	29.82	
PM (IN HG)	29.94205	29.94573	29.94794	
PS (GUAGE)	0.67	0.67	0.67	
PS (IN HG)	29.86926	29.86926	29.86926	
tM (DEG F)	60.6	82	97.9	
TM (DEG R)	520.6	542	557.9	
VM (FT3)	52.67	53.73	56.06	
VM STD (FT3)	53.45805	52.38716	53.10507	
VLQ (ML)	247	228.8	220.9	
VV STD (FT3)	11.63805	10.78051	10.40828	
V STD (FT3)	65.09611	63.16767	63.51336	
%M	17.87826	17.06650	16.38755	17.11077
MD	0.821217	0.829334	0.836124	
MWD	29.5948	29.624	29.56	
M	27.52185	27.64018	27.66559	
tS (DEG F)	142	139.4	138	139.8
TS (DEG R)	602	599.4	598	599.8
SUM SQRT DP	18.9646	18.8634	19.1521	
N DP	24	24	24	
AVG SQRT DP	0.790191	0.785975	0.798004	
CP	0.84	0.84	0.84	
VS (FT/SEC)	48.55382	48.08704	48.74356	48.46147
DS (IN)	42	42	42	
AS (FT2)	9.61625	9.61625	9.61625	
QS, ACFM	28014.34	27745.02	28123.81	27961.06
Q STD (FT3/MIN)	24588.83	24461.08	24854.91	24634.94
Q STD DRY, SCFM	20192.77	20286.43	20781.80	20420.33
WT (GM)	0.1215	0.0827	0.091	
PMRC (LB/HR)	6.071821	4.236879	4.711383	5.006694
DN (IN)	0.25	0.25	0.25	
AN (IN2)	0.049062	0.049062	0.049062	
TIME (MIN)	72	72	72	
PMRA (LB/HR)	6.301184	4.288954	4.719405	5.103181
%I	103.7775	101.2290	100.1702	
PMR AVG (LB/HR)	6.186502	4.262917	4.715394	5.054938
%CO2	6.29	6.38	6	6.223333
%O2	14.71	15.08	15	14.93
%C0	0	0	0	0
%N2	79	78.54	79	78.84666
%EA	239.3426	266.6874	256.1475	254.0592
CS (GR/SCFD)	0.035069	0.024358	0.026440	0.028622

SUM SQRT DP CALCULATION

DATE 11/14/90

RUN 1		RUN 2		RUN 3	
DP	SQRT DP	DP	SQRT DP	DP	SQRT DP
0.5	0.707106	0.6	0.774596	0.73	0.854400
0.59	0.768114	0.62	0.787400	0.68	0.824621
0.58	0.761577	0.62	0.787400	0.7	0.836660
0.55	0.741619	0.58	0.761577	0.6	0.774596
0.51	0.714142	0.54	0.734846	0.63	0.793725
0.49	0.7	0.48	0.692820	0.62	0.787400
0.58	0.761577	0.5	0.707106	0.55	0.741619
0.8	0.894427	0.78	0.883176	0.55	0.741619
0.82	0.905538	0.9	0.948683	0.88	0.938083
0.85	0.921954	0.8	0.894427	1	1
0.81	0.9	0.82	0.905538	0.8	0.894427
0.8	0.894427	0.9	0.948683	0.88	0.938083
1	1	1	1	1	1
1	1	1.1	1.048808	1.1	1.048808
1.1	1.048808	1.1	1.048808	1.1	1.048808
1	1	1.1	1.048808	1.1	1.048808
1	1	0.95	0.974679	1	1
0.74	0.860232	0.9	0.948683	0.72	0.848528
0.45	0.670820	0.38	0.616441	0.35	0.591607
0.35	0.591607	0.28	0.529150	0.3	0.547722
0.39	0.624499	0.22	0.469041	0.28	0.529150
0.28	0.529150	0.2	0.447213	0.22	0.469041
0.25	0.5	0.2	0.447213	0.2	0.447213
0.22	0.469041	0.21	0.458257	0.2	0.447213
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	0		0		0
	18.96464		18.86336		19.15214

NOMENCLATURE

AN	(square inches), Cross sectional area of nozzle
AS	(square feet), Cross sectional area of stack
CP	Pitot tube calibration coefficient
% EA	Percent Excess Air
F	(scfd/10 6 BTU), F factor
DH	(inches of water) Average orifice meter reading
HI	(million BTU/hr), Heat Input Rate
% I	Percent Isokineticity
M	(lb/lb mole), Molecular Weight of wet gas
% M	Percent Moisture
MD	Mole fraction of dry gas
MWD	(lb/lb mole) molecular weight of dry gas
N DP	Number of sample points
P ATM	(in Hg), Local atmospheric pressure
PM	(in Hg), Absolute pressure in dry gas meter
PS	(in Hg), Absolute stack pressure
PS GAUGE	(inches of water), Measured static stack pressure gauge
P STD	(29.92 in Hg), Standard pressure
PMRA	(lb/hr), Pollutant mass rate based on ratio of areas
PMR AVG.	(lb/hr), Average pollutant mass rate
PMRC	(lb/hr), Pollutant mass rate based on concentration
PMRU	(lb/million BTU), Specific emission rate
DP	(inches of water), Velocity pressure
QS	(cubic feet/min.), Actual stack volume flow rate

Q STD (cubic feet/min.), Stack volume flow rate at standard conditions

TM (degrees R), Average dry gas meter temperature

TS (degrees R), Average stack temperature

T STD (528 degrees R), Standard temperature

VLQ (ml), Liquid volume

VM (cubic feet), Sample volume measured by dry gas meter

VM STD (cubic feet), Sample volume at standard conditions

VS (ft/sec), stack velocity

VV STD (cubic feet), Volume of water vapor collected, corrected to standard conditions

WT (gm), Total weight of particulate collected

TIME (MIN.)Duration of test

CALCULATION FORMULAE

1. Absolute pressure in dry gas meter

   $$PM = P\ ATM + DH/13.6$$

2. Absolute Stack Pressure

   $$PS = P\ ATM + PS\ gauge/13.6$$

3. Sample volume at standard conditions

   $$VM\ STD = (VM)\ (T\ STD/TM)\ (PM/P\ STD)$$

4. Volume of water collected, corrected to standard conditions

   $$VV\ STD = (.00267)\ (VLQ)\ (T\ STD/P\ STD)$$

5. Total sample volume at standard conditions

   $$V\ STD = VM\ STD + VV\ STD$$

6. Percent moisture in stack gas

   $$\%M = (100)\ (VV\ STD)/V\ STD$$

7. Mole Fraction of dry gas

   $$MD = (100-\%M)/100$$

8. Molecular weight of the wet gas

   $$M = (MWD)\ (MD) + 18(1-MD)$$

9. Stack velocity

   $$VS = (85.48)(CP)((TS/(PS)(M))^{1/2}((Sum\ DP)^{1/2}\ N\ DP))$$

10. Stack volume flow rate

    $$QS = (60)(VS)(AS)$$

11. Stack volume flow rate, standard conditions including moisture

$$Q\ STD = (T\ STD/P\ STD)(PS/TS)(QS)$$

12. Stack volume flow rate standard conditions dry

$$Q\ STD\ DRY = (Q\ STD)(1-\%M)$$

13. Pollutant mass rate, concentration basis

$$PMRC = (.1323)(WT)(Q\ STD)/V\ STD$$

14. Pollutant mass rate ratio of areas basis

$$PMRA = (.1323)(WT)(AS)(144)/(Time)(AN)$$

15. Percent Isokineticity

$$\%I = (100)\ (PMRA)/PMRC$$

16. Average pollutant mass rate

$$PMR\ AVG = (PMRA + PMRC)/2$$

17. % EXCESS AIR

$$\%EA = (100)\ (\%oxygen - (.5)(\%carbon\ monoxide)$$
$$(.264)(\%nitrogen) - \%oxygen + (.5)\ (\%carbon\ monoxide)$$

18. Heat input rate

$$HI = ((.6)\ (Q\ STD\ DRY)/F)((20.9 - \%oxygen)/20.9)$$

19. Specific emission rate

$$PMRU = PMR\ AVG/HI$$

DATA SHEETS

Method 5 Sampling Data Sheets
Impinger Data Sheets
Temperature Data Sheets
Orsat Data Sheets
Chain of Custody Sheets
Source Test Survey
Equal Area Determinations
Laboratory Reports
Calibration Information

ANALYTICAL TESTING CONSULTANTS, INC.
Kannapolis, N. C. Atlanta, Ga.

MODULE SAMPLING DATA SHEET

CLIENT Triangle Paving DATE 11-14-90

LOCATION Burlington N.C. SOURCE Scrubber

TEST TEAM TP SM BS RUN # 1

Pbar 29.82
P +.67
MODULE Nat 1
FILTER B982
NOZZLE 44
PITOT 52
METHOD 5

TIME	POINT	LINE VAC	t_m °F	t_s °F	V_p H_2O	P_m H_2O	V_m ft^3	REMARKS
8:01 0	A1	2	47	138	.50	1.3	594.77	
3	2	2	48	141	.59	1.5	596.74	
6	3	2	49	140	.58	1.5	598.80	
9	4	2	50	141	.55	1.4	580.88	
12	5	2	51	146	.51	1.3	582.94	
15	6	2	53	147	.49	1.3	584.93	
18	7	2	55	149	.58	1.5	586.95	
21	8	3	56	149	.80	2.0	588.05	
24	9	3	57	147	.82	2.1	591.36	
27	10	4	58	145	.85	2.2	593.82	
30	11	4	60	144	.81	2.0	596.35	
33	12	4	60	141	.80	2.0	598.79	
8:37 36	Shut Down Change Ports						601.21	
8:40 0	B1	4	61	134	1.0	2.5	601.21	
3	2	4	63	140	1.0	2.5	603.84	
6	3	4	65	141	1.1	2.6	606.45	
9	4	4	66	141	1.0	2.5	609.17	
12	5	4	67	140	1.0	2.5	611.96	
15	6	4	69	141	.74	1.9	614.67	
AVERAGE/NET								

NOTES:

LEAK RATES:
Start @ 13
.01
End @ 11
.02
Pitot:
Start
A 4.5 B 5.8
dc
End
A 5.0 B 6.1
dc

SETUP:
g 1.7
t_m 75
% H_2O 20%
NOZZLE 1/4
C .71
t_s 140
Theo. Pitot
.69

ANALYTICAL TESTING CONSULTANTS, INC.
Kannapolis, N. C. Atlanta, Ga.

MODULE SAMPLING DATA SHEET

CLIENT Triangle Paving DATE 11-14-90

LOCATION Burlington N.C. SOURCE Scrubber

TEST TEAM DM SM JP BS RUN # 1

TIME	POINT	LINE VAC	t_m °F	t_s °F	V_p H_2O	P_m H_2O	V_m ft^3	REMARKS
18	7	3	70	140	.45	1.2	617.19	
21	8	3	70	140	.35	.95	619.56	
24	9	2	70	140	.39	1.0	621.33	
27	10	2	70	140	.28	.71	623.09	
30	11	2	70	143	.25	.67	624.64	
33	12	2	70	140	.22	.60	626.08	
9:48 36		Shut Down	End	Run	—		627.44	
			1455	340s		39.73		
AVERAGE/NET			60.6	142	19.9646	1.66	52.67	

NOTES:

P_{bar} _____

P_s _____

MODULE _____

FILTER _____

NOZZLE _____

PITOT _____

METHOD _____

LEAK RATES:
Start @ _____
End @ _____

Pitot:
Start
A ___ B ___
End
A ___ B ___

SETUP:
g _____
t_m _____
% H_2O _____
NOZZLE _____
C _____
t_s _____
Theo. Pitot _____

ANALYTICAL TESTING CONSULTANTS, INC.
Kannapolis, N. C. Atlanta, Ga.

MODULE SAMPLING DATA SHEET

CLIENT Triangle Paving DATE 11-14-90

LOCATION Burlington N.C. SOURCE Scrubber

TEST TEAM DM BS SM TP RUN # 2

P_{bar} 29.82

P_g +.67

MODULE Nut 1

FILTER B986

NOZZLE 47

PITOT 51

METHOD EPA 5

TIME	POINT	LINE VAC	t_m °F	t_s °F	V_p H_2O	F_m H_2O	V_m ft^3	REMARKS
10:00 0	A1	2	68	130	.60	1.5	627.94	Begin
3	2	2	69	130	.62	1.6	630.16	
6	3	2	70	132	.62	1.6	632.35	
9	4	2	72	135	.58	1.5	634.60	
12	5	2	74	136	.54	1.4	636.36	
15	6	2	75	140	.48	1.2	638.71	
18	7	2	76	142	.50	1.4	640.72	
21	8	3	77	142	.78	2.1	642.79	
24	9	3	78	142	.90	2.5	645.22	
27	10	3	80	140	.80	2.2	647.91	
30	11	3	82	140	.82	2.3	650.51	
33	12	4	83	138	.90	2.5	653.12	
10:36 36	Shut Down			Change Ports			655.83	change over
10:39 0	B1	3	83	142	1.0	2.5	655.83	
3	2	4	85	142	1.1	2.6	658.06	
6	3	5	86	143	1.1	2.6	660.58	
9	4	5	87	144	1.1	2.6	663.23	
12	5	5	88	143	.95	2.6	666.38	
15	6	5	89	142	.90	2.5	669.48	
AVERAGE/NET								

NOTES:

LEAK RATES:
Start @ .005 12
End @ .008 10
Pitot:
Start A 4.8 B 5.9
End A 5.0 B 5.5 ok

SETUP:
g
t_m see Run 1
% H_2O
NOZZLE
C
t_s
Theo. Pitot

ANALYTICAL TESTING CONSULTANTS, INC.
Kannapolis, N. C. Atlanta, Ga.

MODULE SAMPLING DATA SHEET

CLIENT Triangle Paving DATE 11-14-90

LOCATION Burlington N.C. SOURCE Scrubber

TEST TEAM BS SM DM TP RUN # 2

TIME	POINT	LINE VAC	t_m °F	t_s °F	V_p H_2O	P_m H_2O	V_m ft^3	REMARKS
18	7	5	91	142	.38	1.0	672.33	
21	8	5	91	142	.28	.71	—	
24	9	4	91	140	.22	.56	676.03	
27	10	3	91	140	.20	.55	677.44	
30	11	3	91	139	.20	.55	678.80	
33	12	3	91	139	.21	.57	680.16	
11:18 36	Shut Down			End	Rev	—	681.67	
			1968	3345		41.14		
AVERAGE/NET			82	139.4	18.8634	1.71	53.73	

NOTES:

P_{bar} _____

P_s _____

MODULE _____

FILTER _____

NOZZLE _____

PITOT _____

METHOD _____

LEAK RATES:
Start @ _____
End @ _____
Pitot:
Start
A ____ B ____
End
A ____ B ____

SETUP:
g _____
t_m _____
% H_2O _____
NOZZLE _____
C _____
t_s _____
Theo. Pitot _____

ANALYTICAL TESTING CONSULTANTS, INC.
Kannapolis, N. C. Atlanta, Ga.

MODULE SAMPLING DATA SHEET

CLIENT Triangle Paving DATE 11-14-90

LOCATION Burlington NC. SOURCE Scrubber

TEST TEAM TD SM BS RUN # 3

P_{bar} 29.82

P_s +.67

MODULE Nut 1

FILTER B987

NOZZLE 43

PITOT 53

METHOD EPA 5

TIME	POINT	LINE VAC	t_m °F	t_s °F	V_p H_2O	P_m H_2O	V_m ft^3	REMARKS
11:35 0	A1	3	87	130	.73	2.0	681.80	Begin
3	2	4	87	134	.68	1.9	684.30	
6	3	4	90	137	.70	1.9	686.77	
9	4	4	91	140	.60	1.7	689.23	
12	5	4	92	141	.63	1.7	691.61	
15	6	4	93	140	.62	1.7	693.98	
18	7	4	94	140	.55	1.4	696.38	
21	8	4	95	140	.55	1.4	698.64	
24	9	5	96	140	.88	2.2	700.85	
27	10	5	97	139	1.0	2.5	703.34	
30	11	5	97	138	.80	2.1	705.05	
33	12	5	98	137	.88	2.2	708.74	
12:09 36	Shut Down		Change Parts				711.41	Stop
12:15 0	B1	6	99	139	1.0	2.5	711.41	Begin
3	2	6	100	139	1.1	2.6	713.11	
6	3	6	100	138	1.1	2.6	716.93	
9	4	6	101	141	1.1	2.6	719.98	
12	5	6	101	141	1.0	2.5	722.82	
15	6	6	104	140	.72	2.0	725.71	
AVERAGE/NET								

LEAK RATES:
Start @ .008 @ 12
End .009 @ 11
Pitot:
Start
A 4.3 B. 5.1 dk
End
A 4.0 B. 5.3 dk

SETUP:
g ____
See Run 1
t_m ____
% H_2O ____
NOZZLE ____
C ____
t ____
Theo. Pitot ____

NOTES:
137 PSI
Inlet water Pressure to Scubber

ANALYTICAL TESTING CONSULTANTS, INC.
Kannapolis, N. C. Atlanta, Ga.

MODULE SAMPLING DATA SHEET

CLIENT Triangle Paving DATE 11-14-90

LOCATION Burlington SOURCE Scrubber

TEST TEAM TP BS JM RUN # 3

TIME	POINT	LINE VAC	t_m °F	t_s °F	V_p H_2O	P_m H_2O	V_m ft^3	REMARKS
14	7	5	104	138	.35	.99	728.39	
21	8	4	104	138	.30	.83	730.41	
24	9	4	105	137	.28	.72	732.09	
27	10	3	105	137	.22	.56	733.67	
30	11	3	105	134	.20	.56	735.05	
33	12	3	105	134	.20	.56	736.46	
12:51 36	Shut Down End Test ←						737.86	
			2350	3312		41.72		
AVERAGE/NET			97.9	138	19.1521	1.74	56.06	

NOTES:

P_{bar} _____

P_s _____

MODULE _____

FILTER _____

NOZZLE _____

PITOT _____

METHOD _____

LEAK RATES:
Start @ _____
End @ _____
Pitot:
Start
A ____ B ____
End
A ____ B ____

SETUP:
g _____
t_m _____
% H_2O _____
NOZZLE _____
C _____
t_s _____
Theo. Pitot _____

ANALYTICAL TESTING CONSULTANTS, INC.

IMPINGER DATA SHEET

JOB Triangle Paving LOCATION Burlington, NC UNIT Scrubber

RUN #		DATE	CYCLONE	CONTENTS OF IMPINGERS 1	2	3	4 (cc)	TOTAL CONDENSATE V_{lc} EPA (OR V_w) WP-50	LOCATION & REMARKS
1	START	11/14/90		100 ml H_2O	100 ml H_2O	0	300 g SiO_2		
	END			315	114	2	316		
	Δ			215	14	2	16	247 ml	
2	START	11/14/90		100 ml H_2O	100 ml H_2O	0	300 g SiO_2		
	END			302	112	2	312.8		
	Δ			202	12	2	12.8	228.8 ml	
3	START	11/14/90		100 ml H_2O	100 ml H_2O	0	300 g SiO_2		
	END			302	101	1	316.9		
	Δ			202	1	1	16.9	220.9 ml	
	START								
	END								
	Δ							ml	
	START								
	END								
	Δ							ml	

80% IPA - Δwt = 8.4.8 g
3% H_2O_2 - " = 44.8 g
1.00 ml

Data by S. Meadows Approved by

(11)

ANALYTICAL TESTING CONSULTANTS, INC.

TEMPERATURE DATA

JOB Triangle Paving LOCATION Burlington, NC UNIT Scrubber Exhaust

DATE 11-14-90 MADE BY Meadows CHECKED BY _____

Run # 1				Run # 2				Run # 3			
Time or Pt.	Probe Temp. F.	"Hot Box" Temp. F.	Exit Gas Temp. F.	Time or Pt.	Probe Temp. F.	"Hot Box" Temp. F.	Exit Gas Temp. F.	Time or Pt.	Probe Temp. F.	"Hot Box" Temp. F.	Exit Gas Temp. F.
1	good	245	52	A 1	good	245	60	A 1	good	240	60
2		250	52	2		245	60	2		245	58
3		250	52	3		250	58	3		245	58
4		255	52	4		250	58	4		250	60
5		255	54	5		255	58	5		250	60
6		260	54	6		255	58	6		254	60
7		260	54	7		260	58	7		255	60
8		260	56	8		260	59	8		260	60
9		260	56	9		260	59	9		260	60
10		255	56	10		265	59	10		260	61
11		255	56	11		265	60	11		260	61
12		260	58	12		265	60	12		265	61
B 1		260	58	B 1		270	60	B 1		255	61
2		260	58	2		270	62	2		255	61
3		260	58	3		265	62	3		260	61
4		255	60	4		265	64	4		260	62
5		260	60	5		265	64	5		260	62
6		265	60	6		265	64	6		265	63
7		265	60	7		260	63	7		265	63
8		265	62	8		260	63	8		270	63
9		270	62	9		260	62	9		265	63
10		270	62	10		255	62	10		265	64
11		270	62	11		255	62	11		265	64
12				12				12		260	64

(21)

ANALYTICAL TESTING CONSULTANTS, INC.

GAS ANALYSIS DATA FOR EPA 3A

DATE: 11-14-90 ANALYST: T. Parker / Meadows

CLIENT: Triangle Paving SOURCE: Scrubber Exhaust

CALIBRATION DATA

INSTRUMENTS Fyrite/

CAL GAS	OXYGEN %	INST. READING
HI PURITY N_2	0%	
AIR	20.95%	
11.0% O_2	11.0%	

CARBON DIOXIDE BY FYRITE

SAMPLE DATA

RUN 1 SAMPLE TYPE: ✓ GRAB ____INTEGRATED ____CONTINUOUS

POINT	CO_2 %	O_2 %	N_2 %	OTHER____ % PPM	REMARK
1	6.5	14.5			
2	6.5	14.5			
3	6.5	14.5			
4	6.0	15.0			
5	6.0	15.0			
6	6.5	14.5			
7	6.5	14.5			
8	6.0	15.0			
9	6.0	15.0			
10	6.0	15.0			
11	6.5	14.5			
12	6.5	14.5			
	75.5	176.5			
AVERAGE	6.29	14.71	79		

ANALYTICAL TESTING CONSULTANTS, INC.

GAS ANALYSIS DATA FOR EPA 3A

DATE: 11/14/90 ANALYST: Meadows

CLIENT: Triangle Paving SOURCE: Scrubber Exhaust

CALIBRATION DATA

INSTRUMENTS Fyrite

CAL GAS	OXYGEN %	INST. READING
HI PURITY N_2	0%	
AIR	20.95%	
11.0% O_2	11.0%	

CARBON DIOXIDE BY FYRITE

SAMPLE DATA

RUN 2 SAMPLE TYPE: ____ GRAB ____INTEGRATED ____CONTINUOUS

POINT	CO_2 %	O_2 %	N_2 %	OTHER____ % PPM	REMARK
1	6.0	15.0			
2	6.0	15.0			
3	5.5	15.5			
4	6.0	15.0			
5	6.0	15.0			
6	6.0	15.0			
7	5.5	15.5			
8	5.5	15.5			
9	6.0	15.0			
10	6.0	15.0			
11	6.5	14.5			
12	6.0	15.0			
	76.5	181			
AVERAGE	6.38	15.08	78.54		

ANALYTICAL TESTING CONSULTANTS, INC.

GAS ANALYSIS DATA FOR EPA 3A

DATE: 11/14/90 ANALYST: Meadows

CLIENT: Triangle Paving SOURCE: Scrubber Exhaust

CALIBRATION DATA

INSTRUMENTS Fyrite

CAL GAS	OXYGEN %	INST. READING
HI PURITY N_2	0%	
AIR	20.95%	
11.0% O_2	11.0%	

CARBON DIOXIDE BY FYRITE

SAMPLE DATA

RUN 3 SAMPLE TYPE: ✓ GRAB ____INTEGRATED ____CONTINUOUS

POINT	CO_2 %	O_2 %	N_2 %	OTHER____ % PPM	REMARK
1	6.0	15.0			
2	6.0	15.0			
3	6.5	14.5			
4	6.5	14.5			
5	6.0	15.0			
6	6.0	15.0			
7	5.5	15.5			
8	5.5	15.5			
9	6.0	15.0			
10	6.0	15.0			
11	6.0	15.0			
12	6.0	15.0			
	72	180			
AVERAGE	6.0	15.0	79		

ANALYTICAL TESTING CONSULTANTS, INC.

CHAIN OF CUSTODY FORM

Plant Triangle Paving

Run No. R1, R2, R3

Sampling Location Burlington, NC

Filter No. B982, B986, B987

Test Method

☑ EPA 5 ☐ EPA 8

☐ EPA 6 ☐ _____

☐ EPA 7 ☐ _____

Container No.	Contents	Sample Recovered by	Remarks
B982, B986, B987	Filter	TP	
R1, R2, R3 ____-Dry Catch Wash	Probe, nozzle and cyclone washings & Filter Bell Top	SM	
Imp R1, R2, R3 ____-Wet Catch Solution	Impinger solutions	TP	Measured & Discarded.
____-Wet Catch Wash	Impinger washings	SM	Discarded.
Imp R1, R2, R3	Silica gel	TP	
Blank	Solvent blank	SM	

Note: Liquid levels to be marked with grease pencil on all sample containers and to be checked when delivered to lab.

Delivered to lab by: Brent Snider Date 11-14-90

Received in lab by: Keith Poole Date 11-14-90

Analysis completed by Keith Poole Date 11/15/90

ANALYTICAL TESTING CONSULTANTS

SOURCE SURVEY AND DESCRIPTION

SYSTEM TYPE: ____BOILER ✓ PROCESS ____OTHER

NARRATIVE DESCRIPTION: Scrubber Exhaust / Asphalt

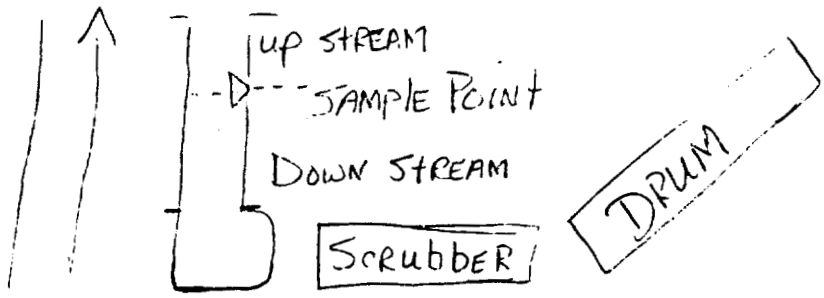
PURPOSE OF TESTING: ✓ COMPLIANCE ____EVALUATION

PROCESS RATE OR CAPACITY: _____ DETERMINED BY: _____

CONTROL EQUIPMENT: ✓ SCRUBBER ____ ESP ____ BAGHOUSE
____ OTHER _____

CONTROL EQUIPMENT OPERATING PARAMETERS: PRESSURE DROP _____
OTHER _____

SAMPLING LOCATION DATA:
DISTANCE DOWNSTREAM FROM FLOW DISTRUBANCE: 8 ft 10 in
NATURE OF DISTURBANCE: BEND, (FAN), EXPANSION, BYPASS, DUCT,
OTHER _____
DISTANCE UPSTREAM FROM FLOW DISTURBANCE: 4 ft
NATURE OF DISTURBANCE: STACK EXHAUST, FAN, EXPANSION, DUCT,
OTHER Stack Exit
INDIVIDUAL STACK ____ COMMON STACK ____
STACK DIAMETER OR DIMENSIONS: 42"
NUMBER OF PORTS: 2 POINTS PER PORT: 12
SKETCH:



ESTIMATED TEMPERATURE: 150° ESTIMATED MOISTURE: _____
GAS COMPOSITION BY: (FYRITE,) OXYGEN METER, INSTRUMENTAL,
OTHER _____

LABORATORY:

SAMPLE RECOVERY: ATC LABORATORY ✓ CLEAN FIELD AREA _____
ATC VAN ____ OTHER _____

SAMPLE SHIPMENT: ✓ ATC VAN ____OTHER_____

SAMPLE ANALYSIS: ✓ ATC ____OTHER _____

FILTER MATERIAL: ____GELMAN A/E ✓ WHATMAN 934AH ____OTHER____

ANALYTICAL TESTING CONSULTANTS, INC.

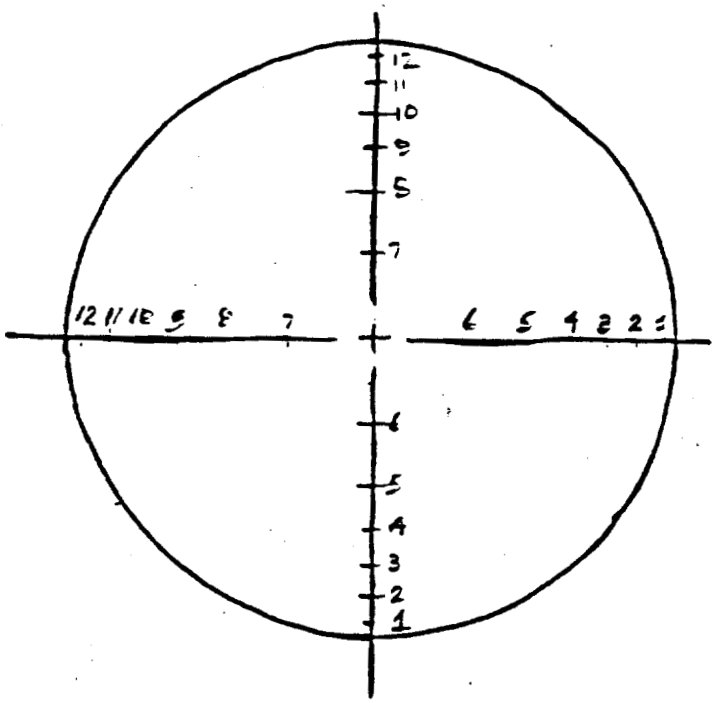
JOB Triangle Paving LOCATION Burlington NC. DATE 11-14-90

UNIT Scrubber MADE BY Parker CHECKED BY _____

Description EQUAL AREA CALCULATIONS

ROUND DUCT - TWELVE POINT TRAVERSE PER DIAMETER

Port depth = 5"



STACK I.D = 42 IN.		
POINT NO.	% OF DIAMETER	DISTANCE (INCHES)
1	2.1	.88
2	6.7	2.81
3	11.8	4.96
4	17.7	7.43
5	25.0	10.5
6	35.5	14.91
7	64.5	27.09
8	75.0	31.5
9	823	34.57
10	88.2	37.04
11	93.3	39.19
12	97.9	41.12

Triangle Paving
Burlington N.C.
11-14-90

Beakers

Run #	Beaker #	Initial	Final	Net
1	BS1	79.8679	79.8908	.0229
2	BS2	80.7217	80.7350	.0133
3	BS3	80.1324	80.1460	.0136
Blank	BS4	82.6455	82.6465	.0010

Filters

Run #	Filter #	Initial	Final	Net
1	B982	.3482	.4468	.0986
2	B986	.3506	.4200	.0694
3	B987	.3489	.4263	.0774

Totals

Run	Beaker	Filter	Net
1	.0229	.0986	.1215
2	.0133	.0694	.0827
3	.0136	.0774	.0910

T. Parker
11-14-90

ANALYTICAL TESTING CONSULTANTS, INC

BAROMETER #1 CALIBRATION

DATE/TIME	STATION PRES.	BAR. READING	ADJUSTMENT	INIT
2/01/89	29.61	29.59	.02	WDF
3/01/89	29.45	26.42	.03	WDF
4/03/89	29.29	29.28	.01	WDF
5/01/89	29.10	29.11	.11	WDF
8/18/89	29.35	29.40	.05	WDF
9/01/89	29.22	29.25	.03	WDF
10/01/89	29.23	29.23	0	WDF
11/01/89	29.46	29.40	.06	WKP
12/01/89	29.21	29.20	.01	WKP
01/01/90	29.73	29.73	0	WKP
02/01/90	29.54	29.47	.07	WKP
03/01/90	29.69	29.71	.02	CDM
04/02/90	28.84	28.84	0	WKP
05/01/90	29.64	29.64	0	WDF
06/11/90	29.77	29.77	0	WDF
07/10/90	29.31	29.27	.04	WKP
08/09/90	29.90	29.91	.01	WKP
09/05/90	30.25	30.25	0	WKP
10/12/90	29.26	29.22	.04	TP
11/12/90	29.86	29.87	.01	TP

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? ✓ yes _____ no

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

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

β_2 = 0 ° (<5°)

γ = 0 °, θ = 0 °, A = 1.0 ~~cm~~ (in.)

z = A sin γ = 0 ~~cm~~ (in.); <0.32 cm (<1/8 in.),

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

P_A .50 ~~cm~~ (in.) P_b .50 ~~cm~~ (in.)

D_t = 3/8 ~~cm~~ (in.)

Comments: _____

_____

_____

Calibration required? ____ yes ✓ no

K Poole
3/20/90

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? ✓ yes _____ no

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

α_1 = 1 ° (<10°), α_2 = 0 ° (<10°), β_1 = 2 ° (<5°),
β_2 = 3 ° (<5°)

γ = 0 °, θ = 1 °, A = 1.3 ~~cm~~ (in.)

z = A sin γ = 0 ~~cm~~ (in.); <0.32 cm (<1/8 in.),
w = A sin θ = < 1/64 ~~cm~~ (in.); <.08 cm (<1/32 in.)

P_A .65 cm (in.) P_b .65 cm (in.)

D_t = 3/8 ~~cm~~ (in.)

Comments: _____

Calibration required? ____ yes ✓ no

K Pob
3/20/90

#53

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? ✓ yes _____ no

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

α_1 = 0 ° (<10°), α_2 = 1 ° (<10°), β_1 = 1 ° (<5°),

β_2 = 0 ° (<5°)

γ = 0 °, θ = 0 °, A = 1.1 cm (in.)

z = A sin γ = 0 cm (in.); <0.32 cm (<1/8 in.),

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

P_A .60 cm (in.) P_b .60 cm (in.)

D_t = 3/8 cm (in.)

Comments: _____

_____

_____

Calibration required? ____ yes ✓ no

K Pace 3/20/90

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 3/20/90 Thermocouple number 51

Ambient temperature 75 °F Barometric pressure — in. Hg

Calibrator Rob Reference: mercury-in-glass ✓

other

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature, °F	Temperature difference,[c] %
	Refrigerator	39°	39°	
	Ambient	75°	75°	
	Thelco Oven	120	120	
		160	160	
		183	183	
		214	214	
		265	264	<1%
		310	309	<1%
		361	360	<1%

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

[b] Type of calibration system used.

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

Quality Assurance Handbook

Calibration Data Handbook Page 3

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 3/20/90 Thermocouple number 52

Ambient temperature 75 °F Barometric pressure — in. Hg

Calibrator Pale Reference: mercury-in-glass ✓

other*

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature, °F	Temperature difference,[c] %
	Refrigerater	39°	39°	
	AMBIENT	75°	75°	
	Thelco OVEN	120	120	
		160	160	
		183	183	
		214	214	
		265	265	
		310	310	
		361	360	<1%

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

[b] Type of calibration system used.

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

Quality Assurance Handbook

Calibration Data Handbook Page 3

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 3/20/90 Thermocouple number 53

Ambient temperature 75 °F Barometric pressure — in. Hg

Calibrator Rob Reference: mercury-in-glass ✓

other

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature, °F	Temperature difference,[c] %
	Refrigerator	39°	39°	
	Ambient	75°	75°	
	Thelco Oven	120	120	
		160	160	
		183	183	
		214	214	
		265	265	
		310	308	<1%
		361	360	<1%

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

[b] Type of calibration system used.

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

NOZZLE CALIBRATION DATA

NOZZLE #	DIAMETER ONE	DIAMETER TWO	DIAMETER THREE	DIAMETER FOUR	DIAMETER FIVE	DIAMETER SIX
31	0.173	0.173	0.174	0.173	0.172	0.173
32	0.19	0.19	0.191	0.191	0.19	0.19
33	0.191	0.191	0.191	0.19	0.19	0.191
34	0.192	0.192	0.191	0.191	0.192	0.193
35	0.19	0.19	0.19	0.191	0.191	0.189
36	0.192	0.192	0.191	0.193	0.191	0.19
37	0.2	0.201	0.199	0.2	0.201	0.2
38	0.2	0.2	0.201	0.199	0.2	0.2
41	0.25	0.25	0.25	0.25	0.25	0.25
42	0.25	0.25	0.25	0.25	0.25	0.25
43	0.25	0.25	0.25	0.25	0.25	0.25
44	0.25	0.25	0.25	0.25	0.25	0.251
45	0.25	0.25	0.249	0.25	0.249	0.25
46	0.25	0.25	0.25	0.25	0.249	0.25
47	0.252	0.251	0.25	0.251	0.251	0.25
48	0.25	0.25	0.25	0.25	0.25	0.25
51	0.3	0.3	0.3	0.3	0.3	0.3
52	0.3	0.3	0.3	0.3	0.3	0.3
53	0.312	0.312	0.312	0.313	0.311	0.312
54	0.312	0.312	0.313	0.312	0.312	0.312
55	0.313	0.312	0.312	0.312	0.312	0.313
56	0.3	0.3	0.3	0.3	0.3	0.3
57	0.3	0.3	0.3	0.3	0.3	0.3
58	0.312	0.312	0.312	0.312	0.312	0.313
59	0.312	0.312	0.312	0.313	0.313	0.313
61	0.375	0.375	0.375	0.375	0.375	0.376
62	0.375	0.375	0.375	0.374	0.375	0.375
63	0.377	0.375	0.375	0.375	0.375	0.376
64	0.377	0.376	0.375	0.375	0.375	0.375
65	0.375	0.375	0.375	0.376	0.376	0.376
66	0.374	0.375	0.375	0.375	0.374	0.374
67	0.375	0.375	0.375	0.375	0.375	0.375
71	0.44	0.44	0.44	0.44	0.44	0.44
72	0.44	0.44	0.44	0.44	0.44	0.44
81	0.5	0.5	0.5	0.501	0.501	0.501
82	0.502	0.502	0.502	0.5	0.5	0.5
83	0.5	0.5	0.5	0.501	0.502	0.501
84	0.5	0.502	0.502	0.5	0.501	0.499
85	0.502	0.501	0.501	0.501	0.502	0.502
86	0.502	0.501	0.501	0.501	0.501	0.5
87	0.5	0.5	0.5	0.5	0.5	0.5
88	0.5	0.5	0.5	0.5	0.5	0.5

NOZZLE CALIBRATION DATA

NOZZLE #	DIAMETER SEVEN	DIAMETER EIGHT	DIAMETER NINE	DIAMETER TEN	AVERAGE
31	0.173	0.174	0.173	0.174	0.1732
32	0.19	0.191	0.189	0.19	0.1902
33	0.19	0.19	0.191	0.191	0.1906
34	0.192	0.193	0.193	0.192	0.1921
35	0.19	0.19	0.191	0.192	0.1904
36	0.193	0.192	0.192	0.192	0.1918
37	0.201	0.2	0.199	0.199	0.2
38	0.201	0.2	0.2	0.2	0.2001
41	0.25	0.25	0.25	0.25	0.25
42	0.25	0.25	0.25	0.25	0.25
43	0.25	0.25	0.25	0.25	0.25
44	0.25	0.25	0.251	0.251	0.2503
45	0.249	0.249	0.249	0.25	0.2495
46	0.25	0.249	0.25	0.25	0.2498
47	0.25	0.251	0.251	0.251	0.2508
48	0.25	0.25	0.25	0.25	0.25
51	0.3	0.3	0.3	0.3	0.3
52	0.3	0.3	0.3	0.3	0.3
53	0.313	0.312	0.312	0.312	0.3121
54	0.312	0.312	0.312	0.312	0.3121
55	0.313	0.313	0.313	0.312	0.3125
56	0.3	0.3	0.3	0.3	0.3
57	0.3	0.3	0.3	0.3	0.3
58	0.313	0.313	0.313	0.312	0.3124
59	0.313	0.313	0.312	0.312	0.3125
61	0.376	0.376	0.375	0.375	0.3753
62	0.375	0.375	0.375	0.374	0.3748
63	0.376	0.376	0.375	0.375	0.3755
64	0.375	0.375	0.374	0.374	0.3751
65	0.374	0.375	0.375	0.375	0.3752
66	0.375	0.374	0.375	0.375	0.3746
67	0.375	0.375	0.375	0.375	0.375
71	0.44	0.44	0.44	0.44	0.44
72	0.44	0.44	0.44	0.44	0.44
81	0.501	0.5	0.5	0.5	0.5004
82	0.502	0.501	0.501	0.501	0.5011
83	0.502	0.5	0.5	0.501	0.5007
84	0.5	0.5	0.5	0.501	0.5005
85	0.501	0.501	0.5	0.5	0.5011
86	0.5	0.5	0.5	0.501	0.5007
87	0.5	0.5	0.5	0.5	0.5
88	0.5	0.5	0.5	0.5	0.5

PRIMARY MODULE CALIBRATION CALCULATION

DATE 3/19/90
P BAR 29.76
MODULE ID NUT #1
BY POOLE

ORIFICE	Vw	Vd	Tw	Td	TIME	D H@	Y
0.5	4.04	4.05	73	73	10	1.739245	0.996300
1	5.8	5.83	73	74	10	1.684548	0.994264
1.5	7.05	7.09	73	74	10	1.710222	0.992545
2	8.35	8.38	73	75	10	1.622497	0.995240
3	9.79	9.83	73	77	10	1.763852	0.996022
						1.704073	0.994874

4:21:46	0	2865	6705	6705	0	381	381	21391
4:22:44	0	2865	6705	6705	0	381	381	28477
4:23:55	0	2880	6725	6725	0	383	383	35585

Load #	Load Total	Job Total	Time & Date	Fob/Del	Location
39	35585	754.00	4:24:42 pm Aug 23, 1990	F	RALEIGH

NELLO L. TEER CO.

PLANT 4

Customer: NELLO L.TEER CO.
Job: NELLO L. TEER CO.
Cust# 1 Ticket # 667155
Job# 1
Truck# MF143 Operator
Mix# HDS
Name HEAVY DUTY SURFACE

Time	Agg T	AGG 2	AGG 1	Agg Total	Asp T	ASP A	Asp Total	Batch Total
Target		2800	6527			373		6900
4:25:44	0	3095	6585	6585	0	373	373	6878
4:26:28	0	2900	6645	6645	0	374	374	13897
4:27:17	0	2785	6535	6535	0	372	372	20804
4:28:18	0	2735	6510	6510	0	370	370	27684
4:29:24	0	2760	6635	6635	0	377	377	34696

Load #	Load Total	Job Total	Time & Date	Fob/Del	Location
40	34696	771.35	4:30:08 pm Aug 23, 1990	F	RALEIGH

NELLO L. TEER CO.

PLANT 4

Customer: NELLO L.TEER CO.
Job: NELLO L. TEER CO.
Cust# 1 Ticket # 667156
Job# 1
Truck# MF135 Operator
Mix# HDS
Name HEAVY DUTY SURFACE

Time	Agg T	AGG 2	AGG 1	Agg Total	Asp T	ASP A	Asp Total	Batch Total
Target		3188	7410			423		7833
4:31:28	0	3475	7495	7495	0	419	419	7914