AP42 Section:	11.7
Reference:	30
Title:	Stationary Source Sampling Report Reference No. 6445, Lead And Particulate Emissions Testing, Spray Booth 2A Stack, Entropy Environmentalists, Inc., Research Triangle Park, NC, September 20, 1989.

AP-42 Section 11.7
Reference 30
Report Sect. 4
Reference 28

ENTROPY

ENVIRONMENTALISTS INC.

POST OFFICE BOX 12291
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709-2291
919-781-3550

STATIONARY SOURCE SAMPLING REPORT

REFERENCE NO. 6445

MANNINGTON CERAMIC TILE, INC.

LEXINGTON, NORTH CAROLINA

LEAD AND PARTICULATE EMISSIONS TESTING

SPRAY BOOTH 2A STACK

SEPTEMBER 20, 1989

DIVISION OF ENVIRONMENTAL MANAGEMENT

Air Quality Section

June 20, 1991

MEMORANDUM

To: Myron Whitley

From: Shannon M. Vogel

Subject: Mannington Ceramic Tile
Mid-State Tile Company
Lexington, Davidson County, North Carolina
Particulate and Lead Emissions Testing of Spray Booth No. 2A
Performed on August 20, 1989 by
Entropy Environmentalists Inc.

A report of the subject testing has been reviewed and is found to be acceptable. The results appear reliable and demonstrate that compliance with the applicable particulate emission standard was achieved during the test period.

The emission standard that applies to the subject facility is 15A NCAC 2D .0515, PARTICULATES FROM MISCELLANEOUS INDUSTRIAL PROCESSES, which limits particulate emissions according to process rates.

No maximum process rate is stated in permit No. 5408R for spray booth 2A. The production rate during testing was 4425 pounds per hour, for which the allowable particulate emission rate is 3.98 pounds per hour. The average particulate emission rate demonstrated by the test results was 3.86 pounds per hour.

Compliance for particulate is demonstrated.

cc: Central File via Earl McCune
Mike Aldridge

NORTH CAROLINA DIVISION OF ENVIRONMENTAL MANAGEMENT

Air Quality Action Request

Computer ____

Name	Location	Reg/Co./Prem. No.
Mannington Ceremic Tile	Lexington, Davidson Company	4-29-00097
Contact		Telephone
Mike Tkach, Plant Manager		

Type Action: CI ___ EE x SR ___ PC ___ VE ___ PI ___ Other Source Test

Air Program Status 03 ____ ____ ____ ____ Class B Chg ____

Action Requested By: Address/Phone Rec'd Date

Last Insp. Date ____ Action Date 9-20-89 Next Insp. Date ____

Permit # 5408R Issued ____ Expires 4-1-93 Stip. # ____ Met Y/N ____

Recommendations:	Signature	Date
Await Test Results		
Re-visit as previously scheduled	Stephen M. Moser	12-89

Dist: Yellow (Central File) - Blue (Region) - White (Opt.) Specify ____

On 9-20-89 Entropy Environmentalists Inc. performed a stack test on one of the glaze spray booths at Mannington Ceramic Tile. The company identifies the booth as No. 2-A and the booth was chosen for testing because the glaze mixture contains lead. The test is part of a testing program which will also contain high volume sampling as a measure to determine the facility's emissions and hopefully will reduce or eliminate the rash of complaints the company has recently experienced.

RECEIVED
NOV 27 1989
AIR QUALITY TECH SERVICES

In addition to Mike Tkach, the following people were contacted:

(1) Bill Piske, P.E. - Charles T. Main, Inc.
(2) Neill Hardin - Entropy, and
(3) Lee Marchmen - Entropy

During the test, a 30 minute visible emissions evaluation was performed on the stack which indicates compliance. The booth is a 20% source. The company has seven booths, Five are 20% sources and 2 are 40% sources. All appeared to comply. The booths and their respective opacity limits have been identified.

The testing I observed seemed acceptable. Source test data was obtained. The company has supplied process rates during the test. According to their figures, 4026 lbs/hr of tile and 399 lbs/hr. of glaze were processed in the booth, for a total of 4425 lbs per hour.

At the time of the testing, Mr. Bill Piske with Charles T. Main, Inc. (Mannington's consultant) asked how often, and for how long, the high volume sampling should be done. At the time I did not know. The next day I discussed this question with my supervisor and it was decided that modling would be preferable to monitoring, but if the company chose to do the monitoring anyway, the more frequent schedule, and the larger the better. I informed Mike Tkach of this by phone the next day.

mannington
CERAMIC TILE by MID-STATE

9-21-89

unglazed wt. 189.5 g/pc
glazed wt. 208.3 g/pc
glaze wt. 18.8 g/pc

7 am - 9:00 am 2 hr
9:15 am - 11:20 am 2 hr 5 min
11:50 am - 2:00 pm 2 hr 10 min

from 7 am - 2pm, 60,293 pcs. of tile were spray

60,293 X 189.5 g/pc = 25,166 lbs of unglazed tile

60,293 X 18.8 g/pc = 2,496 lbs of glaze

$\frac{25,166 \text{ lbs}}{6.25 \text{ hrs}}$ = 4,026 lbs/hr unglazed tile

$\frac{2,496 \text{ lbs}}{6.25 \text{ hrs}}$ = 399 lbs/hr glaze

Process rate 9-20-89
Spray booth 2A
308 g/glaze

SOURCE TEST
OBSERVERS CHECKLIST

N. C. Division of Environmental Management / Air Quality Section

Source Name: Mannington Ceramic Tile	Testing Firm: Entergy Environmental Systs.
Address: P.O. Box 1777 Lexington 27293	Address: P.O. Box 12291 RTP, NC 27709
Plant Location: 20 Victor St 27292	Phone: (919) 781-3550
Source Contact: Mike Tkach	Test Engineer: Neil Harden
Phone: 249-3931	Assistant: Lee Matthews

Other Personnel Involved	Affiliation
William E. Piske, P.E.	Chas. T. Main, Inc.

Process Description: Spray Booth #2-A - Lead Glaze
Process Rate During Test: 4425 lbs. per hour
Maximum Process Rate: 4425 lbs per hour
Burner Sizes (Incin.) Pri: ____ Sec: ____

Soot Blowing Parameters: N-A
A = ____ Hr B = ____ Hr
R = ____ Hr S = ____ Hr
A = Hours of soot blowing during sample(s)
B = Hours not soot blowing during sample(s) containing soot blowing
R = Average hours of operation per 24 hours
S = Average hours of soot blowing per 24 hours

TEST PARAMETERS

Duct Size: 20 inch
Distance Before Ports: 3ϕ
Distance After Ports: 3ϕ
Number of Test Points: 12 x 2
Number of Runs: 3
Sampling Time Per Run (min.): 60

Pollutant Sampled: Particulate
E. P. A. Method No.: 5
If method differs from E. P. A. method, explain:

For Method 5 sampling train record ΔH@ 1.714 Y .9803

	Run #1	Run #2	Run #3
Leakage Rate (ft^3/min.) (0.02 ft^3/min. or less)	0.001 P3 "Hg	0.001 P5 "Hg	0.000 P3 "Hg
Time Started (24 hr. Clock)	0827	1002	1258
Time Ended	0945	1104	1155
Test Date(s)	9/20/89	9/20/89	9/20/89

See Graph on Reverse Side For Number of Test Points.
Use Reverse Side for Comments.

Request 2 Copies of Report
OBSERVERS SIGNATURE

VISIBLE EMISSION OBSERVATION FORM

No. 1

COMPANY NAME: Mauvington Ceramic Tile
STREET ADDRESS: 20 Victor St
CITY: Lexington | STATE: NC | ZIP:
PHONE (KEY CONTACT): | SOURCE ID NO.:

PROCESS EQUIPMENT: Spray Booth | OPERATING MODE: Lead Glaze
CONTROL EQUIPMENT: | OPERATING MODE:

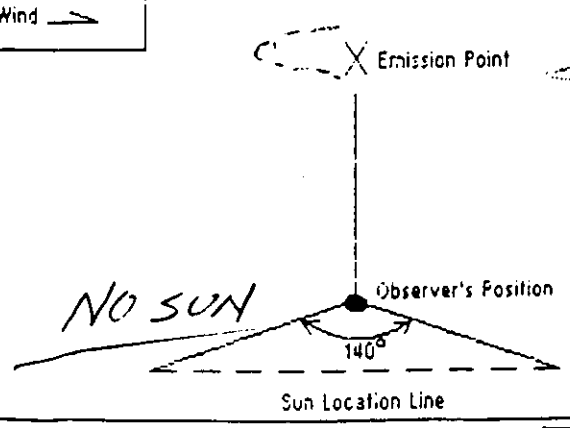
DESCRIBE EMISSION POINT: Spray Booth Stack on Roof of Plant
HEIGHT ABOVE GROUND: 30 | HEIGHT RELATIVE TO OBSERVER: Start 0 End 0
DISTANCE FROM OBSERVER: Start End | DIRECTION FROM OBSERVER: Start End

DESCRIBE EMISSIONS: Start Glaze Dust End —
EMISSION COLOR: Start White End — | IF WATER DROPLET PLUME: Attached ☐ Detached ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED: Start Stack Exit End —

DESCRIBE PLUME BACKGROUND: Start Trees End —
BACKGROUND COLOR: Start Green End — | SKY CONDITION: Start Cloudy End —
WIND SPEED: Start 5-10 End — | WIND DIRECTION: Start End
AMBIENT TEMP: Start 70°F End — | WET BULB TEMP: | RH, percent: 90% +5%

Stack with Plume
Sun
Wind

SOURCE LAYOUT SKETCH — Draw North Arrow



ADDITIONAL INFORMATION: 15 second intervals estimated

OBSERVATION DATE: 9-20-89 | START TIME: 1100 | END TIME: 1130

SEC / MIN	0	15	30	45	SEC / MIN	0	15	30	45
1	5	10	10	5	31				
2	10	10	5	5	32				
3	5	10	10	5	33				
4	5	10	5	5	34				
5	10	5	5	10	35				
6	10	5	5	5	36				
7	5	5	5	5	37				
8	5	10	10	10	38				
9	5	5	5	5	39				
10	5	10	5	5	40				
11	5	5	5	10	41				
12	5	10	10	5	42				
13	5	5	5	10	43				
14	5	5	5	5	44				
15	5	10	5	10	45				
16	5	10	5	10	46				
17	5	10	0	0	47				
18	0	0	5	5	48				
19	5	10	5	5	49				
20	5	5	5	5	50				
21	5	5	5	0	51				
22	10	5	5	5	52				
23	5	5	5	5	53				
24	5	5	5	5	54				
25	5	—	5	5	55				
26	5	5	5	—	56				
27	5	5	—	—	57				
28	0	5	0	0	58				
29	0	5	5	5	59				
30	0	0	0	5	60				

OBSERVER'S NAME (PRINT): Stephen M Moore
OBSERVER'S SIGNATURE: Stephen M Moore | DATE: 9-20-89
ORGANIZATION: NC Division of Env. Mgmt
CERTIFIED BY: | DATE:

CONTINUED ON VEO FORM NUMBER:

AQ-23 Rev. 11-20-87

State of North Carolina
Department of Natural Resources and Community Development
Winston-Salem Regional Office

James G. Martin, Governor

William W. Cobey, Jr., Secretary

DIVISION OF ENVIRONMENTAL MANAGEMENT

November 21, 1989

CERTIFIED MAIL NUMBER P-614 922 490
RETURN RECEIPT REQUESTED

Mr. Micheal Tkach, Plant Manager
Mannington Ceramic Tile
P.O. Box 1777
Lexington, N.C. 27293-1777

Dear Mr. Tkach:

Subject: Comments on Emissions Assessment Program
Mannington Ceramic Tile
Lexington, North Carolina
Davidson County

Reference is made to your program to assess the emissions from your facility and their impact on your neighbors. The following comments are offered:

1. The test report for the particulate and lead emissions stack test conducted September 20, 1989, on the spray booth 2A stack has been received at this office. A copy of the test report will be forwarded to our stack test unit in Raleigh for review. You will be notified of the results of that review when it is completed.

2. This office considers ambient dispersion modeling to be the most reliable method to predict the maximum pollutant impact from a facility. Due to the complaints received regarding your facility and our concern over the potential high level of emissions it is required that Mannington Ceramic Tile submit ambient dispersion modeling for total suspended particulate (TSP), particulate matter (PM_{10}) and lead. The modeling should address all significant sources of emission at Mannington Ceramic Tile as well as sources of significant emissions at neighboring facilities. Prior to modeling submittal, a modeling plan must be

submitted to this Division for approval. You should contact Mr. Kevin Eldridge, Air Quality Section Meteorologist, (919) 733-3340, to discuss modeling requirements and details of the modeling plan.

3. It is my understanding that Mannington Ceramic Tile has set up several particulate samplers. While the data from these samplers may be useful, the value of the data is limited unless the sampling program complies with Section 1.6 of "Procedures for Standard Operation and Quality Assurance" (QA Plan) (copy enclosed). If the QA plan is not followed, the data cannot be used to document compliance or noncompliance. If Mannington wishes to use the data for compliance purposes you should make sure that your sampling program meets the requirements of the QA plan.

4. There is no air permit for Mannington Ceramic Tile. Permit No. 5408R, which is the last permit issued that covers your equipment, was issued to Mid-State Tile Company. Mannington Ceramic Tile should request that Permit No. 5408R be reissued in its name, describing any changes or modifications that have occurred since its last issuance. A check for $25.00 should accompany the request.

Please submit the required information as soon as possible. If you have any questions, please call Steve Moser or me.

Sincerely,

Myron G. Whitley
Regional Engineer
Air Quality Section

MGW/ahl

cc: Lee Daniel
Kevin Eldridge
Mike Aldridge
Jim Critopoulos - EPA

TABLE OF CONTENTS

INTRODUCTION

1.1 Outline of Test Program. Stationary source sampling was performed for Mannington Ceramic Tile, Inc. at their facility in Lexington, North Carolina on September 20, 1989. Three sets of combined EPA Methods 5 and 12 runs were performed at the spray booth 2A stack to determine the lead and particulate emissions.

1.2 Test Participants. Table 1-1 lists the personnel present during the test program.

TABLE 1-1

TEST PARTICIPANTS

Mannington Ceramic Tile, Inc.	Michael Tkach Test Coordinator
North Carolina Dept. of Environment, Health, and Natural Resources	Steve Moser Test Observer
Entropy Environmentalists Inc.	Neill M. Harden Project Manager
	R. Lee Marchman Engineering Technician

SUMMARY OF RESULTS

2.1 Presentation. Table 2-1 summarizes the results of lead and particulate emissions testing performed on September 20, 1989, at the spray booth 2A stack. Detailed test results are presented in Appendix A; field and analytical data are given in Appendix B.

2.2 Cyclonic Flow Check. Prior to testing, a cyclonic flow check was performed at the spray booth 2A stack to determine if any cyclonic flow existed at the sampling location. An average yaw angle of less than 2° was measured, indicating an acceptable location with respect to EPA Method 1 requirements.

2.3 Average Emission Rates. The average lead and particulate emission rates for the test program were 0.599 and 3.86 pounds per hour, respectively.

TABLE 2-1

LEAD AND PARTICULATE TESTS SUMMARY

Spray Booth 2A Stack

	M5&12-1	M5&12-2	M5&12-3
Run Date	8/20/89	9/20/89	9/20/89
Run Start Time	827	1002	1155
Run Finish Time	945	1104	1258
Test Train Parameters:			
Volume Of Dry Gas Sample, SCF *	44.230	44.410	49.730
Percent Isokinetic	100.9	100.0	101.9
Flue Gas Parameters:			
Temperature, °F	78	77	74
Air Flow Rate, Dry SCFM *	4,225	4,555	4,705
Air Flow Rate, Wet ACFM	4,502	4,881	5,019
Lead:			
Concentration, ppmvd	4.63	3.92	3.87
Emission Rate, lb/hr	0.632	0.577	0.588
Filterable Particulate:			
Concentration, grains/DSCF *	0.111	0.0950	0.0951
Emission Rate, lb/hr	4.03	3.71	3.84

* 68° F -- 29.92 Inches of Mercury (Hg).

PROCESS DESCRIPTION AND OPERATION

3.1 General. Mannington Ceramic Tile, Inc. sprays glaze on ceramic tile at their facility in Lexington, North Carolina.

3.2 Source Air Flow. Figure 3-1 is an air flow schematic which shows the passage of flue gases exhausted from spray booth 2A.

3.3 Operation During Testing. The production rate during testing was 4,026 lb/hr of tile and 399 lb/hr of glaze. Process data supplied by Mannington is presented in Appendix D.

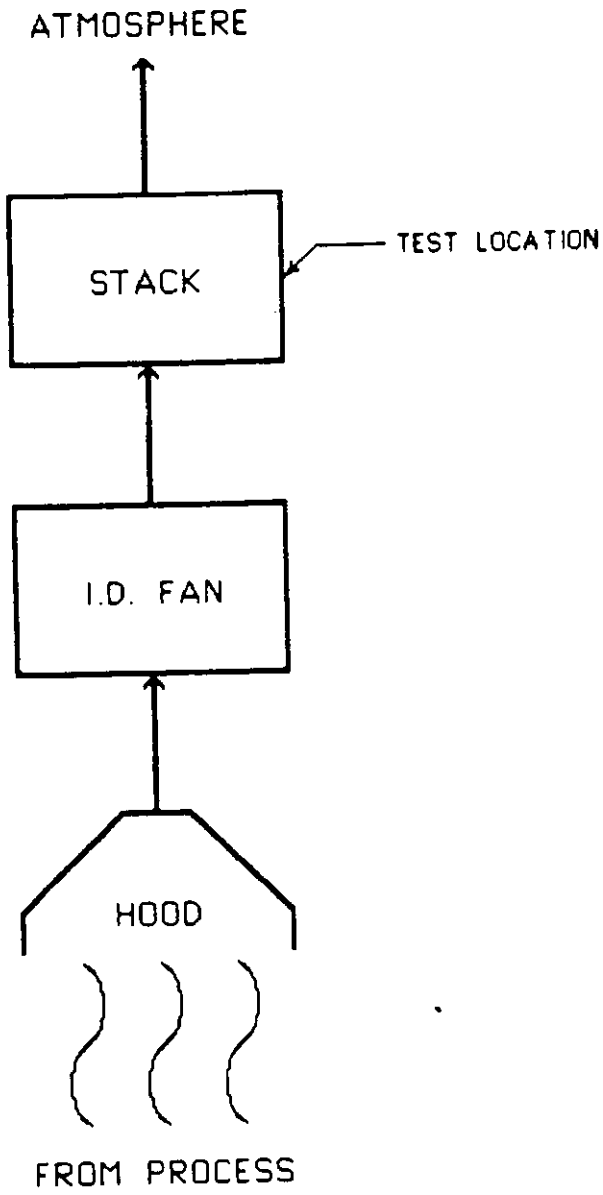


FIGURE 3-1. SPRAY BOOTH 2A AIR FLOW SCHEMATIC.

SAMPLING AND ANALYTICAL PROCEDURES

4.1 General. All sampling and analytical procedures were those recommended by the United States Environmental Protection Agency and the North Carolina Department of Environment, Health, and Natural Resources. This section provides brief descriptions of the sampling and analytical procedures. Detailed descriptions of the procedures are provided in Appendix E.

4.2 Sampling Points. The number and location of the sampling points were determined according to EPA Method 1. The stack cross section was divided into 24 equal areas with 12 sampling points on each of two traverse axes, as shown in Figure 4-1.

4.3 Cyclonic Flow Check. A Type S pitot tube assembly, Magnehelic gauges, and a universal protractor (angle finder) were used to determine the nonvertical flow angles at each of the 24 points. At each point, the pitot tube was positioned at a right angle to vertical. The angles were determined by rotating the pitot tube until a null reading was obtained on the Magnehelic gauges. When the null reading was obtained, the angle of the pitot tube was recorded.

4.4 Volumetric Air Flow Rates

4.4.1 Flue Gas Velocity. EPA Method 2 was used to take the velocity measurements during the traverses of the stack cross section.

4.4.2 Flue Gas Composition. The flue gas composition and molecular weight were assumed to be that of ambient air.

4.4.3 Flue Gas Moisture. Moisture content was determined by analyzing the sampling train impinger reagents according to the procedures outlined in EPA Method 5.

4.5 Emissions Determinations. A combined EPA Methods 5 and 12 sampling train was used to determine the lead and particulate emissions. The sampling train was modified by using 100 ml of 0.1 N nitric acid in the first and second impingers. The particulate analysis was performed according to EPA Method 5. The lead analysis was performed according to EPA Method 12. Each of the 24 points was sampled for 2.5 minutes, resulting in net run times of 60 minutes.

4.6 Equipment Calibration. Pertinent calibration data are provided in Appendix C.

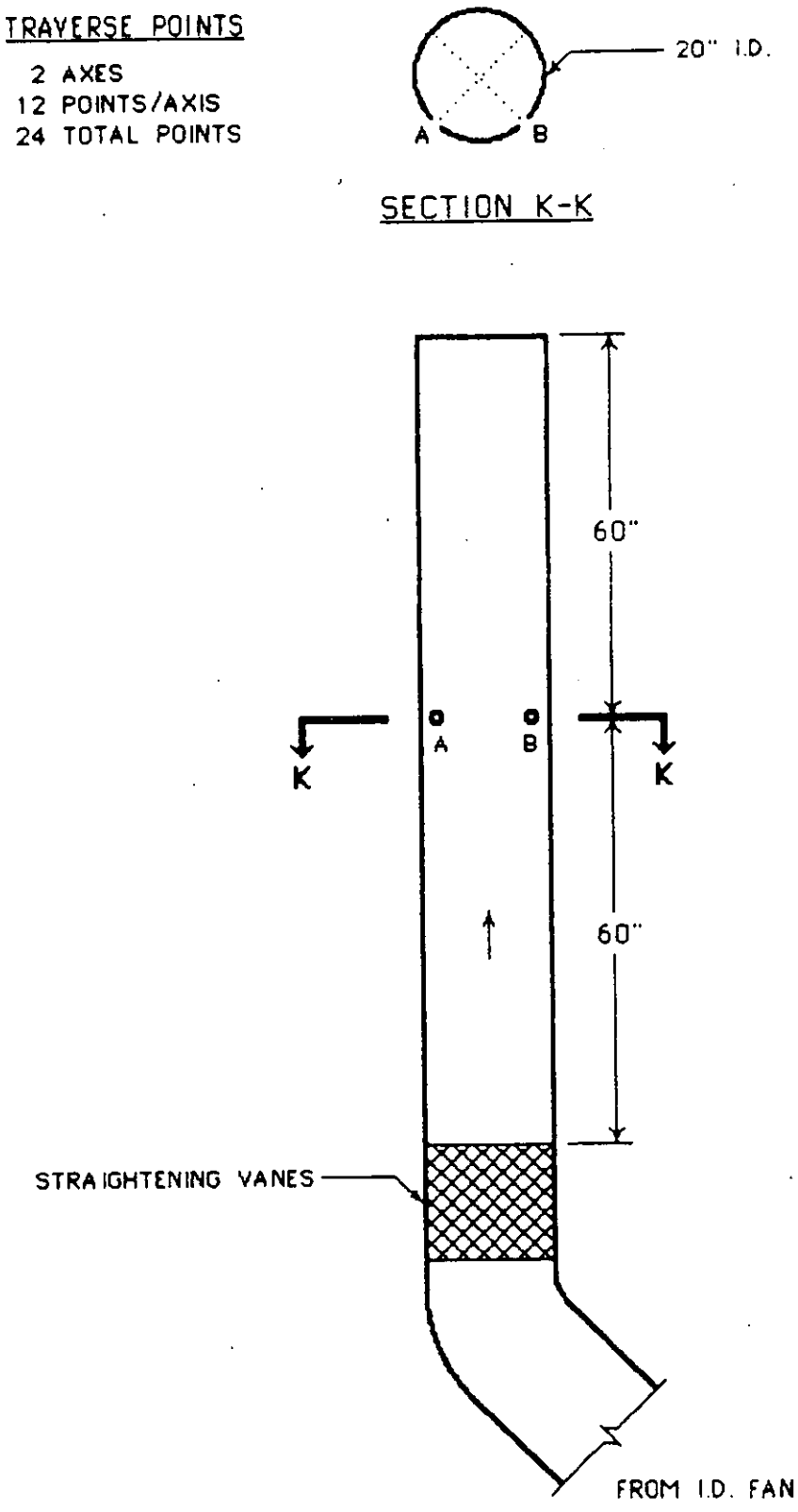


FIGURE 4-1. SPRAY BOOTH 2A STACK TEST LOCATION.

APPENDIX A

TEST RESULTS AND EXAMPLE CALCULATIONS

FIELD DATA AND RESULTS TABULATION

PLANT: Mannington Ceramic Tile, Inc., Lexington, North Carolina

RUN #	DATE	SAMPLING LOCATION	OPERATOR
M5&12-1	8/20/89	Spray Booth 2A Stack	Neill M. Harden
M5&12-2	9/20/89	Spray Booth 2A Stack	Neill M. Harden
M5&12-3	9/20/89	Spray Booth 2A Stack	Neill M. Harden

		M5&12-1	M5&12-2	M5&12-3
	Run Start Time	827	1002	1155
	Run Finish Time	945	1104	1258
	Net Traversing Points	24	24	24
Theta	Net Run Time, Minutes	60.00	60.00	60.00
Dia	Nozzle Diameter, Inches	0.263	0.255	0.263
Cp	Pitot Tube Coefficient	0.840	0.840	0.840
Y	Dry Gas Meter Calibration Factor	0.9863	0.9863	0.9863
Pbar	Barometric Pressure, Inches Hg	29.20	29.20	29.20
Delta-H	Avg. Pressure Differential of Orifice Meter, Inches H_2O	1.85	1.88	2.30
Vm	Volume Of Metered Gas Sample, Dry ACF	48.008	49.940	55.572
tm	Dry Gas Meter Temperature, Degrees F	94	114	111
Vmstd	Volume Of Metered Gas Sample, Dry SCF*	44.230	44.410	49.730
Vlc	Total Volume of Liquid Collected in Impingers & Silica Gel, ml	19.5	26.0	30.5
Vwstd	Volume of Water Vapor, SCF*	0.918	1.224	1.436
$\%H_2O$	Moisture Content, Percent by Volume	2.0	2.7	2.8
Mfd	Dry Mole Fraction	0.980	0.973	0.972
Md	Gas Molecular Weight, lb/lb-Mole, Dry	28.84	28.84	28.84
Ms	Gas Molecular Weight, lb/lb-Mole, Wet	28.62	28.55	28.54
Pg	Flue Gas Static Pressure, Inches H_2O	-0.20	-0.15	-0.21
Ps	Absolute Flue Gas Pressure, Inches Hg	29.19	29.19	29.18
ts	Flue Gas Temperature, Degrees F	78	77	74
Delta-p	Average Velocity Head, Inches H_2O	0.3561	0.4182	0.4446
vs	Flue Gas Velocity, Feet/Second	34.39	37.28	38.34
A	Stack/Duct Area, Square Inches	314.2	314.2	314.2
Qsd	Volumetric Air Flow Rate, Dry SCFM*	4,225	4,555	4,705
Qaw	Volumetric Air Flow Rate, Wet ACFM	4,502	4,881	5,019
%I	Isokinetic Sampling Rate, Percent	100.9	100.0	101.9

* 68° F -- 29.92 Inches of Mercury (Hg)

(Continued next page)

PLANT: Mannington Ceramic Tile, Inc., Lexington, North Carolina

		M5&12-1	M5&12-2	M5&12-3
	Lead			
fwt	Formula Weight, lb/lb-Mole	207.19	207.19	207.19
mg	Catch Weight, Milligrams	50	42.5	47
ppmvd	Concentration, ppmvd	4.63	3.92	3.87
lb/hr	Emission Rate, lb/hr	0.632	0.577	0.588
	Filterable Particulate			
mg	Catch Weight, Milligrams	318.6	273.5	306.6
gr/DSCF	Concentration, grains/DSCF *	0.111	0.0950	0.0951
lb/hr	Emission Rate, lb/hr	4.03	3.71	3.84

* 68° F -- 29.92 Inches of Mercury (Hg)

EXAMPLE TEST CALCULATIONS RUN M5&12-1

Spray Booth 2A Stack

VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS

$$Vmstd = 17.64 * Y * Vm * \frac{Pbar + (Delta\ H/13.6)}{(460 + tm)}$$

$$Vmstd = 17.64 * 0.9863 * 48.008 * \frac{29.20 + (1.850/13.6)}{(460 + 94)} = 44.230 \text{ DSCF}$$

VOLUME OF WATER VAPOR AT STANDARD CONDITIONS

$$Vwstd = 0.04707 * Vlc$$

$$Vwstd = 0.04707 * 19.5 = .918 \text{ SCF}$$

PERCENT MOISTURE, BY VOLUME, AS MEASURED IN FLUE GAS

$$\%H_2O = 100 * Vwstd / (Vwstd + Vmstd)$$

$$\%H_2O = \frac{0.918}{0.918 + 44.230} * 100 = 2.0\ \%$$

ABSOLUTE FLUE GAS PRESSURE

$$Ps = Pbar + (Pg / 13.6)$$

$$Ps = 29.20 + (-0.20/13.6) = 29.19 \text{ inches Hg}$$

DRY MOLE FRACTION OF FLUE GAS

$$Mfd = 1 - \%H_2O / 100$$

$$Mfd = 1 - 2.0/100 = 0.980$$

DRY MOLECULAR WEIGHT OF FLUE GAS

$$Md = (\%CO_2/100 * 44) + (\%O_2/100 * 32) + ((100 - \%CO_2 - \%O_2)/100 * 28)$$

$$Md = (0.0/100 * 44) + (20.9/100 * 32) + ((100 - 0.0 - 20.9)/100 * 28)$$

$$Md = 28.84 \text{ lb/lb-Mole}$$

WET MOLECULAR WEIGHT OF FLUE GAS

$$Ms = (Md * Mfd) + (0.18 * \%H_2O)$$

$$Ms = (28.84 * 0.980) + (0.18 * 2.0) = 28.62 \text{ lb/lb-Mole}$$

AVERAGE FLUE GAS VELOCITY [Note: (Delta p)avg is square of average square root]

$$vs = 85.49 * Cp * \text{SQUARE ROOT}\left[\frac{(\text{Delta P})avg * (460 + ts)}{Ps * Ms}\right]$$

$$vs = 85.49 * 0.840 * \text{SQUARE ROOT}\left[\frac{0.3561 * (460 + 78)}{29.19 * 28.62}\right] = 34.39 \text{ ft/sec}$$

DRY VOLUMETRIC FLUE GAS FLOW RATE AT STANDARD CONDITIONS

$$Qsd = \frac{60}{144} * Mfd * vs * A * \frac{Tstd}{460 + ts} * \frac{Ps}{Pstd}$$

$$Qsd = \frac{60}{144} * 0.980 * 34.39 * 314.2 * \frac{528}{460 + 78} * \frac{29.19}{29.92}$$

Qsd = 4,225 SCFM

WET VOLUMETRIC FLUE GAS FLOW RATE AT STANDARD CONDITIONS

Qaw = 60 / 144 * vs * A

Qaw = 60 / 144 * 34.39 * 314.2 = 4,502 ACFM

PERCENT ISOKINETIC OF SAMPLING RATE

$$\%I = \frac{Pstd}{Tstd} * \frac{100}{60} * \frac{(ts + 460) * Vmstd}{Ps * vs * Mfd * Theta * (\pi * (NozzleDia/2)^2/144)}$$

$$\%I = \frac{29.92}{528} * \frac{100}{60} * \frac{(78 + 460) * 44.230}{29.19 * 34.39 * 0.980 * 60.00 * (\pi * (0.263/2)^2/144)}$$

%I = 100.9 %

CONCENTRATION, PARTS PER MILLION BY VOLUME DRY, LEAD

$$ppmvd = \frac{385.3 * 10^6 * (mg/10^3)}{453.592 * \text{Mol. Wt.} * Vmstd}$$

$$ppmvd = \frac{385.3 * 10^6 * (50.0/10^3)}{453.592 * 207.19 * 44.230} = 4.63 \text{ ppmvd}$$

EMISSION RATE, POUNDS PER HOUR, LEAD

$$lb/hr = \frac{60}{453.592} * \frac{(mg / 10^3)}{Vmstd} * Qsd$$

$$lb/hr = \frac{60}{453.592} * \frac{(50.0/10^3)}{44.230} * 4,225 = 0.632 \text{ lb/hr}$$

CONCENTRATION, GRAINS PER DRY STANDARD CUBIC FOOT, FILTERABLE PARTICULATE

$$gr/DSCF = \frac{7{,}000}{453.592} * \frac{(mg / 10^3)}{Vmstd}$$

$$gr/DSCF = \frac{7{,}000}{453.592} * \frac{(318.6/10^3)}{44.230} = 0.111 \ gr/DSCF$$

APPENDIX B

FIELD AND ANALYTICAL DATA

Preliminary Field Data

PLANT NAME MANNINGTON TILE

SAMPLING LOCATION SPRAY BOOTH 2A STACK

~~SAMPLING~~ LOCATION LEXINGTON, NC

NO. OF PORTS 2

PORT INSIDE DIAMETER 3"

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 20

NIPPLE LENGTH 0

DEPTH OF DUCT 20

WIDTH (RECTANGULAR DUCT) _____

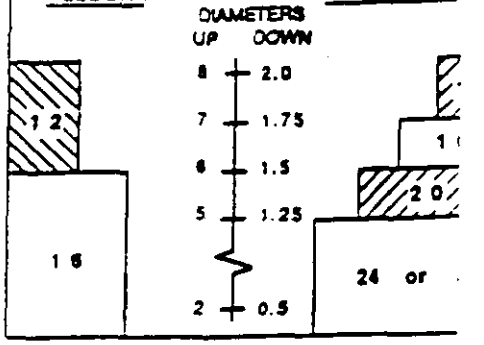
EQUIVALENT DIAMETER:
$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(\quad)(\quad)}{(\quad + \quad)} =$ _____

DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE	UPSTREAM	DOWNSTREAM
	60"	60"
DIAMETERS	3	3

STACK AREA = $\pi(100)$ = 314 IN²

DRAW HORIZONTAL LINE THROUGH DIAMETER

If more than 8 and 2 diameters and if duct dia. is less than 24", use 8 or 9 points.



LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

	4	6	8	10	12	14	16	18	20	22	24
1	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3	75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4	93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5		85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6		95.6	80.6	65.8	35.6	28.9	22.0	18.8	16.5	14.6	13.2
7			89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8			96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9				91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10				97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11					93.3	85.4	78.0	70.4	61.2	39.3	32.3
12					97.9	90.1	83.1	76.4	69.4	60.7	39.8
13						94.3	87.5	81.2	75.0	68.5	60.2
14						98.2	91.5	85.4	79.6	73.8	67.7
15							95.1	89.1	83.5	78.2	72.8
16							98.4	92.5	87.1	82.0	77.0
17								95.6	90.3	85.4	80.6
18								98.6	93.3	88.4	83.9
19									96.1	91.3	86.8
20									98.7	94.0	89.5
21										96.5	92.1
22										98.9	94.5
23											96.6
24											98.9

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

	2	3	4	5	6	7	8	9	10	11	12
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5
3		83.3	62.5	50.0	41.7	35.7	31.3	27.8	25.0	22.7	20.8
4			87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5				90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6					91.7	78.6	68.8	61.1	55.0	50.0	45.8
7						92.9	81.3	72.2	65.0	59.1	54.2
8							93.8	83.3	75.0	68.2	62.5
9								94.4	85.0	77.3	70.8
10									95.0	86.4	79.2
11										95.5	87.5
12											95.8

POINT	% OF DUCT DEPTH	DISTANCE FROM INSIDE WALL	DISTANCE FROM OUTSIDE OF PORT
1	2.1	$\frac{1}{2}$"	SAME
2	6.7	$1\frac{3}{8}$	
3	11.8	$2\frac{3}{8}$	
4	17.7	$3\frac{1}{2}$	
5	25.0	5	
6	35.6	$7\frac{1}{8}$	
7	64.4	$12\frac{7}{8}$	
8	75.0	15	
9	82.3	$16\frac{1}{2}$	
10	88.2	$17\frac{5}{8}$	
11	93.3	$18\frac{5}{8}$	
12	97.9	$19\frac{1}{2}$	
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

ENTROPY ENVIRONMENTALISTS, INC.

YAW ANGLE DATA
FOR CASES OF NON-STREAMLINED FLOW

Plant name MANNINGTON TILE Date 9-20-89

Plant location LEXINGTON, NC Initials MH

Measurement site SPRAY BOOTH 2A STACK Pitot type S

POINT	PORT A	PORT B	PORT C	PORT D	PORT E	PORT F	PORT G
1	-5	0					
2	-4	0					
3	0	0					
4	-4	+4					
5	-4	+4					
6	-4	-4					
7	0	-3					
8	0	0					
9	0	0					
10	0	0					
11	-4	0					
12	0	-3					

Average of absolute values of all angles = 1.79

ISOKINETIC TYPE FIELD DATA SHEET

COMPANY NAME MANNINGTON TILE — RUN NUMBER MS 8/12-1
ADDRESS LEXINGTON, NC — TIME START 0827
SAMPLING LOCATION SPRAY BOOTH 2A STACK — TIME FINISH 0945
DATE 9-20-89 TEAM LEADER MW — TECHNICIANS LM
BAROMETRIC PRESSURE. IN. HG 29.7 — STATIC PRESSURE IN. H_2O −0.20
TRAIN LEAK CHECK VACUUM IN. HG 15 3(F)
TRAIN LEAK RATE, CU.FT/MIN 0.010 0.001

EQUIPMENT CHECKS

- ✓ PITOTS, PRETEST
- ✓ PITOTS, POSTTEST
- — M3 SAMPLING SYS/TED BAG
- ✓ THERMOCOUPLE @ 68 PRE
- ✓ THERMOCOUPLE @ 75 POST

IDENTIFICATION NUMBERS

REAGENT BOX 203 NOZZLE 705 DIAMETER 0.263
METER BOX N9 T/C READOUT E69
UMBILICAL U6 T/C PROBE 6-4
SAMPLE BOX 21 ORSAT PUMP —
PROBE 3-9 PITOT — TEDLAR BAG —

LEAK CHECK READINGS

8 1	
8 2	
8 3	
8 4	
8 5	
8 6	

FILTER #	TARE
E8446	0.5041

						FYRITE
DELTA $H_@$	1.714					
METER TEMP	80	95				
EST. $\%H_2O$	2					
C FACTOR	0.99	1.01				
STACK TEMP	78					
REF DELTA P	0.37	0.365				
K-FACTOR						C_p 0.84

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H2O IDEAL	ORIFICE SETTING IN. H2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #	
1	A1	0	127.420	0.34	1.70	1.70	71	1	255	60	75		
2	2	2½	129.41	0.42	2.10	2.10	74	1	260	60	76		
3	3	5	131.52	0.57	2.80	2.80	79	1	250	60	77		
4	4	7½	134.33	0.62	3.05	3.05	84	1	235	60	77		
5	5	10	136.39	0.63	3.10	3.10	86	1	235	60	77		
6	6	12½	139.41	0.52	2.60	2.60	88	1	240	60	77		
7	7	15	141.52	0.28	1.40	1.40	91	1	240	60	78		
8	8	17½	143.43	0.23	1.15	1.15	92	1	245	60	78		
9	9	20	144.99	0.18	0.89	0.89	92	1	245	60	78		
10	10	22½	146.52	0.17	0.83	0.83	93	1	245	56	78		
11	11	25	147.95	0.16	0.77	0.77	95	1	245	56	78		
12	12	27½	149.25	0.16	0.77	0.77	96	1	250	56	78		
13	B1	30/0	150.573	0.26	1.27	1.27	97	1	245	55	78		STOP 0900 START 0911
14	2	2½	152.02	0.40	1.98	1.98	96	1	245	55	78		
15	3	5	154.69	0.38	1.91	1.91	97	1	245	55	78		
16	4	7½	156.21	0.40	1.98	1.98	97	1	240	58	79		
17	5	10	158.16	0.42	2.14	2.14	98	1	245	58	79		
18	6	12½	160.36	0.43	2.20	2.20	100	1	235	60	79		
19	7	15	162.63	0.44	2.27	2.27	102	1	235	60	79		
20	8	17½	164.88	0.43	2.20	2.20	103	1	235	60	79		
21	9	20	167.14	0.38	1.91	1.91	104	1	235	60	79		
22	10	22½	169.38	0.37	1.90	1.90	104	1	240	62	79		
23	11	25	171.38	0.32	1.63	1.63	106	1	240	62	79		
24	12	27½	173.52	0.34	1.78	1.78	107	1	240	62	78		
25		60/OFF	175.428										

60	48.008	0.3561	1.85	94	78
minutes	Vm	$(\sqrt{\Delta p})^2$	ΔH	tm	ts

F1010
9/89
p1

ENTROPY

ISOKINETIC TYPE FIELD DATA SHEET

COMPANY NAME MANNINGTON TILE — RUN NUMBER MS12-2
ADDRESS LEXINGTON, NC — TIME START 1002
SAMPLING LOCATION SPRAY BOOTH 2A STACK — TIME FINISH 1104
DATE 9-20-89 — TEAM LEADER MH — TECHNICIANS LM
BAROMETRIC PRESSURE. IN. HG 29.2 — STATIC PRESSURE IN. H_2O -0.15
TRAIN LEAK CHECK VACUUM IN. HG 15 5F
TRAIN LEAK RATE, CU.FT/MIN 0.003 0.001

EQUIPMENT CHECKS

- ✓ PITOTS, PRETEST
- ✓ PITOTS, POSTTEST
- — M3 SAMPLING SYS/TED BAG
- ✓ THERMOCOUPLE @ 75 PRE
- ✓ THERMOCOUPLE @ 78 POST

IDENTIFICATION NUMBERS

REAGENT BOX 203 — NOZZLE 706 — DIAMETER 0.255
METER BOX N9 — T/C READOUT E69
UMBILICAL U6 — T/C PROBE S-14
SAMPLE BOX ____ — ORSAT PUMP —
PROBE 3-6 — PITOT ____ — TEDLAR BAG —

LEAK CHECK READINGS

B1 B2 B3 B4 B5 B6

FILTER #	TARE
E8447	0.5023

DELTA $H_@$	1.714			
METER TEMP	105			
EST. $\%H_2O$	2			
C FACTOR	1.02			
STACK TEMP	80			
REF DELTA P	0.42			
K-FACTOR				

FYRITE — C_p 0.84

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H2O IDEAL	ORIFICE SETTING IN. H2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #
1	A 1	0	175.588	0.42	1.84	1.84	103	1	230	60	75	
2	2	2½	177.44	0.59	2.60	2.60	105	1	235	60	75	
3	3	5	180.20	0.63	2.75	2.75	107	1	250	60	74	
4	4	7½	182.82	0.69	3.00	3.00	109	1	255	60	76	
5	5	10	185.69	0.67	2.90	2.90	112	1	255	58	76	
6	6	12½	188.04	0.58	2.58	2.58	109	1	250	58	79	
7	7	15	190.64	0.36	1.60	1.60	114	1	250	58	80	
8	8	17½	192.25	0.33	1.48	1.48	114	1	250	58	80	
9	9	20	194.29	0.30	1.30	1.30	115	1	245	55	80	
10	10	22½	195.95	0.29	1.27	1.27	115	1	245	55	79	
11	11	25	197.76	0.28	1.22	1.22	115	1	245	55	80	
12	12	27½	199.35	0.28	1.22	1.22	115	1	245	55	79	
13	B 1	30/0	201.056	0.37	1.63	1.63	115	1	245	52	76	
14	2	2½	202.98	0.37	1.63	1.63	116	1	245	52	76	
15	3	5	205.05	0.39	1.75	1.75	116	1	245	52	76	
16	4	7½	207.11	0.41	1.81	1.81	117	1	245	52	76	
17	5	10	209.12	0.44	1.94	1.94	118	1	240	50	77	
18	6	12½	211.06	0.46	2.10	2.10	118	1	240	50	77	
19	7	15	213.50	0.43	1.90	1.90	118	1	245	53	76	
20	8	17½	215.50	0.45	1.99	1.99	119	1	245	53	77	
21	9	20	217.82	0.39	1.75	1.75	119	1	245	53	77	
22	10	22½	219.55	0.35	1.56	1.56	119	1	245	53	78	
23	11	25	221.74	0.35	1.56	1.56	119	1	245	53	77	
24	12	27½	223.58	0.37	1.64	1.64	119	1	245	53	78	
25		60/OFF	225.528									

60	49.940	0.4182	1.88	114		77
minutes	Vm	$(\sqrt{\Delta p})^2$	ΔH	tm		ts

F1010
9/89
p1

ENTROPY

ISOKINETIC TYPE FIELD DATA SHEET

12

COMPANY NAME MANNINGTON TILE — RUN NUMBER MS#2-3
ADDRESS LEXINGTON, NC — TIME START 1155
SAMPLING LOCATION SPRAY BOOTH 2-A STACK — TIME FINISH 1258
DATE 9-20-89 — TEAM LEADER MK — TECHNICIANS LM
BAROMETRIC PRESSURE. IN. HG 29.7 — STATIC PRESSURE IN. H_2O -0.21
TRAIN LEAK CHECK VACUUM IN. HG 15 3.5 (F) ___ ___ ___ ___ ___
TRAIN LEAK RATE, CU.FT/MIN 0.004 0.001 ___ ___ ___ ___ ___

EQUIPMENT CHECKS

- ✓ PITOTS, PRETEST
- ✓ PITOTS, POSTTEST
- — M3 SAMPLING SYS/TED BAG
- ✓ THERMOCOUPLE @ 78 PRE
- ✓ THERMOCOUPLE @ 78 POST

IDENTIFICATION NUMBERS

REAGENT BOX 203 — NOZZLE 705 — DIAMETER 0.263
METER BOX N9 — T/C READOUT E69
UMBILICAL U6 — T/C PROBE 6-4
SAMPLE BOX Z1 — ORSAT PUMP —
PROBE 3-9 — PITOT ___ — TEDLAR BAG —

LEAK CHECK READINGS

B 1	
B 2	
B 3	
B 4	
B 5	
B 6	

FILTER #	TARE
E8448	0.5056

DELTA $H_@$	1.714			
METER TEMP	105			
EST. $\%H_2O$	2			
C FACTOR	1.02			
STACK TEMP	80			
REF DELTA P	0.365			
K-FACTOR				

FYRITE: C_p 0.84

LINE	SAMPLE POINT	CLOCK TIME MINUTES	DRY GAS METER READINGS CUBIC FEET	PITOT READING IN. H_2O	ORIFICE SETTING IN. H2O IDEAL	ORIFICE SETTING IN. H2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMPERATURES FILTER BOX °F	GAS TEMPERATURES IMPINGER EXIT °F	STACK TEMP. °F	LK CHK #
1	A1	0	225.642	0.58	2.90	2.90	97	2	235	60	76	
2	2	2½	228.25	0.59	2.94	2.94	98	2	235	60	77	
3	3	5	230.88	0.68	3.40	3.40	101	3	235	60	75	
4	4	7½	233.60	.71	3.65	3.65	103	3	235	60	74	
5	5	10	236.00	.68	3.40	3.40	104	3	235	56	74	
6	6	12½	239.01	.60	3.10	3.10	107	3	240	56	74	
7	7	15	241.72	.45	2.37	2.37	108	3	240	56	74	
8	8	17½	244.24	.40	2.10	2.10	109	2	240	56	74	
9	9	20	246.51	.35	1.81	1.81	110	3	240	56	73	
10	10	22½	248.63	.37	1.89	1.89	111	3	240	56	74	
11	11	25	250.71	.37	1.89	1.89	112	2	240	56	74	
12	12	27½	252.80	.37	1.89	1.89	112	2	240	53	74	
13	B1	30/0	255.13	.38	1.91	1.91	112	2	240	54	74	
14	2	2½	257.75	.39	1.95	1.99	112	2	240	55	74	
15	3	5	259.31	.42	2.11	2.11	113	2	240	54	75	
16	4	7½	261.91	.42	2.1	2.11	113	2	242	55	74	
17	5	10	263.93	.46	2.30	2.30	115	2	240	55	74	
18	6	12½	266.90	.49	2.51	2.51	116	2	240	55	74	
19	7	15	265.57	.48	2.00	2.00	117	2	240	56	74	
20	8	17½	270.92	.38	1.95	1.95	117	2	240	55	74	
21	9	20	272.00	.37	1.89	1.89	118	2	240	55	75	
22	10	22½	275.25	.34	1.79	1.75	118	2	245	57	75	
23	11	25	277.32	.34	1.75	1.75	119	2	245	57	75	
24	12	27½	279.41	.30	1.51	1.51	119	2	245	57	75	
25		60 OFF	281.264	.30	~~1.51~~	~~1.51~~	~~118~~	2	245	~~57~~	75	

60	55.572	0.4446	2.30	111	74
minutes	Vm	$(\sqrt{\Delta p})^2$	ΔH	tm	ts

F1010
9/89
pl

ENTROPY

MOISTURE SAMPLING LABORATORY RESULTS

Plant Name: MANNINGTON CERAMIC TILE EEI Ref# 6445

Sampling Location: Spray Booth 2A Stack

Date Received: 9/21 Date Analyzed: 9/21 Reagent Box(es): 0203

Run Number	MS#12-1	MS#12-2	MS#12-3
Run Date	9/20	9/20	9/20
ANALYSIS OF MOISTURE CATCH			
Reagent 1 (0.1N HNO3)			
Final Weight, g.	587.0	570.5	593.5
Tared Weight, g.	579.5	555.0	575.5
Water Catch,g.	7.5	15.5	18.0
Reagent 2 ( )			
Final Weight, g.			
Tared Weight, g.			
Water Catch,g.	0.0	0.0	0.0
Reagent 3 ( )			
Final Weight, g.			
Tared Weight, g.			
Water Catch,g.	0.0	0.0	0.0
CONDENSED WATER, g.	7.5	15.5	18.0
Silica Gel:			
Final Weight, g.	212.0	210.5	212.5
Tared Weight, g.	200.0	200.0	200.0
ADSORBED WATER, g.	12.0	10.5	12.5
TOTAL WATER COLLECTED, g.	19.5	26.0	30.5

PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name: MANNINGTON CERAMIC TILE EEI Ref# 6445

Sampling Location: Spray Booth 2A Stack

Date Received: 9/21 Date Analyzed: 9/26 Reagent Box(es): 0203

Run Number	M5k12-1	M5k12-2	M5k12-3
Run Date	9/20	9/20	9/20
Sample ID/Container #	F / 1177	F / 1178	F / 1179
	78.0182	83.1582	82.2594
	✓78.0178	✓83.1579	✓82.2593
	78.0189	83.1591	82.2606
Tare Weight., g.	77.3497	82.4613	81.6161
SAMPLE WT., g.	0.6681	0.6966	0.6432
Sample ID/Container #	R / 2255	R / 2256	R / 2257
	103.4262	✓101.3087	✓104.2574
	✓103.4259	101.3089	104.2578
	103.4311	101.3102	104.2630
Tare Wt., g.	103.2710	101.2291	104.0880
SAMPLE WT., g.	0.1549	0.0796	0.1694
Sum of Particulate, mg.	823.0	776.2	812.6
Total Filter Tare, mg.	504.1	502.3	505.6
Blank Residue, mg.	0.3 (150 ml)	0.4 (175 ml)	0.4 (200 ml)
TOTAL PARTICULATE CATCH, mg.	318.6	273.5	306.6

Blank Beaker # 2003
Final wt., mg. 99546.3
Tare wt., mg. 99545.9
Residue, mg. 0.4
Volume, ml. 200

Concentration, mg/ml 0.002

---Legend---
✓ = Final Weight
L = Loose Particulate
F = Filter D = Dish
R = Rinse P = Pan

Notes and Comments

Oxford Laboratories, Inc.

Analytical and Consulting Chemists
1316 South Fifth Street
Wilmington, N.C. 28401
(919) 763-9793

DATE RECEIVED 9-29-89
DATE REPORTED 10-20-89
89W8144

PAGE 1 OF 1

ENTROPY ENVIRONMENTALIST INC
P.O. BOX 12291
RESEARCH TRIANGLE PK , N.C. 27709-2291

P.O. # 6445A-1

ATTENTION: BRUCE HAWKS

SAMPLE DESCRIPTION: M5/12 0.1N NaOH

1. M5/12-1
2. M5/12-2
3. M5/12-3
4. METHOD CODE

RESULTS

	1	2	3	4
Lead, as Pb, total mg	50.0	42.5	47.0	SW846-7000

Roger C. Oxford

ROGER C. OXFORD , CHEMIST

method code SW846-7000

P.O# 6445A-1 Entropy 10-3-89
89W 814/c

	#1	#2	#3
Pb	10.0 x 50 x 100 ÷ 1000 = 50.0 mg	8.5 x 50 x 100 ÷ 1000 = 42.5 mg	9.4 x 50 x 10 = 47.0

Samples prepared by digesting in HNO_3. Final volume = 100 ml

CUSTODY SHEET FOR REAGENT BOX # 0203

Date of Makeup 14 Sept 1989 Initials BJH Locked? ✓

Individual Tare of Reagent: 200 mls. of 0.1N HNO_3

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME MANNINGTON TILE (LEXINGTON, NC)

SAMPLING LOCATION MS/12 SPRAY BOOTH 2-A STACK

Run Number	Date Used	Initials	Locked?	Date Cleanup	% S. Gel Spent	Initials	Locked?
MS12-1	9/20/89	LM	✓	9/20/89	5%	LM	✓
MS12-2	"	LM	✓	"	5%	LM	✓
MS12-3	"	LM	✓	"	5%	LM	✓

Received in Lab Date 9/21 Initials PA Locked? ✓

Zero & Span Balance Initials PA

Sampling Method: MS/12

Filter #	Tare Weight (grams)	Used on Test
E8446	0.5041	MS12-1
E8447	0.5023	MS12-2
E8448	0.5056	MS12-3

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

ENTROPY
ENVIRONMENTALISTS INC.

POST OFFICE BOX 12291
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709-2291
919-781-3550

REQUEST FOR ANALYSIS

PURCHASE ORDER # 6445 A-1

JOB NAME: Mannington Tile

LABORATORY: OLI

DATE SAMPLES WERE TRANSMITTED: 9-28-89

EXPECTED DATE OF RESULTS: 10-12-89

SAMPLE MATRIX: M5&12 0.1 N NaOH

TYPE OF ANALYSIS REQUESTED: Pb

Sample #	I.D.	~~Be~~ Filter Beaker #	Rinse Beaker #	F.V.	Components
1	M5&12-1	1177	2255	400	Reagent, HNO3 rinse (a
2	M5&12-2	1178	2256	450	" "
3	M5&12-3	1179	2257	475	" "

SUBMITTED BY: Richard Tebeau

L-0005a
8/86

ENTROPY
ENVIRONMENTALISTS INC.

POST OFFICE BOX 12291
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709-2291
919-781-3550

INTERLABORATORY SAMPLE TRANSFER CHAIN-OF-CUSTODY FORM

Please return this form along with the analytical results.

The samples referenced on EEI Purchase Order Number: 6445 A-1 were shipped via Pony Express on 9-28 by EAT to OLI

Samples received at Enfield Lab on 9-29-89 by M. Congleton

Note any broken seals, leakage, spillage, and/or damage to the samples.

APPENDIX C

CALIBRATION DATA

QUALITY ASSURANCE PROCEDURES

General. Each item of field test equipment purchased or constructed by Entropy is assigned a unique, permanent identification number. New items for which calibration is required are calibrated before initial field use. Equipment with the possibility of the calibration status changing with use or with time is inspected in the field before testing begins, and again upon return from each field use. When an item of equipment is found to be out of calibration, it is adjusted and recalibrated or retired from service. All equipment is periodically recalibrated in full, regardless of the outcome of these regular inspections.

Calibrations are conducted in a manner and at a frequency which meet or exceed U. S. EPA specifications. Entropy Environmentalists Inc. (EEI) follows the calibration procedures outlined in EPA Reference Methods, and those recommended within the Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III (EPA-600/4-77-027b, August, 1977). When the Reference Methods are inapplicable, EEI uses methods such as those prescribed by the American Society for Testing and Materials (ASTM).

Data obtained during calibrations are recorded on standardized forms, which are checked for completeness and accuracy by the Quality Assurance Manager or the Quality Assurance Director. Data reduction and subsequent calculations are performed using EEI's in-house computer facilities. Calculations are generally performed at least twice as a check for accuracy. Copies of calibration data are included in the test or project reports.

Inspection and Maintenance. An effective preventive maintenance program is necessary to ensure data quality. Each item of equipment returning from the field is inspected before it is returned to storage. During the course of these inspections, items are cleaned, repaired, reconditioned, and recalibrated when necessary.

Each item of equipment used for this test program was inspected again before being packed and transported to the job site. The majority of the equipment needs a visual inspection only. In the case of the meter consoles, a 10-minute quick calibration check is conducted. EEI performs these quality assurance activities prior to departure to detect equipment problems which may originate during periods of storage. This minimizes on-site delays due to equipment failure.

Occasional equipment failure in the field is unavoidable despite the most rigorous inspection and maintenance procedures. For this reason, EEI makes every effort to transport sufficient backup equipment to the job site to have complete redundancy of all critical sampling train components.

Calibration. Equipment that require calibration include the nozzle, pitot tube, pressure gauges, thermometers, flow meters, dry gas meters, and barometers. The following sections elaborate on the calibration procedures followed by EEI for these items of equipment. Calibration data for the specific items of equipment used for this test program follow the text.

Nozzles. Each probe nozzle is uniquely and permanently identified at the time of purchase, calibrated before initial field use, and visually inspected on-site prior to testing. Each time a nozzle is calibrated, the inside diameter of the nozzle is measured to the nearest 0.001 in. using a micrometer. Five measurements are made using different diameters each time. If the difference between the high and the low numbers does not exceed 0.004 inch, the average of the five measurements is used. If the difference exceeds this amount, or when the nozzle becomes nicked, dented, or corroded, the nozzle is reshaped, sharpened, and recalibrated.

Pitot Tubes. All Type S pitot tubes used by EEI, whether separate or attached to a sampling probe, are constructed in-house or by Nutech Corporation. Each pitot is calibrated when new in accordance with the geometry standards contained in EPA Reference Method 2. A Type S pitot tube, constructed and positioned according to these standards, will have a coefficient of 0.84 ± 0.02. This coefficient should not change as long as the pitot tube is not damaged.

Each pitot tube is inspected visually before it is transported to the field and again on-site prior to testing. If either of these visual inspections indicate damage or raise doubt that the pitot remains in accordance with the EPA geometry standards, the pitot tube is not used until it has been refurbished and recalibrated.

Differential Pressure Gauges. Some meter consoles used by EEI are equipped with 10-in. W.C. inclined-vertical manometers. Fluid manometers

do not require calibration other than leak checks. Manometers are leak checked in the field prior to each test series, and again upon return from the field.

Most of EEI's meter consoles are equipped with Magnehelic® differential pressure gauges. Each set of gauges is calibrated initially over its full range, 0-10 inches W.C. After each field use, the calibration of the gauge set is checked against an inclined manometer at the average delta p encountered during the test. If the agreement is within ± 5 %, the calibration is acceptable.

Thermometers

Impinger Thermometer. On-site, prior to the start of testing, the thermometer used to monitor the temperature of the gas leaving the last impinger is compared with a mercury-in-glass thermometer which meets ASTM E-1 specifications. If necessary, the impinger thermometer is adjusted until it agrees within ± 2°F of the reference thermometer. (If the thermometer is not adjustable, it is labeled with a correction factor.)

Dry Gas Meter Thermometer. Prior to each field use, the thermometer used to measure the temperature of the metered gas sample is checked against an ASTM mercury-in-glass thermometer. The dry gas meter thermometer is acceptable if the values agree within ± 5.4°F. Thermometers not meeting this requirement are adjusted or labeled with a correction factor.

Flue Gas Temperature Sensor. All thermocouples employed by EEI for the measurement of flue gas temperatures are calibrated upon receipt. Each receives an initial, 3-point calibration (ice bath, boiling water, and hot oil) using an ASTM mercury-in-glass thermometer as a reference. The thermocouple is acceptable if the agreement is within ± 1.5 % (absolute) at each of the three calibration points.

On-site, prior to the start of testing, the reading from the stack gas thermocouple-potentiometer combination is compared with a mercury-in-glass reference thermometer. If the two agree within ± 1.5 % (absolute), the thermocouple and potentiometer are considered to be in proper working order for the test series.

After each field use, the thermocouple-potentiometer system is again compared with an ASTM mercury-in-glass reference. If the absolute temperatures agree within ± 1.5 %, the temperature data are considered valid.

Dry Gas Meter and Orifice

General. The dry gas meter and orifice are typically installed in a common console and are calibrated simultaneously. As a transfer standard, EEI uses a dry gas meter that is calibrated annually against a spirometer. During the annual transfer standard calibration, three calibration runs are performed at each of seven flow rates ranging from approximately 0.2 to 1.25 cfm.

EEI uses three calibration procedures: 1) full calibration, 2) 10-minute quick calibration, and 3) posttest calibration.

Full Calibration. The full calibration is a complete calibration procedure used to obtain the calibration factor of the dry gas meter and orifice before their first use and, at a minimum, every six months thereafter. Two calibrations are performed at each of three different orifice settings (flow rates): 0.5, 2.1, and 4.8 in. H_2O, and at zero vacuum.

EPA Reference Method 5 calls for another full calibration anytime a posttest meter calibration indicates that the average meter coefficient (Y_d) has changed by more than 5 %. Standard practice at EEI is to recalibrate the meter anytime Y_d is found to be outside the range $0.97 \leq Y_d \leq 1.03$, or deviates more than the 5 %.

An orifice calibration factor (delta-H@) is calculated for each of the six flow settings during the full calibration. If the range of values does not vary by more than 0.15 in. H_2O, the arithemtic average of the six values obtained during the calibration is used. Standard practice at EEI is to recalibrate if the average delta-H@ is found to be outside the range 1.6 to 2.0 in. H_2O.

Ten-Minute Quick Calibration. The 10-minute quick calibration is conducted prior to reporting to the test site and again prior to each day of testing. The meter console is not used if Y_d is not within ± 3 % of that of the full test.

Posttest Calibration. The posttest calibration is designed to check whether the calibration factors have changed. Posttest calibrations are performed after each field test series. Each posttest calibration is performed at an average orifice setting (based on the test data) and at the maximum vacuum reached during the testing. Three calibrations are performed at these settings.

If the post test Y_d deviates by less than 5 % from that of the full test calibration, the test data are acceptable. If Y_d deviates by more than 5 %, the meter is recalibrated prior to reuse, and the Y_d (initial or posttest) that yields the lowest sample volume is used for all calculations.

If the posttest delta-H@ deviates by more than 10 % from that of the full test, the orifice is recalibrated prior to reuse. No adjustments are made for calculation purposes.

Barometer. Each field barometer is adjusted before each test series to agree within $\pm$ 0.1 inches of a reference aneroid barometer. The reference barometer is checked weekly against the station pressure value (corrected for elevation difference) reported by the National Weather Service station at the Raleigh-Durham International Airport, approximately 2.5 miles from EEI's location.

Dry Gas Meter Identification: 6838323 Calibration by: WLS Page 1 of 2

Date: 3-30-89 Barometric Pressure (P_b): 29.56 in. Hg

*Date: 3-31-89 *Barometric Pressure (P_b): 29.34 in. Hg

ENTROPY ENVIRONMENTALISTS, INC.

Approx. Flow Rate (Q) cfm	Spirometer Gas Volume (V_s) ft^3	Spirometer Temp. (t_s) °F	Dry Gas Meter Gas Volume (V_{ds}) ft^3	Dry Gas Meter Temp. (t_{ds}) °F	Pressure (Δp) in. H_2O	Time (θ) min.	Flow Rate (Q) cfm	Meter Meter Coeff. (Y_{ds})	Avg. Meter Coeff. ($\bar{Y}_{ds}$)
	2.859	77	2.757	77	.5	10	.2776		1.0357
	2.823	77	2.726	77	.5		.2741		1.0343
	2.796	79	2.710	77	.5		.2705		1.0266
	4.144	79	4.127	77	.8		.4009		0.9984
	4.189	79	4.133	77	.8		.4053		1.0078
	4.262	79	4.136	77	.8		.4123		1.0246
	5.027	79	4.92	77	1.0		.4863		1.0154
	4.945	79	4.884	77	1.0		.4784		1.0062
	5.055	79	4.909	77	1.0		.4890		1.0234
	8.069	79	7.955	77	2.2		.7806		1.0051
	8.078	79	7.917	77	2.2		.7815		1.011
	8.051	79	7.938	77	2.2		.7789		1.005
*	10.700	79	10.436	76	3.4		1.0274		1.011
*	10.665	79	10.525	76	3.4		1.0241		0.9991
*	10.565	79	10.452	76	3.4		1.0145		0.9967

$$(V_s)\ (t_{ds} + 460)\ (P_b)$$

$$Q = (17.64)\ \frac{(P_b)\ (V_s)}{\theta}$$

92

Dry Gas Meter Identification: 683323 Calibration by: WLS

Date: 3-30-89 Barometric Pressure (P_b): 29.56 in. Hg

ENTROPY ENVIRONMENTALISTS, INC.

*Date: 3-31-89 *Barometric Pressure (P_b): 29.34 in. Hg

Approx. Flow Rate (Q) cfm	Spirometer Gas Volume (V_s) ft^3	Spirometer Temp. (t_s) °F	Dry Gas Meter Gas Volume (V_{ds}) ft^3	Dry Gas Meter Temp. (t_{ds}) °F	Pressure (Δp) in. H_2O	Time (θ) min.	Flow Rate (Q) cfm	Meter Meter Coeff. (Y_{ds})	Avg. Meter Coeff. ($\bar{Y}_{ds}$)
*	12.168	79	12.110	77	4.52	10	1.1684		0.9898
*	12.231	79	12.180	77	4.52		1.1744		0.9893
*	12.186	79	12.177	77	4.52		1.1701		0.9859
	13.461	79	13.355	77	5.50		1.3022		0.9906
	13.661	79	13.575	77	5.50		1.3216		0.9891
	13.461	79	13.413	77	5.50		1.3022		0.9864

$Y_{DS} = 1.0063$

$$Q = (17.64)\frac{(P_b)(V_s)}{(V_s)(t_{ds} + 460)(P_b)}$$

SAMPLING EQUIPMENT CALIBRATION CHECKLIST

JOB NAME/NUMBER MANNINGTON TILE TEAM LEADER MH

SAMPLING LOCATION SPRAY BOOTH 2A STACK

BAROMETER CHECK

DATE	ENTROPY IN-HOUSE REFERENCE BAROMETER	FIELD BAROMETER
9-19-89	29.69	29.7

THERMOMETERS AND THERMOCOUPLE CHECK

DATE 9-19 REFERENCE THERMOMETER AMBIENT TEMPERATURE 77 °F

	AMBIENT TEMPERATURE °F	MUST BE WITHIN ACCEPTANCE RANGE °F
THERMOMETERS		
Impinger Exit	75	±2°F
Filter Compartment	75	±5.4°F
Dry Gas Meter	76	±5.4°F
Other		
THERMOCOUPLE	77	±8°F

NOTE: Adjust thermometer until acceptable. If thermometer can't be adjusted, use a backup. If no back up, then record the ambient temperature indicated by the unadjusted thermometer.

PITOT AND NOZZLE CHECK

	I.D. #	VISUAL INSPECTION CHECK
PITOTS		
	3-9	✓
	3-6	✓
NOZZLES	705	✓
	706	✓

Meter Box Number: N9 Calibration by: MBC

Standard Meter Number: 6838323 Standard Meter Gamma: 1.0063

Date: 7-19-89 Barometric Pressure (P_b): 29.57 in. Hg

*Date: _____ *Barometric Pressure (P_b): _____ in. Hg

METERBOX CALIBRATION

Standard Meter			Meter Box Metering System				
Gas Volume (V_{ds}) ft^3	Temp. (t_{ds}) °F	Time (θ) min.	Orifice Setting (ΔH) in. H_2O	Gas Volume (V_d) ft^3	Temp. (t_d) °F	Coeff. (Y_d)	$\Delta H_@$ in. H_2O
4.042	76	10	0.5	4.197	84	.9824	1.709
4.061	↓	↓	0.5	4.199	84	.9884	1.687
8.180			2.1	8.462	85	.9840	1.750
8.180			2.1	8.480	86	.9837	1.746
12.535			4.8	12.899	88	.9880	1.694
12.505	↓	↓	4.8	12.853	89	.9910	1.699
					Average	.9863	1.714

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + \Delta H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$

ON-SITE DRY GAS METER AUDIT

Date 9-19-89 Meter Box Identification Number N9

Time _____ Pretest Gamma (Y) 0.9863 ΔH_a 1.714

Auditor MB Barometric Pressure (P_{bar}) 29.2 in.Hg

Dry Gas Meter Readings, ft^3	Meter Temperatures, ^oF	Upper and Lower Limits for Audit Gamma
Initial 119.500	Initial 84	0.97 * Y = 0.9567
Final 127.317	Final 93	1.03 * Y = 1.0159

Dry Gas Volume Metered, ft^3	Average Meter Temperature, ^oF	Run Time, min.	Calculated Audit Gamma
Vm = 7.817	Tm = 89	10	Y_c = 0.9903

$$Y_c = \frac{10}{Vm} * \sqrt{\frac{0.0319\ (Tm + 460)}{P_{bar}}}$$

$$Y_c = \frac{10}{7.817} * \sqrt{\frac{0.0319\ (89 + 460)}{29.2}} = 0.9903$$

Audit Gamma Within Acceptable Limits? Yes ✓ No ___

F-1040
9/86

Meter Box Number N9 Calibration by: MBC

Meter Box Vacuum: 3 (in. Hg) Job No. 645

Standard Meter Number: 6838323 Standard Meter Game: 1.0063

Date: 9-29-85 Barometric Pressure (P_b): 29.8 (in. Hg)

POST TEST CALIBRATION

Standard Meter			Meter Box Metering System				
Gas Volume (V_{ds}) ft^3	Temp. (t_{ds}) °F	Time (θ) min.	Orifice Setting (ΔH) in. H_2O	Gas Volume (V_d) ft^3	Temp. (t_d) °F	Coeff. (Y_d)	$\Delta H_@$ in. H_2O
7.916	74	10	2.0	8.565	98	.9631	1.722
8.010	74	10	2.0	8.685	100	.9685	1.676
7.919	74	10	2.0	8.563	100	.9695	1.719
					Average	.9685	1.706

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + \Delta H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$

ΔP (Magnehelic®)	ΔP (Manometer)	% Difference
.16	.16	0
.44	.448	1.8
.21	.21	0

F-1038
7/89

NOZZLE NUMBER: 705

Date	Initials	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Dia. 5	Average
12-2-82	ST	.255	.254	.255	.253	.255	0.254"
4-6-83	PLO	.260	.259	.258	.258	.259	0.259"
11-18-83	PLO	.260	.257	.257	.259	.260	0.259"
3-8-84	JNC	.253	.254	.254	.255	.255	0.254"
7-6-84	TTM	.253	.253	.252	.253	.252	0.253
10-23-84	ATM	.249	.251	.252	.250	.249	0.250
2-19-85	JDE	.251	.252	.250	.252	.253	0.252
10-24-85	GC	.256	.257	.254	.257	.256	0.256
2-13-86	T. McD.	.252	.255	.254	.255	.253	0.254
6-30-86	B.B	.257	.255	.258	.255	.259	0.257
3-10-87	ST	.258	.257	.258	.257	.259	.258
3/20/87	SH	.251	.255	.255	.255	.254	.254
12/10/87	DJ3	.255	.253	.253	.253	.254	.254
8-11-88	JC	.257	.254	.254	.255	.254	.255
10/18/88	BKG	.264	.265	.265	.266	.265	.265
1/13/89	BKG	.270	.273	.271	.274	.272	.272
6/22/89	LM	.276	.273	.275	.274	.275	.275
8-21-89	JRW	.262	.264	.262	.264	.260	.262

NOTE: All diameters measured in inches.

NOZZLE NUMBER: 706

Date	Initials	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Dia. 5	Average
3/10/87	ST	.248	.248	.249	.249	.249	0.249
3/20/87	SH	.242	.245	.244	.245	.245	.244
8-11-88	DC	Missing	—	—	—	—	—
9-20-88	RDS	.257	.255	.256	.257	.257	.256
10/18/88	BKG	.270	.270	.271	.270	.269	.270
1/13/89	BKG	.274	.276	.277	.274	.275	.275
6/22/89	LM	.270	.272	.272	.271	.270	.271
8-21-89	JRW	.258	.252	.256	.256	.255	.255

NOTE: All diameters measured in inches.

APPENDIX D

PROCESS DATA

Mannington CERAMIC TILE

9-19-89

308 Glaze - Mill Formula

	Wet %
Feldspar	6.8 %
Silica	6.6
Clay	10.1
Limestone	2.3
Ultrox	20.0
Zinc Oxide	4.0
Fluorspar	1.0
Calcined Alumina	4.16
Lead Monosilicate	28.3
FZ-16 Frit	13.9
Titania	2.5
	100.1 %

Does not include :

	CMC	.03 %	
	VGUM T	.05 %	
Unknown Composition	14M200 Coral stain	.12 %	(Zr Si Fe stain)
	14H705 Yellow "	.17 %	(Zr Si Ps stain)
	41166 Gray "	.08 %	(Co Ni Fe Zr Si stain)

mannington
CERAMIC TILE by MID-FLOR

308 9-19-89

Glaze Composition % by wgt - oxides

K_2O	.3 %
Na_2O	1.8
CaO	2.7
ZnO	6.1
PbO	24.1
Al_2O_3	9.9
B_2O_3	4.2
SiO_2	32.4
ZrO_2	13.4
TiO_2	2.5
F	.5 %
CO_2	1.0 %
H_2O	1.4 %
	100.3 %

APPENDIX E

SAMPLING AND ANALYTICAL PROCEDURES