AP42 Section:	11.3
Background Chapter	4
Reference:	20
Title:	*Stationary Source Sampling Report: Lee Brick And Tile Company, Sanford, NC, Compliance Testing, Tunnel Kiln,* Entropy Environmentalists, Inc., Research Triangle Park, NC, June 1978.

ENTROPY
ENVIRONMENTALISTS, INC

SPECIALISTS IN
SOURCE
SAMPLING

STATIONARY SOURCE SAMPLING REPORT

Coal Fired

LEE BRICK AND TILE COMPANY
SANFORD, NORTH CAROLINA
PARTICULATE EMISSIONS COMPLIANCE TESTING
TUNNEL KILN

JUNE, 1978

P.O. Box 12291, Research Triangle Park, North Carolina 27709
Phone 919-781-3550

REPORT CERTIFICATION

The sampling and analysis performed for this report was carried out under my direction and supervision.

Date July 11, 1978 Signature Roy N. Doster

Roy N. Doster

I have reviewed all testing details and results in this test report and hereby certify that the test report is authentic and accurate.

Date July 11, 1978 Signature

D. James Grove, P.E.

TABLE OF CONTENTS

INTRODUCTION

Stationary source sampling was performed at Lee Brick and Tile Company, Sanford, North Carolina to determine the particulate emissions from a coal-fired tunnel kiln. Three sets of simultaneous particulate tests were made on each of the two kiln stacks on June 29, 1978.

Observing the tests were Scott Frame of Pullman-Swindell, Inc., and Sammy Amerson of the North Carolina Department of Natural Resources and Community Development.

The measurements made for stack gas flow rate and particulate emissions were made according to North Carolina Department of Natural Resources and Community Development recommendations.

The following sections of this report treat the summary of results, a brief description of the process and its operation, and the sampling and analytical procedures used.

SUMMARY OF RESULTS

Presented in Table 1 below are the emission rates as determined by the six particulate emission tests performed on the tunnel kiln exhaust outlets. The values shown are reasonably consistent and reflect the non-changing nature of the process.

Table 1

Particulate Emissions

Test Set No.	Pounds Per Hour		
	South	North	Total
1	11.4	6.85	18.3
2	8.93	6.40	15.3
3*	7.89	5.68	13.6
Avg.	9.41	6.31	15.7

*During the third set of tests, the kiln doors remained closed.

According to North Carolina Regulation 2D.0515, the maximum allowable emission rate is 17.7 pounds per hour. This is based on a process weight rate of 8.90 tons per hour and includes an estimate of the coal being combusted.

Table 2 and 3 on the following pages give the individual test summaries for the tests performed at stack #1 (south) and stack #2 (north), respectively.

TABLE 2

SUMMARY OF RESULTS, PARTICULATE EMISSIONS

KILN STACK #1 (SOUTH)

RUN NUMBER	1	2	3
DATE	6/29/78	6/29/78	6/29/78
STACK TEMPERATURE, DEG. F	282.	291.	288.
PERCENT EXCESS AIR	690.	690.	690.
PERCENT ISOKINETIC	100.5	106.9	99.5
STACK FLOW RATE SCFM* DRY	20527.	20344.	21073.
STACK FLOW RATE ACFM,WET	29517.	29883.	30254.
VOLUME OF GAS SAMPLED SCF* DRY	61.07	66.50	65.75
PARTICULATES, EPA METHOD 5:			
CATCH - MGRAMS	257.4	221.2	186.4
CONCENTRATION - GR/DSCF*	0.0649	0.0512	0.0437
EMISSION RATE - LBS/HR	11.42	8.93	7.89

* 68 DEG F, 29.92 IN. HG

TABLE 3

SUMMARY OF RESULTS, PARTICULATE EMISSIONS

KILN STACK #2 (NORTH)

RUN NUMBER	4	5	6
DATE	6/29/78	6/29/78	6/29/78
STACK TEMPERATURE, DEG. F	492.	512.	512.
PERCENT EXCESS AIR	402.	402.	402.
PERCENT ISOKINETIC	105.9	102.5	108.4
STACK FLOW RATE SCFM* DRY	8105.	8231.	8014.
STACK FLOW RATE ACFM,WET	15231.	15755.	15309.
VOLUME OF GAS SAMPLED SCF* DRY	46.22	40.25	39.82
PARTICULATES, EPA METHOD 5:			
CATCH - MGRAMS	295.8	237.0	213.8
CONCENTRATION - GR/DSCF*	0.0986	0.0907	0.0827
EMISSION RATE - LBS/HR	6.85	6.40	5.68

* 68 DEG F, 29.92 IN. HG

PROCESS DESCRIPTION AND OPERATION

Lee Brick and Tile Company in Sanford, North Carolina manufactures bricks, which involves the screening and blending of the raw materials, and the drying and firing of the final, shaped, product.

The firing of the bricks takes place in a tunnel kiln, with the bricks traveling on cars on rails through the kiln. After a set time, a car leaves the kiln at the same time a car is entering the kiln at the other end. At this time, doors at the end of the kiln are opened, allowing ambient air to enter uncontrolled.

Firing takes place in six steps: evaporation of free water, dehydration, oxidation, vitrification, flashing, and cooling. The actual fire zone is located near the middle of the kiln, with the 2000°F temperature provided by the combustion of coal. As shown in Figure 1, ambient air is used to cool the bricks and conversely preheat the air for the firing zone. Also some of the preheated air is ducted to the brick dryer for drying the bricks. The kiln is exhausted by two fans at opposite ends of the kiln.

Potential emissions from the kiln consist mainly of particulate matter in the form of dust generated by the handling of the bricks, and of combustion products from the coal. No emission control equipment is presently in use.

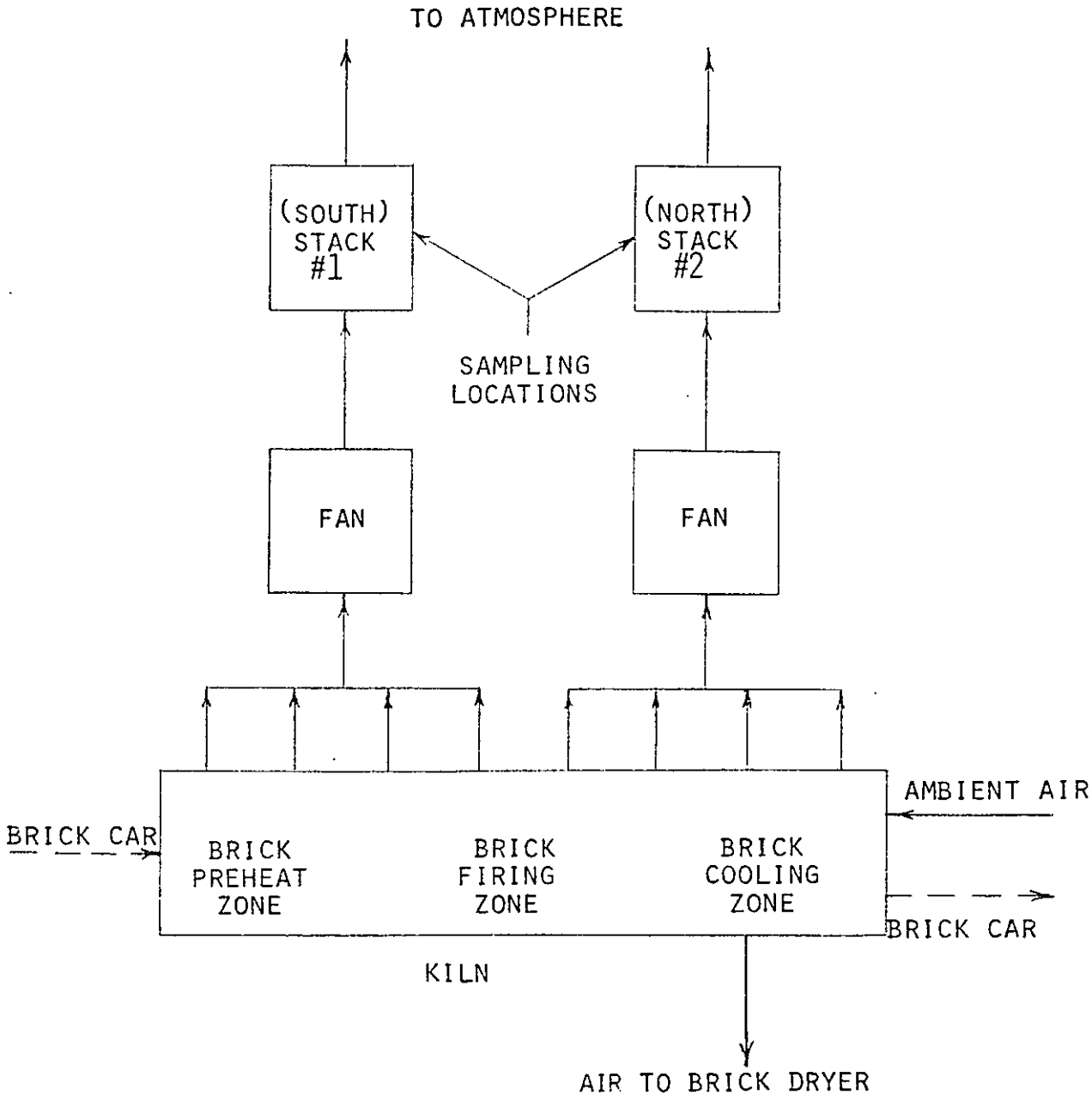


FIGURE 1. PROCESS SCHEMATIC AND SAMPLING LOCATIONS

During the testing performed at the outlet of the two kiln exhaust fans, the kiln was firing a carload containing 8064 of type #320 bricks every 100 minutes. With an average brick weight of 3.43 pounds, this converts to a process rate of 8.3 tons of bricks per hour. When the estimated coal usage rate of 0.60 tons per hour is added, the total process weight rate is 8.90 tons per hour.

It is suspected that the opening of the kiln doors increased the emissions; therefore, the last of the three sets of tests performed was made without a door opening occurring. As shown in Table 1 in the Summary of Results, the particulate tests did show a decrease in the emissions.

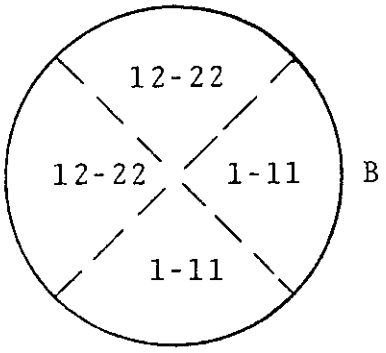
SAMPLING AND ANALYTICAL PROCEDURES

All sampling and analytical procedures used were those recommended by the United States Environmental Protection Agency and the North Carolina Department of Natural Resources and Community Development. Complete details of the equipment and procedures used are described in Appendix D, which is extracted from the Federal Register, August 18, 1977.

Method 1 was used to determine the number and location of the sampling points. The two kiln exhaust stacks are identical, with each stack cross section divided into 44 equal areas. Two ports labeled A and B, as shown in Figure 2, access the traverse axes, with each axis having 22 points. Every point was sampled for one and a half minutes, giving a total testing time of 66 minutes for each run on a stack.

Velocity measurements were in accordance with Method 2. Molecular weights for the stack gases were determined by Method 3 procedures. Particulate emissions were found using Method 5 analytical and sampling procedures.

All sampling equipment used was manufactured by Nutech Corporation or Entropy Environmentalists, Inc.



A

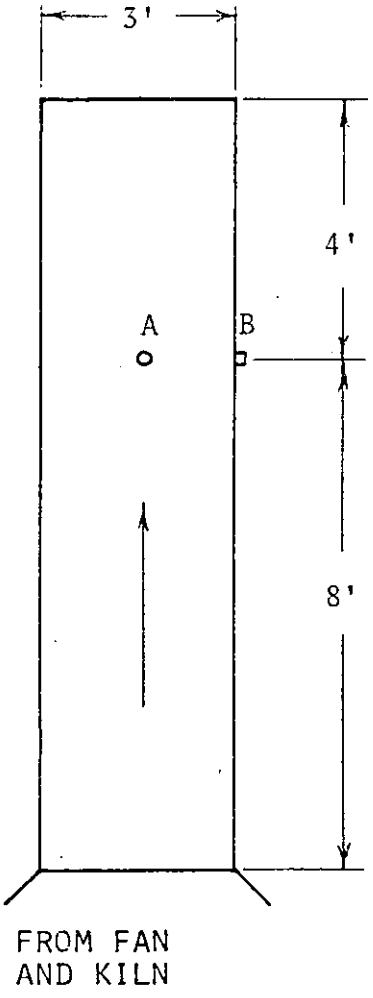


FIGURE 2. STACK DIMENSIONS AND SAMPLING POINT LOCATIONS, KILN EXHAUST STACKS (1 AND 2)

APPENDICES

RESULTS PREPARED BY

**ENTROPY ENVIRONMENTALISTS, INC. **

APPENDIX A-1

PARTICULATE FIELD DATA & RESULTS TABULATION

PLANT: LEE BRICK & TILE COMPANY, SANFORD, N. C.

TEST TEAM LEADER: WILLIS NESBIT

TEST 1 KILN STACK #1 (SOUTH)

TEST 2 KILN STACK #1 (SOUTH)

TEST 3 KILN STACK #1 (SOUTH)

RUN NUMBER		1	2	3
TEST DATE		6/29/78	6/29/78	6/29/78
TB	TIME-START	1055	1246	1429
TF	TIME-FINISH	1207	1410	1550
TT	NET TIME OF TEST,MIN.	66.0	66.0	66.0
FNP	NET SAMPLING POINTS	44.	44.	44.
DN	SAMPLING NOZZLE DIA., IN.	0.241	0.245	0.248
CP	PITOT TUBE COEFFICIENT	0.84	0.84	0.84
Y	DRY GAS METER CAL. FACTOR	1.00	1.00	1.00
PM	AVERAGE ORIFICE PRESSURE DROP, IN. H2O	3.24	3.54	3.74
VM	VOLUME OF DRY GAS SAMPLED CU. FT. AT METER CONDITIONS	67.543	73.747	73.740
TM	AVERAGE GAS METER TEMP DEGREES F	128.	130.	137.
VMSTD	VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS*,SCF	61.069	66.501	65.747
VW	TOTAL H2O COLLECTED IN IMPINGERS & SILICA GEL,ML.	29.5	45.5	18.0
VWV	VOLUME OF WATER VAPOR AT STANDARD CONDITIONS*, SCF	1.39	2.14	0.847
PMV	PERCENT MOISTURE BY VOL.	2.2	3.1	1.3
MD	MOLE FRACTION DRY GAS	0.978	0.969	0.987
PCO2	PERCENT CO2 BY VOL.,DRY	1.8	1.8	1.8
PO2	PERCENT O2 BY VOL.,DRY	18.4	18.4	18.4
PCO	PERCENT CO BY VOL.,DRY	0.0	0.0	0.0

PN2	PERCENT N2 BY VOL.,DRY	79.8	79.8	79.8
MWD	MOLECULAR WT-DRY STACK GAS	29.02	29.02	29.02
MW	MOLECULAR WT-STACK GAS	28.78	28.68	28.88
PB	BAROMETRIC PRESSURE,IN. HG.	29.90	29.90	29.90
PSI	STATIC PRES OF STACK GAS IN. H2O	0.0	0.0	0.0
PS	STACK PRES,ABS., IN. HG.	29.90	29.90	29.90
TS	AVERAGE STACK TEMP. DEG. F	282.	291.	288.
DPS	AVERAGE VELOCITY HEAD OF STACK GAS,IN. H2O	1.089	1.099	1.139
VS	AVE STACK GAS VELOCITY, FPS	69.6	70.5	71.3
AS	STACK AREA, SQUARE INCHES	1018.	1018.	1018.
QS	STACK FLOW RATE,DRY,SCFM*	20527.	20344.	21073.
QA	ACTUAL STACK FLOW RATE,ACFM	29517.	29883.	30254.
PERI	PERCENT ISOKINETIC	100.5	106.9	99.5
FMF	PARTICULATE,MG, EPA 5	257.4	221.2	186.4
CAN	PARTICULATE,GR/DSCF* EPA 5	0.0649	0.0512	0.0437
CAW	PARTICULATE,LBS/HR EPA 5	11.42	8.93	7.89
PEA	PERCENT EXCESS AIR	690.	690.	690.

* 68 DEG F, 29.92 IN. HG

x

PARTICULATE FIELD DATA & RESULTS TABULATION

PLANT: LEE BRICK & TILE COMPANY, SANFORD, N. C.

TEST TEAM LEADER: ROY N. DOSTER

TEST 4 KILN STACK #2 (NORTH)

TEST 5 KILN STACK #2 (NORTH)

TEST 6 KILN STACK #2 (NORTH)

RUN NUMBER		4	5	6
TEST DATE		6/29/78	6/29/78	6/29/78
TB	TIME-START	1055	1240	1409
TF	TIME-FINISH	1205	1350	1530
TT	NET TIME OF TEST,MIN.	66.0	66.0	66.0
FNP	NET SAMPLING POINTS	44.	44.	44.
DN	SAMPLING NOZZLE DIA., IN.	0.325	0.306	0.300
CP	PITOT TUBE COEFFICIENT	0.84	0.84	0.84
Y	DRY GAS METER CAL. FACTOR	1.00	1.00	1.00
PM	AVERAGE ORIFICE PRESSURE DROP, IN. H2O	1.94	1.35	1.24
VM	VOLUME OF DRY GAS SAMPLED CU. FT. AT METER CONDITIONS	50.497	44.418	43.509
TM	AVERAGE GAS METER TEMP DEGREES F	119.	124.	118.
VMSTD	VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS*,SCF	46.219	40.249	39.824
VW	TOTAL H2O COLLECTED IN IMPINGERS & SILICA GEL,ML.	41.0	33.5	31.5
VWV	VOLUME OF WATER VAPOR AT STANDARD CONDITIONS*, SCF	1.93	1.58	1.48
PMV	PERCENT MOISTURE BY VOL.	4.0	3.8	3.6
MD	MOLE FRACTION DRY GAS	0.960	0.962	0.964
PCO2	PERCENT CO2 BY VOL.,DRY	2.6	2.6	2.6
PO2	PERCENT O2 BY VOL.,DRY	17.0	17.0	17.0
PCO	PERCENT CO BY VOL.,DRY	0.0	0.0	0.0

PN2	PERCENT N2 BY VOL.,DRY	80.4	80.4	80.4
MWD	MOLECULAR WT-DRY STACK GAS	29.10	29.10	29.10
MW	MOLECULAR WT-STACK GAS	28.65	28.68	28.70
PB	BAROMETRIC PRESSURE,IN. HG.	29.90	29.90	29.90
PSI	STATIC PRES OF STACK GAS IN. H2O	0.0	0.0	0.0
PS	STACK PRES,ABS., IN. HG.	29.90	29.90	29.90
TS	AVERAGE STACK TEMP. DEG. F	492.	512.	512.
DPS	AVERAGE VELOCITY HEAD OF STACK GAS,IN. H2O	0.225	0.236	0.223
VS	AVE STACK GAS VELOCITY, FPS	35.9	37.1	36.1
AS	STACK AREA, SQUARE INCHES	1018.	1018.	1018.
QS	STACK FLOW RATE,DRY,SCFM*	8105.	8231.	8014.
QA	ACTUAL STACK FLOW RATE,ACFM	15231.	15755.	15309.
PERI	PERCENT ISOKINETIC	105.9	102.5	108.4
FMF	PARTICULATE,MG, EPA 5	295.8	237.0	213.8
CAN	PARTICULATE,GR/DSCF* EPA 5	0.0986	0.0907	0.0827
CAW	PARTICULATE,LBS/HR EPA 5	6.85	6.40	5.68
PEA	PERCENT EXCESS AIR	402.	402.	402.

* 68 DEG F, 29.92 IN. HG

EXAMPLE PARTICULATE CALCULATIONS TEST NO. 4

KILN STACK #2 (NORTH)

VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS

VMSTD = 17.64 * VM * Y * (PB+PM/13.6) / (TM+460)

$$VMSTD = \frac{17.64 * 50.497 * 1.00 * (29.90+1.940/13.6)}{579.0} = 46.219 \text{ DSCF}$$

VOLUME OF WATER VAPOR AT STANDARD CONDITIONS

VWV = .04707 * VW

VWV = .04707 * 41.0 = 1.930 SCF

PERCENT MOISTURE IN STACK GAS

PMV = (100*VWV)/(VMSTD+VWV)

$$PMV = \frac{100.* 1.93}{46.219+ 1.93} = 4.0 \text{ PERCENT}$$

MOLE FRACTION OF DRY STACK GAS

MD = (100.-PMV)/100.

$$MD = \frac{100.- 4.0}{100.} = 0.960$$

AVERAGE MOLECULAR WEIGHT OF DRY STACK GAS

MWD = (PCO2*.44)+(PO2*.32)+(PN2+PCO)*.28

MWD = (2.6*0.44)+(17.0*0.32)+((80.4+0.0)*0.28) = 29.10 LB/LB MOLE

MOLECULAR WEIGHT OF STACK GAS

MW = MWD*MD + 18*(1-MD)

MW = 29.10*0.960 + 18*(1-0.960) = 28.65 LB/LB MOLE

STACK GAS VELOCITY AT STACK CONDITIONS

VS = 85.49*CP*SQRT((DPS*(TS+460))/(PS*MW))

VS = 85.49*.84*SQRT((0.225* 952.) / (29.90*28.65)) = 35.9 FPS

STACK GAS VOLUMETRIC FLOW AT STACK CONDITIONS

QA = VS * AS * 60 / 144

QA = 35.9 * 1018. * 60 / 144 = 15231. ACFM

STACK GAS VOLUMETRIC FLOW AT STANDARD CONDITIONS

QS = (17.64*QA*PS*MD) / (TS+460)

$$QS = \frac{17.64 * 15231. * 29.90 * 0.960}{952.0} = 8105.\ SCFM$$

PERCENT ISOKINETIC

PERI = (17.3*(TS+460)*VMSTD)/(VS*TT*PS*MD*DN*DN)

$$PERI = \frac{17.3 * 952.0 * 46.22}{35.9 * 66.0 * 29.90 * 0.960 * 0.325 * 0.325} = 105.9\ PERCENT$$

PARTICULATE LOADING -- EPA METHOD 5
(AT STANDARD CONDITIONS)

CAN = 0.0154*FMF/VMSTD

CAN = 0.0154*(295.8/ 46.22) = 0.0986 GR/DSCF

PARTICULATE LBS/HR--EPA METHOD 5

CAW = 0.00857*CAN*QS

CAW = 0.00857* 0.099* 8105. = 6.85 LBS/HR

PERCENT EXCESS AIR

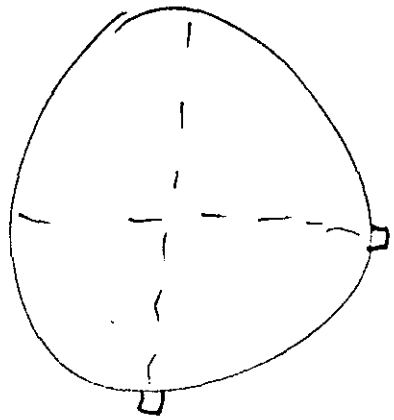
$$PEA = \frac{(PO2-0.5*PCO)}{0.264*PN2-PO2+0.5*PCO} * 100$$

$$PEA = \frac{17.0-(0.5*0.0}{(0.264*80.4)-(17.0+0.5*0.0} * 100 = 402.3\ PERCENT$$

APPENDIX B-1

PRELIMINARY FIELD DATA

Stack Geometry



Sketch of stack cross section showing sampling ports.

Plant Name La Brick & Tile

Plant Location Sanford

Sampling Location Kiln Stacks 1 & 2

Date(s) 6-29-78

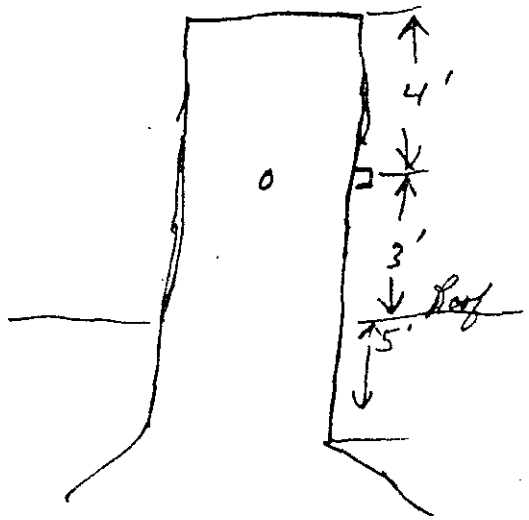
A. Dist. from inside of far wall to outside of near wall: 38 3/4 inches

B. Wall thickness: 2 3/4 inches

Inside diameter of stack (A-B): 36" inches

Stack Area: 1018 square inches

Comments: # 1 Stack is the South Stack
2 Stack is the North Stack



Sketch of stack dimensions and location of sampling ports.

Point	% of Diameter	Distance from inside wall	Distance from outside of port
1	1.1	3/8	5 1/8
2	3.5	1 1/4	4
3	6.0	2 1/8	4 7/8
4	8.7	3 1/8	5 7/8
5	11.6	4 1/8	6 7/8
6	14.6	5 1/4	8
7	18.0	6 1/2	9 1/4
8	21.8	7 7/8	10 5/8
9	26.2	9 1/2	12 1/4
10	31.5	11 3/8	14 1/8
11	39.3	14 1/8	16 7/8
12	60.7	21 7/8	24 5/8

Point	% of Diameter	Distance from inside wall	Distance from out-side of port
13	68.5	24 5/8	27 3/8
14	73.8	26 1/2	29 1/4
15	78.2	28 1/8	30 7/8
16	82.0	29 1/2	32 1/4
17	85.4	30 3/4	33 1/2
18	88.4	31 7/8	34 5/8
19	91.3	32 7/8	35 5/8
20	94.0	33 7/8	36 5/8
21	96.5	34 3/4	37 1/2
22	98.9	35 5/8	38 3/8

ENTROPY ENVIRONMENTALISTS, INC ..... SPECIALISTS IN SOURCE SAMPLING

ORSAT FIELD DATA

Plant Name Lee Brick Date 6-29-78

Sampling Location Stack #1 (South) Operator RD

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
1429 & 1550	1600	1.8	20.2	20.2	18.4	0	79.8

PROCESS DESCRIPTION

FUEL TYPE

Wood ☐ bark ☐ shavings ☐ chips ☐ sawdust

Oil ☐ #1 ☐ #2 ☐ #3 ☐ #4 ☐ #5 ☐ #6

Coal ☐ coke ☐ anthracite ☐ pulverized? ☑ bituminous

Nat. Gas ☑ Other _____

BOILER TYPE

Feeding Location ☐ overfeed ☐ underfeed

Mechanism ☐ manual ☐ steam ☐ flipper ☐ screw ☐ vibrator ☐ gravity ☐ chain ☐ air ☐ ram

Grating type ☐ solid ☐ traveling ☐ stationary ☐ vibrating

Control Equipment? None

Combustion Air Configuration ☐ overfire jets

PROCESS OPERATION

RATE TYPE	Rated	Normal	Actual
Feed Rate (lbs/hr, gals/hr, cu. ft./hr			16 600 lbs/hr.
Steam Rate (lbs/hr)			
KW produced (power boilers only)			
MBTU/hr produced			
H.P. produced			

PARTICULATE FIELD DATA

Company/Location Lee Brick
Sanford, NC
Sampling Location: Stack 1 (South)
Date 6/29/88 Test Participants WMBH
Bar. Press., in. Hg 29.90 Meter Box # N-6
Static Press., in. H_2O 0 ΔH@ 1.88
Ambient Temp, °F 92 C Factor 1.13
Est. Moisture, % 4 Temp. Device T/C

Run # 1
Start: 10:55
Finish: 12:07

Filter # 2976
Tare Wt. ~~1.0073~~ .4142

Sample Box # 1 @ Heat Setting HI
Probe # 4-1 @ Heat Setting HI
Nozzle # 205 with Dia., inches .241
Pitot Leak Tests: Before ✓ After ✓
Sampling Train Leak Test (from nozzle)
Before @ ≥ 15 in. Hg = 0.00 cfm
After @ 6 in. Hg = 0.005 cfm
Avg. Δp 0.64 at ΔH of 1.84

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
A 1	0	14.758	0.48	1.30	1.30	115	2	250	70	300
2	1½	15.68	0.70	2.00	2.00	116	2	250	70	300
3	3	16.87	0.90	2.60	2.60	117	3	280	70	301
4	4½	18.23	1.05	3.10	3.10	118	3	250	70	302
5	6	19.65	1.20	3.50	3.50	119	4	250	70	303
6	7½	21.25	1.10	3.20	3.20	120	4	250	70	302
7	9	22.77	1.05	3.10	3.10	120	4	250	70	275
8	10½	24.27	1.10	3.20	3.20	120	4	250	70	279
9	12	25.79	1.10	3.20	3.20	120	4	250	70	272
10	13½	27.32	1.00	2.90	2.90	120	4	250	70	310
11	15/0	28.79	1.15	3.30	3.30	120	4	250	70	325
12	1½	30.32	1.05	3.10	3.10	121	4	250	70	281
13	3	31.82	1.10	3.20	3.20	121	4	250	70	276
14	4½	33.35	1.10	3.20	3.20	121	4	250	70	277
15	6	34.87	1.10	3.20	3.20	122	4	250	70	278
16	7½	36.42	1.10	3.20	3.20	123	4	250	70	276
17	9	37.94	1.25	3.60	3.60	125	4	250	70	331
18	10½	39.54	1.25	3.60	3.60	126	4	250	70	302
19	12	41.17	1.20	3.50	3.50	128	4	250	70	382
20	13½	42.77	1.20	3.50	3.50	129	4	250	70	283
21	15/0	44.39	1.15	3.30	3.30	130	4	250	70	281

Company Lee Brick

Run # 1

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F	
22	1½	45.95	1.15	3.30	3.30	130	4	250	70	275	
B 1	3	47.53	0.85	2.50	2.50	130	3	250	70	245	
2	4½	48.90	0.85	2.50	2.50	130	3	250	70	248	
3	6	50.13	0.95	2.80	2.80	130	3	250	70	250	
4	7½	51.56	1.65	4.80	4.80	131	6	250	70	252	
5	9	53.26	1.55	4.50	4.50	132	6	250	70	230	
6	10½	55.11	1.50	4.30	4.30	132	6	250	70	225	→ Changed nomo
7	12	57.03	1.15	3.50	3.50	132	6	250	70	265	
8	13½	58.95	1.15	3.50	3.50	132	6	250	70	265	
9	15/0	60.31	1.10	3.30	3.30	133	5	250	70	267	ΔP .61 @ 275
10	1½	61.98	1.15	3.50	3.50	134	5	250	70	268	
11	3	63.47	1.20	3.60	3.60	135	5	250	70	269	
12	4½	65.11	1.05	3.20	3.20	136	4	250	70	330	
13	6	66.67	1.05	3.20	3.20	137	4	250	70	280	
14	7½	68.22	1.05	3.20	3.20	137	4	250	70	288	
15	9	69.76	1.05	3.20	3.20	137	5	250	70	279	
16	10½	71.29	1.05	3.20	3.20	137	5	250	70	280	
17	12	72.84	1.30	4.00	4.00	138	5	250	70	330	
18	13½	74.54	1.10	3.30	3.30	138	5	250	70	300	
19	15/0	76.12	1.05	3.20	3.20	139	4	250	70	287	
20	1½	77.67	1.05	3.20	3.20	139	4	250	70	285	
21	3	79.23	1.00	3.10	3.10	139	4	250	70	284	
22	4½	80.79	1.00	3.10	3.10	139	4	250	70	284	
	FINAL	82.301									
	Diff	67.543									
	AVG.		1.089		3.245	128.363				282.386	

PARTICULATE FIELD DATA

Company/Location Lee Brick
Sanford, NC
Sampling Location: Stack 1 (South)
Date 6/29/78 Test Participants WW, WH
Bar. Press., in. Hg 29.90 Meter Box # W-6
Static Press., in. H_2O 0 $\Delta H_@$ 1.88
Ambient Temp, °F 79 C Factor 1.13
Est. Moisture, % 4 Temp. Device T/C

Run # 2
Start: 12:46
Finish: 14:10

Filter #	Tare Wt.
2950	.4121

Sample Box # 2 @ Heat Setting 7
Probe # 4-2 @ Heat Setting 9
Nozzle # 206 with Dia., inches .245
Pitot Leak Tests: Before ✓ After ✓
Sampling Train Leak Test (from nozzle)
Before @ ≥ 15 in. Hg = 0.00 cfm
After @ 14 in. Hg = ~~0.03~~ cfm
Avg. Δp 0.59 at ΔH of 1.84 @ 275

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
A 1	0	82.628	0.47	1.50	1.50	129	4	250	70	276
2	1½	85.74	0.48	1.55	1.55	129	4	250	70	278
3	3	84.80	0.48	1.55	1.55	129	4	250	70	278
4	4½	85.96	0.95	3.00	3.00	129	6	250	70	279
5	6	87.15	1.10	3.45	3.45	129	8	250	70	282
6	7½	88.90	1.35	4.30	4.30	129	11	250	70	283
7	9	89.99	1.35	4.30	4.30	129	12	250	70	286
8	10½	91.36	1.10	3.50	3.50	129	10	250	70	287
9	12	93.04	1.10	3.50	3.50	129	10	250	70	289
10	13½	95.89	1.05	3.40	3.40	129	9	250	70	289
11	15/0	97.85	1.05	3.40	3.40	129	9	250	70	289
12	1½	98.99	1.20	3.80	3.80	129	10	250	70	289
13	3	101.64	1.20	3.80	3.80	129	10	250	70	290
14	4½	102.87	1.10	3.50	3.50	129	10	250	70	330
15	6	104.72	1.45	4.60	4.60	129	13	250	70	289
16	7½	106.89	1.45	4.60	4.60	129	13	250	70	290
17	9	108.75	1.50	4.70	4.70	129	14	250	70	275
18	10½	111.98	1.20	3.80	3.80	130	10	250	70	298
19	12	113.10	1.35	4.30	4.30	130	10	250	70	298
20	13½	114.98	1.15	3.60	3.60	130	10	250	70	279
21	15/0	116.68	1.10	3.50	3.50	130	10	250	70	270

ENTROPY ENVIRONMENTALISTS, INC

Company: Lee Brick

Run # 2

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
22	1½	118.34	1.15	3.60	3.60	130	10	250	70	278
B 1	3	120.96	1.15	3.60	3.60	130	10	250	70	280
2	4½	121.77	1.00	3.20	3.20	130	10	250	70	287
3	6	123.36	1.10	3.50	3.50	130	10	250	70	289
4	7½	124.96	1.10	3.50	3.50	130	10	250	70	290
5	9	126.56	1.10	3.50	3.50	130	10	250	70	286
6	10½	128.19	1.10	3.50	3.50	130	10	250	70	290
7	12	129.84	1.25	4.00	4.00	130	11	250	70	320
8	13½	131.47	1.15	3.60	3.60	130	10	250	70	297
9	15/0	133.12	1.05	3.40	3.40	130	10	250	70	291
10	1½	134.73	1.00	3.20	3.20	131	9	250	70	292
11	3	136.62	1.00	3.20	3.20	131	9	250	70	277
12	4½	137.89	1.00	3.20	3.20	131	9	250	70	292
13	6	139.36	1.25	4.00	4.00	132	12	250	70	295
14	7½	140.99	1.25	4.00	4.00	132	12	250	70	296
15	9	142.76	1.05	3.40	3.40	132	10	250	70	296
16	10½	144.37	1.10	3.50	3.50	132	10	250	70	298
17	12	145.98	1.10	3.50	3.50	132	10	250	70	296
18	13½	147.59	1.15	3.60	3.60	132	10	250	70	295
19	15/0	149.23	1.30	4.10	4.10	132	10	250	70	296
20	1½	151.12	1.30	4.10	4.10	132	10	250	70	304
21	3	152.68	1.05	3.40	3.40	132	10	250	70	301
22	4½	154.27	1.05	3.80	3.40	132	10	250	70	300
	FINAL	156.375								
	Diff	73747								
	AVG.		1.099		3.537	130.50				29075

PARTICULATE FIELD DATA

Company/Location Ja Brick
Sanford, NC
Sampling Location: Stack 1 (South)
Date 6/29/28 Test Participants LW, NH
Bar. Press., in. Hg 29.9 Meter Box # N-6
Static Press., in. H_2O 0 ΔH@ 1.88
Ambient Temp, °F 99 C Factor 1.13
Est. Moisture, % 4 Temp. Device T/C

Run # 3
Start: 14:29
Finish: 15:50

Filter #	Tare Wt.
2975	.4110

Sample Box # 2 @ Heat Setting 6
Probe # 4-3 @ Heat Setting ~~288~~ Hi
Nozzle # 204 with Dia., inches .248
Pitot Leak Tests: Before ✓ After ✓
Sampling Train Leak Test (from nozzle)
Before @ ≥ 15 in. Hg = 0.00 cfm
After @ 7 in. Hg = 0.00 cfm
Avg. Δp 0.56 at ΔH of 1.84 @ 275

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
A 1	0	156.864	0.95	3.15	3.15	128	5	250	70	325
2	1½	158.36	1.00	3.60	3.60	129	5	250	70	297
3	3	160.11	1.10	3.60	3.60	129	5	250	70	286
4	4½	161.70	1.05	3.50	3.50	130	5	250	70	282
5	6	163.23	1.10	3.60	3.60	130	6	250	70	284
6	7½	164.87	1.10	3.60	3.60	150	6	250	70	282
7	9	166.53	1.25	4.10	4.10	132	6	250	70	289
8	10½	168.27	1.20	3.90	3.90	133	6	250	70	336
9	12	169.95	1.20	3.90	3.90	133	6	250	70	287
10	13½	171.67	1.35	4.40	4.40	133	6	250	70	280
11	15	173.56	1.30	4.30	4.30	133	6	250	70	282
12	1½	175.35	1.10	3.60	3.60	136	5	250	70	280
13	3	177.06	1.25	4.10	4.10	137	6	250	70	310
14	4½	128.72	1.15	3.70	3.70	138	6	250	70	269
15	6	180.39	1.15	3.70	3.70	138	6	250	70	267
16	7½	181.99	1.20	3.90	3.90	139	6	250	70	279
17	9	183.76	1.20	3.90	3.90	140	6	250	70	272
18	10½	185.98	1.40	4.60	4.60	140	6	250	70	278
19	12	187.88	1.45	4.80	4.80	140	7	250	70	328
20	13½	188.85	1.25	4.10	4.10	140	6	250	70	282
21	15	171.02	1.25	4.10	4.10	140	6	250	70	278

Company Lee Brick

Run # 3

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
22	1½	192.75	1.20	3.90	3.90	140	5	250	70	279
B 1	3	194.48	1.00	3.30	3.30	140	5	250	70	324
2	4½	196.17	1.30	4.30	4.30	140	6	250	70	289
3	6	197.89	1.10	3.60	3.60	140	5	250	70	286
4	7½	199.55	1.10	3.60	3.60	140	5	250	70	285
5	9	201.20	1.05	3.50	3.50	140	5	250	70	286
6	10½	202.84	1.10	3.60	3.60	140	5	250	70	284
7	12	204.49	1.15	3.70	3.70	140	5	250	70	332
8	13½	206.16	1.15	3.70	3.70	140	5	250	70	336
9	15/0	207.84	1.00	3.30	3.30	140	5	250	70	300
10	1½	209.42	1.00	3.30	3.30	140	5	250	70	289
11	3	210.98	1.00	3.30	3.30	140	5	250	70	288
12	4½	212.56	1.00	3.30	3.30	140	5	250	70	288
13	6	214.14	0.85	2.80	2.80	140	4	250	70	317
14	7½	215.63	1.30	4.30	4.30	140	6	250	70	306
15	9	217.36	1.10	3.60	3.60	140	5	250	70	267
16	10½	218.99	1.10	3.60	3.60	140	5	250	70	260
17	12	220.66	1.15	3.70	3.70	140	5	250	70	259
18	13½	222.34	1.10	3.60	3.60	140	5	250	70	258
19	15/0	223.98	1.15	3.70	3.70	140	5	250	70	259
20	1½	225.66	1.30	4.30	4.30	140	6	250	70	311 → 311
21	3	227.43	1.10	3.60	3.60	140	5	250	70	268
22	4½	229.10	0.90	2.90	2.90	140	5	250	70	262
	FINAL	230.604								
	Diff.	73.74								
	AVG.		1.139		3.742	137.454				288.181

PARTICULATE [illegible] CLEANUP SHEET

Plant Name LEE BRICK & TILE COMPANY
Sampling Location KILN STACK #1 (SOUTH)
Reagent Box # 0207 Date Analyzed 6-30-78

Blank Calculations:	Acetone	Water
Blank Residue	0.2 mg	
Blank Volume	100 ml.	
Concentration	.002 mg/mls	mg/mls
Volume Used	275 mls	mls
#1 Blank Weight	0.55 mgms	mgms
Volume Used	325 mls	mls
#2 Blank Weight	0.65 mgms	mgms
Volume Used	225 mls	mls
#3 Blank Weight	0.45 mgms	mgms

Analysis Method: (Zero & Span Balance EES Initials)
EPA METHOD 5

Description of Sample:
GRAY BROWN PARTICULATE

Remarks:

Date of Test	6-29	6-29	6-29
Test Number	1	2	3
Moisture Collected:			
Impinger water volume	206	220	201
Tared volume	200	200	200
Captured water	6 mls	20 mls	1 mls
Silica Gel weight	248.5	250.5	242.0
Tared weight	225.0	225.0	225.0
Adsorbed water	23.5 gms	25.5 gms	17.0 gms
TOTAL MOISTURE CATCH	29.5 mls	45.5 mls	18.0 mls
Front Half Analysis: (Nozzle, probe, cyclone, filter front half)			
Filter & Particulate	672.2	634.0	597.9
Filter Tare weight	414.2	412.1	411.0
Filter Particulate	258.0	221.9	186.9
Rinsings or Dry Wt.	—	—	—
Particulate catch	258.0 mgms	221.9 mgms	186.9 mgms
Acetone blank	0.6	0.7	0.5
TOTAL FRONT CATCH	257.4 mgms	221.2 mgms	186.4 mgms
Back Half Analysis: (Impingers, filter back half)			
Extractables weight			
Boil Down weight			
Impingers' Catch	mgms	mgms	mgms
Water blank			
TOTAL BACK CATCH	mgms	mgms	mgms
TOTAL TRAIN CATCH	mgms	mgms	mgms

CUSTODY SHEET FOR REAGENT BOX # 0207

Date of Makeup 13 June 78 Individual Water Tare Volume 200 mls

Initials GGS Individual Silica Gel Tare Weight 225.0 gms

Locked? ✓

Plant Name Lee Brick

Sampling Location Sanford, NC (South Stack)

Box/Test Number	Date Used	Initials	Locked?	Date Cleanup	S. Gel Spent?	Initials	Locked?
2/1	6/29	LW	✓	6/29	90%	LW	✓
3/2	6/29	LW	✓	6/29	90%	LW	✓
1/3	6/29	LW	✓	6/29	95%	LW	✓

	Date	Initials	Locked?
Transferred to Lab	6/30/78	LW	✓
Received in Lab	"	GGS	✓

Zero & Span Balance Initials GGS

Sampling Method: EPA-5

Remarks: gray brown particulate

Filter #	Tare Weight (mgms)	Used on Test
2976	414.2	1
2950	412.1	2
2975	411.0	3

ENTROPY ENVIRONMENTALISTS, INC ..... SPECIALISTS IN SOURCE SAMPLING

APPENDIX B-2

ENTROPY ENVIRONMENTALISTS, INC

SPECIALISTS IN SOURCE SAMPLING

ORSAT FIELD DATA

Plant Name Lee Brush & Tile #1 Date 6-29-18

Sampling Location #2 Stack (North) Operator RD

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
1509 & 1530	1615	2.6	19.6	19.6	17.0	0	80.4

PROCESS DESCRIPTION

FUEL TYPE

Wood ☐ bark ☐ shavings ☐ chips ☐ sawdust

Oil ☐ #1 ☐ #2 ☐ #3 ☐ #4 ☐ #5 ☐ #6

Coal ☐ coke ✓ bituminous ☐ anthracite ☐ pulverized?

Nat. Gas ✓ Other _____

BOILER TYPE

Feeding Location ☐ overfeed ☐ underfeed

Mechanism ☐ manual ☐ steam ☐ flipper ☐ screw ☐ vibrator ☐ gravity ☐ chain ☐ air ☐ ram

Grating type ☐ solid ☐ traveling ☐ stationary ☐ vibrating

Control Equipment? None

Combustion Air Configuration ☐ overfire jets

PROCESS OPERATION

RATE TYPE	Rated	Normal	Actual
Feed Rate (lbs/hr, gals/hr, cu. ft./hr			16 600 lbs/hr.
Steam Rate (lbs/hr)			
KW produced (power boilers only)			
MBTU/hr produced			
H.P. produced			

PARTICULATE FIELD DATA

Company/Location Ga Stack

Sampling Location: Stack #2 North

Date 6-29-78 Test Participants RD NH

Bar. Press., in. Hg 29.40 Meter Box # Y3

Static Press., in. H_2O 0 $\Delta H@$ 1.74

Ambient Temp, °F 100 C Factor 1.05

Est. Moisture, % 4 Temp. Device Thermo

Run # 4

Start: 10:55

Finish: 12:05

Filter # Tare Wt.

Sample Box # 4 @ Heat Setting Hi

Probe # 4-1 @ Heat Setting Hi

Nozzle # 209 with Dia., inches .325

Pitot Leak Tests: Before ✓ After ✓

Sampling Train Leak Test (from nozzle)

Before @ ≥ 15 in. Hg = 0.005 cfm

After @ 6 in. Hg = 0.005 cfm

Avg. Δp .22 at ΔH of 1.84

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
A 1	0	40.950	.10	.85	.85	110	2	225	60	498
2	1½	41.87	.10	.85	.85	110	2	225	60	481
3	3	42.50	.22	1.85	1.85	110	4	230	60	503
4	4½	43.51	.24	2.0	2.0	110	4	230	60	503
5	6	44.74	.24	2.0	2.0	110	4	230	60	501
6	7½	45.94	.06	.50	.50	111	2	230	60	501
7	9	46.63	.28	2.4	2.4	111	5	235	60	500
8	10½	47.79	.28	2.4	2.4	111	5	235	60	500
9	12	49.09	.30	2.6	2.6	112	5	230	60	505
10	13½	50.40	.30	2.6	2.6	112	5	230	60	505
11	15	51.79	.30	2.6	2.6	112	5	230	60	503
12	1½	53.16	.06	.50	.50	112	2	235	60	500
13	3	53.87	.30	2.6	2.6	112	5	235	60	500
14	4½	55.10	.30	2.6	2.6	112	5	230	60	505
15	6	56.51	.32	2.8	2.8	112	5	235	60	505
16	7½	57.95	.32	2.8	2.8	112	5	240	60	506
17	9	59.40	.34	3.0	3.0	112	6	240	60	506
18	10½	60.98	.06	.50	.50	113	2	245	60	500
19	12	61.68	.10	.85	.85	113	2	245	60	440
20	13½	62.50	.34	3.0	3.0	113	6	250	60	445
21	15	63.40	.34	3.0	3.0	115	6	250	60	495

Company: Lee Brick

Run # 4

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
22	1½	65.33	.34	3.0	3.0	116	6	255	65	500
B 1	3-0	66.87	.05	0.42	0.42	116	2	260	65	500
2	1½	67.40	.34	3.0	3.0	116	6	260	65	503
3	3	68.81	.32	2.3	2.3	117	6	265	65	508
4	4½	70.10	.32	2.3	2.3	117	6	245	65	515
5	6	71.40	.34	2.5	2.5	118	5	265	65	515
6	7½	72.80	.32	2.3	2.3	118	5	265	65	515
7	9	74.14	.06	.42	.42	119	2	265	65	495
8	10½	74.84	.44	3.2	3.2	119	6	260	65	475
9	12	76.21	.34	2.5	2.5	119	5	260	65	475
10	13½	77.55	.32	2.3	2.3	120	5	255	65	490
11	15	78.92	.30	2.15	2.15	122	5	250	65	470
12	1½	80.21	.30	2.15	2.15	122	5	250	65	520
13	3	81.50	.06	.42	.42	122	2	250	65	520
14	4½	82.15	.06	.42	.41	120	2	250	65	490
15	6	82.71	.30	2.15	2.15	120	5	240	65	505
16	7½	83.95	.28	2.0	2.0	122	4	240	65	515
17	9	85.15	.28	2.0	2.0	122	4	240	65	520
18	10½	86.38	.30	2.15	2.15	122	5	250	70	520
19	12	87.70	.06	.42	.42	124	2	250	70	520
20	13½	88.00	.06	.42	.42	124	2	250	70	500
21	15	88.90	.32	2.3	2.3	122	5	245	70	500
22	1½	90.13	.32	2.3	2.3	122	5	245	70	520
	66 MIN	91.447								
	Diff.	50.497								
	AVG.		0.225		1.941	118.545				492.340

PARTICULATE FIELD DATA

Company/Location Lee Brick
Sanford NC
Sampling Location: Stack #2 (North)
Date 6-29-18 Test Participants RD - JE
Bar. Press., in. Hg 29.90 Meter Box # M3
Static Press., in. H_2O 0 ΔH@ 1.74
Ambient Temp, °F 115 C Factor 1.05
Est. Moisture, % 4 Temp. Device 105

Run # 5
Start: 1240
Finish: 1350

Filter # Tare Wt.

Sample Box # 36 @ Heat Setting Hi
Probe # 4-2 @ Heat Setting Hi
Nozzle # 207 with Dia., inches .306
Pitot Leak Tests: Before ✓ After ✓
Sampling Train Leak Test (from nozzle)
Before @ ≥ 15 in. Hg = 0.000 cfm
After @ 6 in. Hg = 0.09 cfm
Avg. Δp .34 at ΔH of 1.84

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
A 1	0	91.763	.20	1.05	1.05	122	3	255	60	520
2	1½	92.66	.24	1.25	1.25	123	4	260	60	520
3	3	93.61	.28	1.5	1.5	124	4	260	60	525
4	4½	94.65	.26	1.4	1.4	125	4	265	60	530
5	6	95.80	.06	.30	.30	125	2	255	60	500
6	7½	96.32	.28	1.5	1.5	125	4	255	60	500
7	9	97.33	.28	1.5	1.5	125	4	250	60	515
8	10½	98.40	.28	1.5	1.5	125	4	245	60	515
9	12	99.91	.30	1.6	1.6	126	4	250	60	515
10	13½	100.61	.30	1.6	1.6	126	4	250	60	500
11	15	101.65	.06	.30	.30	126	2	250	60	520
12	1½	102.17	.28	1.5	1.5	126	4	250	60	510
13	3	103.11	.28	1.5	1.5	126	4	250	60	500
14	4½	104.00	.28	1.5	1.5	126	4	240	60	505
15	6	105.23	.34	1.85	1.85	125	6	240	60	530
16	7½	106.50	.32	1.7	1.7	125	5	240	60	530
17	9	107.89	.06	.30	.30	125	2	250	60	525
18	10½	108.49	.06	.30	.30	125	2	255	60	510
19	12	108.82	.34	1.85	1.85	125	5	260	60	520
20	13½	109.40	.34	1.85	1.85	124	5	265	60	530
21	15	111.11	.34	1.85	1.85	124	5	265	60	520

Company Lee Brick

Run # 5

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
22	1½	112.30	.34	1.85	1.85	124	5	255	65	525
B1	3-0	113.50	.06	.30	.30	124	5	265	65	525
2	1½	113.98	.24	1.25	125	124	5	265	65	500
3	3	114.92	.38	2.0	2.0	124	6	260	65	490
4	4½	116.40	.38	2.0	2.0	124	6	260	65	470
5	6	117.57	.40	2.2	2.2	123	6	260	65	470
6	7½	119.16	.28	1.5	1.5	123	5	260	65	460
7	9	120.00	.06	.30	.30	122	2	250	65	460
8	10½	120.69	.34	1.85	1.85	122	6	250	65	490
9	12	122.00	.34	1.85	1.85	122	6	245	65	490
10	13½	123.09	.32	1.7	1.7	122	5	245	65	495
11	15	124.32	.30	1.6	1.6	122	5	255	65	515
12	1½	125.42	.30	1.6	1.6	122	5	260	65	530
13	3	126.58	.06	.30	.30	122	2	260	65	515
14	4½	127.18	.28	1.5	1.5	120	5	265	65	515
15	6	128.18	.30	1.6	1.6	122	5	265	65	530
16	7½	129.26	.30	1.6	1.6	122	5	265	65	540
17	9	130.34	.28	1.5	1.5	122	5	270	65	540
18	10½	131.52	.30	1.6	1.6	124	5	260	70	540
19	12	132.65	.06	.30	.30	124	2	260	70	530
20	13½	133.31	.06	.30	.30	124	2	250	70	500
21	15	133.99	.28	1.5	1.5	124	5	250	70	530
22	1½	135.10	.38	1.5	1.5	124	5	255	70	540
	6 Min	136.121								
	Diff.	44.418								
	AVG.		0.236		1.35	123.840				512.50

PARTICULATE FIELD DATA

Company/Location Lee Brick

Run # 6

Sampling Location: #2 Stack North

Start: 1409

Date 6-24-98 Test Participants KDJE

Finish: 1530

Bar. Press., in. Hg 29.90 Meter Box # N3

Static Press., in. H_2O 0 $\Delta H_@$ 1.74

Filter # Tare Wt.

Ambient Temp, °F 120 °C Factor 1.05

Est. Moisture, % 4 Temp. Device Thermo

Sample Box # 29 @ Heat Setting Hi

Probe # 4-21 @ Heat Setting Hi

Nozzle # 208 with Dia., inches .300

Pitot Leak Tests: Before ✓ After ✓

Sampling Train Leak Test (from nozzle)

Before @ ≥ 15 in. Hg = 0.000 cfm

After @ 5 in. Hg = 0.015 cfm

Avg. Δp 0.36 at ΔH of 1.84

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
A 1	0	136.45	.22	1.2	1.2	111	3	225	50	525
2	1½	137.53	.26	1.3	1.3	112	3	230	50	515
3	3	138.53	.24	1.3	1.3	112	3	230	50	520
4	4½	139.63	.28	1.45	1.45	113	3	230	55	525
5	6	140.91	.06	.30	.30	114	2	230	55	525
6	7½	141.53	.06	.30	.30	114	2	235	55	510
7	9	142.01	.28	1.45	1.45	114	2	235	55	510
8	10½	143.07	.28	1.45	1.45	115	3	240	55	530
9	12	144.21	.28	1.45	1.45	115	3	240	55	530
10	13½	145.22	.30	1.5	1.5	115	3	240	55	540
11	15	146.35	.30	1.5	1.5	115	3	240	55	540
12	1½	147.42	.06	.30	.30	115	3	240	55	530
13	3	148.02	.26	1.3	1.3	115	3	250	55	525
14	4½	149.00	.32	1.65	1.65	117	3	250	55	525
15	6	150.03	.32	1.65	1.65	118	4	250	55	550
16	7½	151.30	.32	1.65	1.65	118	4	250	55	550
17	9	152.55	.32	1.65	1.65	118	4	250	55	550
18	10½	153.60	.06	.30	.30	120	2	260	60	550
19	12	154.21	.06	.30	.30	120	2	260	60	550
20	13½	154.78	.36	1.85	1.85	118	4	260	60	520
21	15	156.56	.36	1.85	1.85	118	4	260	60	490

Company Lee Brick

Run # 6

Point	Clock Time	Dry Gas Meter, Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer (ΔH) in. H_2O Desired	Orifice Manometer (ΔH) in. H_2O Actual	Average Meter Temp. °F	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
22	1½	157.43	.44	2.2	2.2	118	4	260	65	465
B 1	3-0	158.64	.06	.30	.30	118	4	260	65	450
2	1½	159.21	0.28	1.45	1.45	120	4	270	65	480
3	3	160.26	.32	1.65	1.65	120	4	265	65	475
4	4½	161.40	.32	1.65	1.65	120	4	265	65	475
5	6	162.58	.34	1.75	1.75	120	4	265	65	500
6	7½	163.72	.32	1.65	1.65	120	4	265	65	505
7	9	164.90	.06	.30	.30	120	2	260	65	525
8	10½	165.50	.06	.30	.30	120	2	260	65	535
9	12	166.01	.34	1.75	1.75	120	4	250	65	500
10	13½	167.43	.34	1.75	1.75	122	4	250	65	490
11	15	168.45	.34	1.75	1.75	122	4	240	65	510
12	16½	169.54	.30	1.5	1.5	122	4	240	65	500
13	30	170.64	.06	.30	.30	122	4	250	65	520
14	4½	171.27	.06	.30	.30	122	4	250	65	530
15	6	171.84	.28	1.45	1.45	118	4	255	65	530
16	7½	172.91	.28	1.45	1.45	120	4	255	65	500
17	9	174.00	.28	1.45	1.45	120	4	255	65	505
18	10½	175.10	.26	1.3	1.3	120	4	255	65	520
19	12	176.20	.28	1.45	1.45	118	4	255	65	500
20	13½	177.25	.06	.30	.30	118	4	250	65	490
21	15	177.88	.28	1.45	1.45	116	5	250	70	475
32	1½	178.88	.28	1.45	1.45	116	5	250	70	460
	60min	179.959								
	Diff.	43.509								
	AVG.		0.223		1.240	117.704				511.818

PARTICULATE [illegible] CLEANUP SHEET

Plant Name: LEE BRICK AND TILE COMPANY
Sampling Location: KILN STACK #2 (NORTH)
Reagent Box #: 0203 Date Analyzed: 6-30-78

Blank Calculations:	Acetone	Water
Blank Residue	0.2 mg.	
Blank Volume	100 ml.	
Concentration	.002 mg/mls	mg/mls
Volume Used	425 mls	mls
# 4 Blank Weight	0.85 mgms	mgms
Volume Used	400 mls	mls
# 5 Blank Weight	0.80 mgms	mgms
Volume Used	400 mls	mls
# 6 Blank Weight	0.80 mgms	mgms

Analysis Method: (Zero & Span Balance EB Initials)
EPA METHOD 5

Description of Sample:
GRAY-BROWN PARTICULATE

Remarks:

Date of Test	6-29	6-29	6-29
Test Number	4	5	6
Moisture Collected:			
Impinger water volume	209	204	202
Tared volume	200	200	200
Captured water	9 mls	4 mls	2 mls
Silica Gel weight	257.0	254.5	254.5
Tared weight	225.0	225.0	225.0
Adsorbed water	32.0 gms	29.5 gms	29.5 gms
TOTAL MOISTURE CATCH	41.0 mls	33.5 mls	31.5 mls
Front Half Analysis: (Nozzle, probe, cyclone, filter front half)			
Filter & Particulate	708.4	647.8	624.5
Filter Tare weight	411.7	410.0	409.9
Filter Particulate	296.7	237.8	214.6
Rinsings or Dry Wt.	—	—	—
Particulate catch	296.7 mgms	237.8 mgms	214.6 mgms
Acetone blank	0.9	0.8	0.8
TOTAL FRONT CATCH	295.8 mgms	237.0 mgms	213.8 mgms
Back Half Analysis: (Impingers, filter back half)			
Extractables weight			
Boil Down weight			
Impingers' Catch	mgms	mgms	mgms
Water blank			
TOTAL BACK CATCH	mgms	mgms	mgms
TOTAL TRAIN CATCH	mgms	mgms	mgms

CUSTODY SHEET FOR REAGENT BOX # 0203

Date of Makeup 6/28/78 Individual Water Tare Volume 300 mls

Initials WW Individual Silica Gel Tare Weight 225.0 gms

Locked? ✓

Plant Name Lee, Bridge

Sampling Location Sanford, NC (North Stack)

Box/Test Number	Date Used	Initials	Locked?	Date Cleanup	S. Gel Spent?	Initials	Locked?
4 / 4	6/29/78	WW	✓	6/29	90%	WW	✓
5 / 5	6/29/78	WW	✓	6/29	90%	WW	✓
7 / 6	6/29/78	WW	✓	6/29	90%	WW	✓

	Date	Initials	Locked?
Transferred to Lab	6/30/78	WW	✓
Received in Lab	"	SSS	✓

Zero & Span Balance Initials SSS

Sampling Method: EPA - 5

Remarks: gray - brown powdery part.

Filter #	Tare Weight (mgms)	Used on Test
2980	411.7	4
3111	410.0	5
2999	409.9	6

ENTROPY ENVIRONMENTALISTS, INC ..... SPECIALISTS IN SOURCE SAMPLING

APPENDIX C

TEST PARTICIPANTS

ROY N. DOSTER	PROJECT DIRECTOR
WILLIS NESBIT	TEAM LEADER
JOHN L. ENGLISH	ENGINEERING TECHNICIAN
NEILL M. HARDEN	ENGINEERING TECHNICIAN

APPENDIX D

F-factor Method

For each sample run, an integrated gas sample is obtained using a stainless steel probe, diaphragm pump and rotameter, and Tedlar bag. The sample is analyzed with an orsat apparatus to determine $\%CO_2$, $\%O_2$, and %CO. An excess air correction factor is calculated based on the oxygen content in the effluent stream.

The F-factor is defined as the ratio of the theoretical quantity of dry effluent gas generated by combustion to the heat content of the fuel. Using this ratio and the excess air correction factor, the ratio of the actual volumetric flow rate to the heat input rate may be calculated. Measurement of the excess air and the flow rate thus allows determination of the heat input rate. In a similar manner, the F-factor, excess air, and pollutant concentration are used to calculate emission rates directly in terms of lbs/10^6 Btu.

Using stoichiometric relations, F-factors may be calculated from the ultimate analysis and heating value of the fuel. However, the values for F are constant for any given fuel category within ±3%. Average values for F (dscf/10^4 Btu), for some common fuels are: bituminous coal-98.2, oil-92.2, gas-87.4, wood bark-96.4, and other wood residue (chips,etc.)-92.8.

The use of the F-factor method eliminates the inconcsistencies which arise in determining heat input rates from fuel burning rates or steam production rates. The accuracy of the F-factor method, however, is dependent on the accuracy of the excess air and volumetric flow rate measurements.

APPENDIX E

CALIBRATIONS

PITOT

All pitot tubes used by Entropy, whether separate or attached to a sampling probe,are constructed in-house or by Nutech Corporation. Prior to their initial usage, they are calibrated. In general, if a type "S" pitot tube is assembed correctly, and positioned properly in relation to the probe nozzle, it will have a Cp of 0.83- 0.87. As long as it is not damaged, it should not change its calibration. The recalibration schedule for pitot tubes is generally related to the physical condition and usage of the pitot tube, not a fixed time schedule.

DRY GAS METER AND ORIFICE METER

All Entropy meter boxes are calibrated at least once every two months, according to their usage history. Basic procedures are outlined in the EPA Publication No. APTD-0576. The only differences are the flow rates used and the volumes metered at each flow rate.

NOZZLES

Each nozzle is calibrated upon purchase, and thereafter whenever it becomes apparent that the nozzle has become damaged. The diameter is measured on four different axes, with the high and low readings differing by no more than 0.004 inches as a tolerance.

TEMPERATURE MEASURING INSTRUMENTS

The thermocouples or thermometers are calibrated against an ASTM precision mercury-in-glass thermometer across a wide range of temperatures. If the initial reading is not within ± 1.0% of the absolute temperature reading of the standard thermometer, the instrument is adjusted until it is in the acceptable range.

MAGNEHELIC GAUGES

The magnehelic gauges are calibrated against inclined manometers at three different settings (low, medium, high) over the range of the individual gauges. If the readings differ more than ± 1% of the full scale of the gauge from the manometer readings, the magnehelics are recalibrated. Calibrations are checked once a month or after three jobs, whichever comes first.

Date 12/15/77 Box Nutech #3 P_B 29.75 Initials TI

ORIFICE SETTING	TEST METER VOLUME	ROOM TEMP °F	TIME MINUTES	ΔH@	BOX METER VOLUME	BOX METER TEMP	Y
0.3	2	66	6.43	1.72	1.99	70	1.01
0.5	3	66	7.48	1.72	3.015	71	1.00
0.7	3	66	6.42	1.77	3.023	72	1.00
1.0	3	66	5.40	1.70	3.035	73	1.00
1.5	5	66	7.43	1.77	5.09	74	.99
2.0	5	66	6.43	1.78	5.077	75	1.00
4.0	5	66	4.43	1.72	5.075	77	1.00
6.0	5	66	3.65	1.74	5.07	80	1.00

$$\Delta H@ = \frac{(0.0317)\Delta H}{P_B(T_{Box} + 460)} \left(\frac{(T_{Room} + 460)\theta}{V_{Test\ Meter}} \right)^2$$

$$Y = \frac{V_{Test}\ (P_B)(T_{Box} + 460)}{V_{Box}\left(P_B + \frac{\Delta H}{13.6}\right)(T_{Room} + 460)}$$

ΔH@ 1.74 Y 1.00

Date 25 Jan 78 Box M-6 P_B 27.25 Initials EES

ORIFICE SETTING	TEST METER VOLUME	ROOM TEMP °F	TIME MINUTES	ΔH@	BOX METER VOLUME	BOX METER TEMP	Y
0.3	2	65	6.625	1.91	1.962	56	1.00
0.5	3	57	7.705	1.86	3.019	57	.99
0.7	3	65	6.48	1.87	2.992	63	.99
1.0	3	57	5.4	1.81	3.028	62	1.00
1.5	5	65	7.5	1.91	4.997	68	.99
2.0	5	65	6.58	1.95	5.0	70	1.00
4.0	5	65	4.58	1.88	4.996	74	1.01
6.0	5	65	3.75	1.87	4.986	78	1.01

MK Done 1-
P_B = 29.
MK Done 1-26
P_B = 29.(

$$\Delta H@ = \frac{(0.0317)\Delta H}{P_B(T_{Box} + 460)} \left(\frac{(T_{Room} + 460)\theta}{V_{Test\ Meter}} \right)^2$$

$\Delta H@_{avg} = 1.88$

$$\gamma = \frac{V_{Test}\ (P_B)(T_{Box} + 460)}{V_{Box}\left(P_B + \frac{\Delta H}{13.6}\right)(T_{Room} + 460)}$$

NOZZLE CALIBRATION DATA

NOZZLE # 204

DATE	INITIALS	DIAMETER, in. 1	2	3	4	AVERAGE
1-3-78	WN	.247	.247	.250	.248	.248
4-6-78	NH	.249	.248	.249	.247	.248

NOZZLE CALIBRATION DATA

NOZZLE # 205

DATE	INITIALS	DIAMETER, in. 1	2	3	4	AVERAGE
1-3-78	WN	.240	.241	.242	.242	.241
4-6-78	MH	.241	.290	.242	.290	.241

NOZZLE CALIBRATION DATA

NOZZLE # 206

DATE	INITIALS	DIAMETER, in. 1	2	3	4	AVERAGE
1-3-78	WN	.243	.244	.246	.245	.245
4-6-78	NH	.245	.244	.245	.246	.245

NOZZLE CALIBRATION DATA

NOZZLE # 207

DATE	INITIALS	DIAMETER, in. 1	2	3	4	AVERAGE
1-3-78	WN	.307	.304	.305	.305	.305
4-5-98	MH	.304	.307	.307	.304	.306

NOZZLE CALIBRATION DATA

NOZZLE # 208

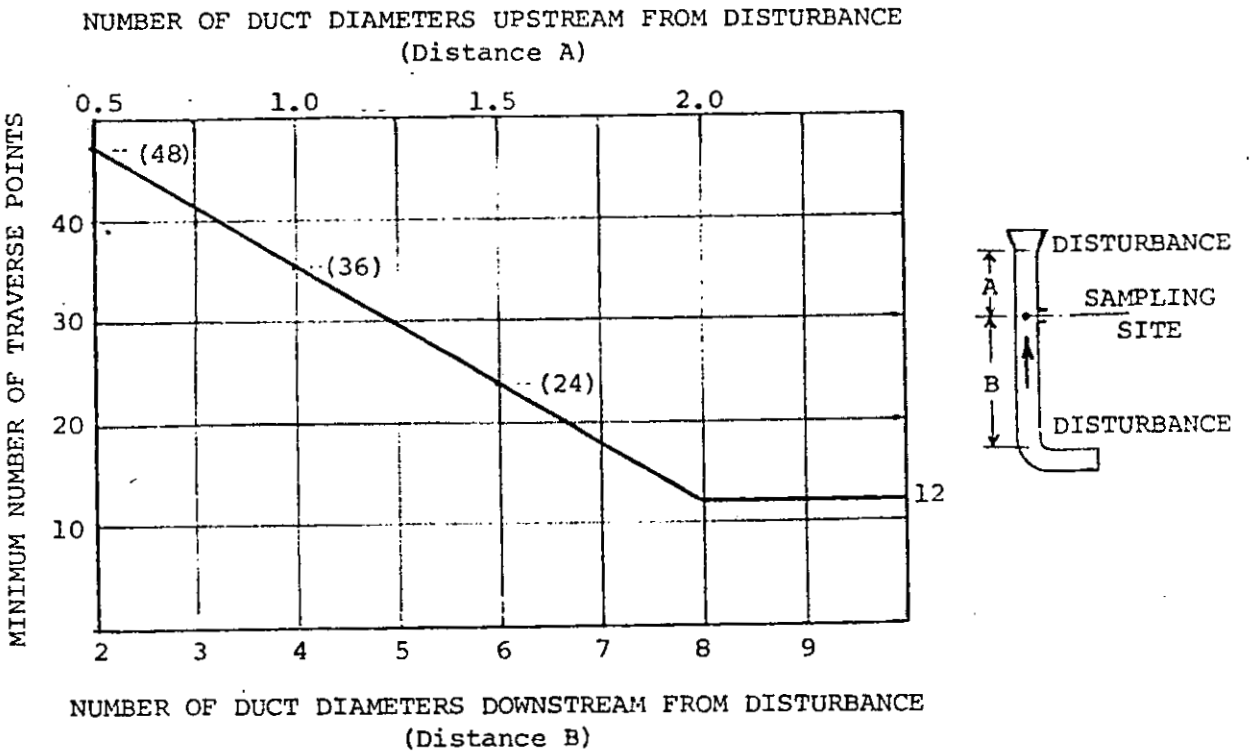
DATE	INITIALS	DIAMETER, in. 1	2	3	4	AVERAGE
1-3-78	CWN	.299	.300	.300	.300	.300
1-5-78	AMA	.300	.300	.300	.301	.300

NOZZLE CALIBRATION DATA

NOZZLE # 209

DATE	INITIALS	DIAMETER, in: 1	2	3	4	AVERAGE
1-3-78	WA	.315	.318	.318	.318	.317
4-5-78	MH	.324	.324	.328	.324	.325

MINIMUM NUMBER OF TRAVERSE POINTS



COMMENTS:

Run 1

ok

Run 2

ok

Run 3

ok

SOURCE TEST
OBSERVERS CHECKLIST

N. C. Division of Environmental Management

STACK "B" 2"

Source Name:	Testing Firm:
Address:	Address:
Plant Location:	Phone:
Source Contact:	Test Engineer:
Phone:	Assistant:

Other Personnel Involved	Affiliation

Process Description:

Process Rate During Test:

Maximum Process Rate:

Burner Sizes (Incinerators) Pri: Sec:

TEST PARAMETERS

Duct Size: 36" OD

Distance Before Ports: 3.22 9'-8"

Distance After Ports: 1.33 4'-0"

Number of Test Points: 49 / stack

Number of Runs: 3

Sampling Time Per Run (min.): 66 1.5

Pollutant Sampled: Part.

E. P. A. Method No.: 5

If method differs from E. P. A. method, explain:

For Method 5 sampling train record ΔH@ 1.84

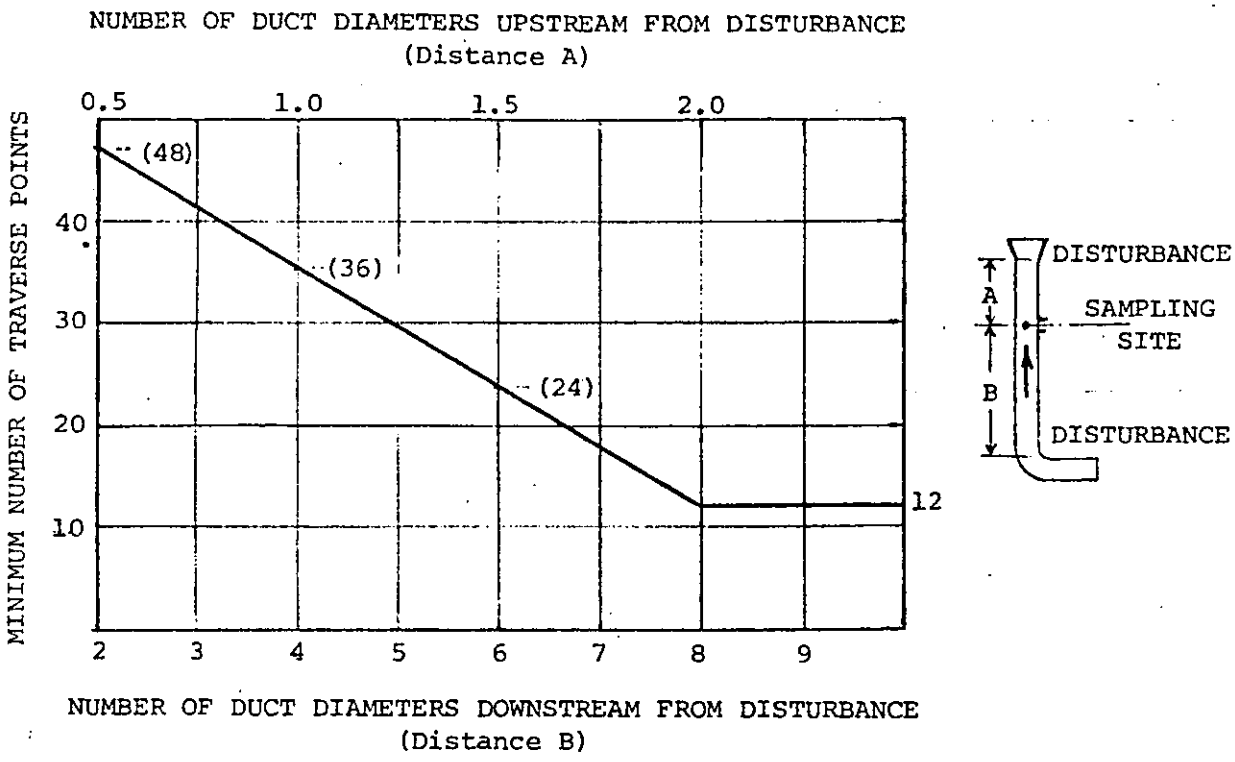
	Run #1	Run #2	Run #3
Leakage Rate (ft^3/min.) (0.02 ft^3/min. or less) STACK "B"	0.01 4"	.005	
Time Started (24 hr. Clock)	same	12:18	
Time Ended	same	1:27	
Test Date(s)	2-9-78	2-9-78	

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

Request 2 Copies of Report

OBSERVERS SIGNATURE

MINIMUM NUMBER OF TRAVERSE POINTS



COMMENTS:

RUN 1: operating (2) trains - one per stack, sampling at the SAME time.
44 points on "A" and 44 points on "B" = (1) one RUN

OK

RUN 2

OK

RUN 3

Had to stop - break in Glass - cause leaking
Did Leak test after problem was corrected

OK

SOURCE TEST
OBSERVERS CHECKLIST

Stack "A"

N. C. Division of Environmental Management

Source Name: Lee Brick & Tile Co.	Testing Firm: Entropy Environmentalist
Address: Sanford	Address: Raleigh
Plant Location: Sanford	Phone:
Source Contact: J.R. Holton	Test Engineer: Jim Grove
Phone: 775-2134	Assistant: Roy Doster

Other Personnel Involved	Affiliation
Paul Sieffert	Pullman Swindell
Scott Frame	" "

Process Description: Coal fired tunnel kiln

Process Rate During Test:

Maximum Process Rate:

Burner Sizes (Incinerators) Pri: Sec:

TEST PARAMETERS

Duct Size: 36" OD	Pollutant Sampled: Particulate
Distance Before Ports: 3.22 9'-8"	E. P. A. Method No.: 5
Distance After Ports: 1.33 4-0"	If method differs from E. P. A. method, explain:
Number of Test Points: 44 / stack	
Number of Runs: 3	
Sampling Time Per Run (min.): 66 min. 1.5 min/point	For Method 5 sampling train record ΔH@ 1.74

	Stack (A) Run #1	Run #2	Run #3
Leakage Rate (ft^3/min.) (0.02 ft^3/min. or less)	END 0.00	0.00	Do not observe
Time Started (24 hr. Clock)	10:25 am	12:15	2:11
Time Ended	11:31	1:27	
Test Date(s)	2-9-78	2-9-78	2-9-78

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

Request 2 Copies of Report

Tommy L Thomas
OBSERVERS SIGNATURE

DIVISION OF ENVIRONMENTAL MANAGEMENT
AIR QUALITY SECTION
TELEPHONE: (919) 733-5125

April 4, 1978

M E M O R A N D U M

To: Sammy Amerson

From: Victor Copelan VC

Subject: A particulate emission test for compliance on both brick kiln stocks at Lee Brick and Tile Company, Sanford, North Carolina. The test was performed by Entropy Environmentalist, Raleigh, North Carolina

I have reviewed the above test report and find it satisfactory as to procedure and presentation.

The results seem to be a reliable indication of the particulate emission from Lee Brick's kiln. The average emission rate from the two stacks was 23.8 pounds/hour at a production rate of 8.9 tons/hour. The allowable for the above production rate is 17.7 pounds/hour. The source is not in compliance with NCAC 2D .0515.

VC/apc

Calculation Summary

SOURCE Lee Brick Date 2/78

LOCATION Sea Coast

ENTRY	Stack No. 1 (South) RUN 1	RUN 2	Stack No. 2 (North) RUN 1	ANSWER
Ave. ΔH (in H_2O)	2.8500		0.2700	
P_{atm} (in Hg)	29.4600		29.4600	
	29.6696		29.4799	P_m (in Hg)
P_s(gage)(in H_2O)	0.0000		0.0000	
	29.4600		29.4600	P_s (in Hg)
T_m (^oR)	529.0000		512.0000	
V_m (ft^3)	61.5090		18.7450	
	61.0960		19.1143	$V_{m_{std}}$ (ft^3)
V_{lq} (ml)	32.0000		8.0000	
	1.5136		0.3784	V_{wstd} (ft^3)
	62.6096		19.4927	V_{std} (ft^3)
	2.4175		1.9412	%M
	0.9758		0.9806	M_d
MW_d	29.0800		29.0800	
	28.8121		28.8649	M
T_s (^oR)	766.0000		796.0000	
$\Sigma\sqrt{\Delta p}$	47.9355		3.4915	
$n_{\Delta p}$	44.0000		44.0000	
	1.0894		0.0794	Ave $\sqrt{\Delta p}$
C_p	0.8400		0.8400	
	74.3119		5.5126	v_s (ft/sec)
D_s (in)	36.0000		36.0000	
	7.0686		7.0686	A_s (ft^2)
	31517.		2338.	Q_s (ft^3/min)
	21467.		1532.	Q_{std} (ft^3/min)
W_t (gm)	0.5287		0.1906	
	23.9824		1.9824	pmr_c (lb/hr)
D_n (in)	0.2430		0.4990	
	0.0464		0.1956	A_n (in^2)
θ (min)	66.0000		66.0000	
	23.2604		1.9886	pmr_a (lb/hr)
	96.9894		100.3120	%I
	23.6214		1.9855	pmr_{avg} (lb/hr)
%CO				
$\%O_2$				
$\%N_2$				
				%EA
F Factor				
				HI (10^6 BTU/hr
				pmr_u (lbs/10^6BTU

APPENDIX F

CALIBRATIONS

PITOT

All pitot tubes used by Entropy, whether separate or attached to a sampling probe,are constructed in-house or by Nutech Corporation. Prior to their initial usage, they are calibrated. In general, if a type "S" pitot tube is assembed correctly, and positioned properly in relation to the probe nozzle, it will have a Cp of 0.83- 0.87. As long as it is not damaged, it should not change its calibration. The recalibration schedule for pitot tubes is generally related to the physical condition and usage of the pitot tube, not a fixed time schedule.

DRY GAS METER AND ORIFICE METER

All Entropy meter boxes are calibrated at least once every two months, according to their usage history. Basic procedures are outlined in the EPA Publication No. APTD-0576. The only differences are the flow rates used and the volumes metered at each flow rate.

NOZZLES

Each nozzle is calibrated upon purchase, and thereafter whenever it becomes apparent that the nozzle has become damaged. The diameter is measured on four different axes, with the high and low readings differing by no more than 0.004 inches as a tolerance.

TEMPERATURE MEASURING INSTRUMENTS

The thermocouples or thermometers are calibrated against an ASTM precision mercury-in-glass thermometer across a wide range of temperatures. If the initial reading is not within ± 1.0% of the absolute temperature reading of the standard thermometer, the instrument is adjusted until it is in the acceptable range.

MAGNEHELIC GAUGES

The magnehelic gauges are calibrated against inclined manometers at three different settings (low, medium, high) over the range of the individual gauges. If the readings differ more than ± 1% of the full scale of the gauge from the manometer readings, the magnehelics are recalibrated. Calibrations are checked once a month or after three jobs, whichever comes first.

NOZZLE CALIBRATION
Box 2

Initials WN

Date 1/3/78

Nominal Size, In.	Measured	Average
213	.499 .500 .498 .500	.499
214	.488 .488 .490 .490	.489
215		

Nominal Size, In.	Measured	Average

NOZZLE CALIBRATION
Box 3

Initials WN

Date 7/18/77

[redacted] Size, In.	Measured	Average
CONTROL # 313	.498 .499 .499 .497	.498
314	.502 .504 .502 .500	.502
315	.500 .500 .503 .504	.502

Nominal Size, In.	Measured	Average

NOZZLE CALIBRATION
BOX 3

Initials LN

Date 7/18/77

[redacted], In.	Measured	Average
CONTROL # 301	.162 .162 .162 .162	.162
302	.164 .166 .165 .165	.165
303	.173 .173 .173 .173	.173
304	.243 .243 .243 .243	.243
305	.245 .243 .244 .244	.244
306	.256 .257 .257 .257	.257

Nominal Size, In.	Measured	Average
307	.299 .299 .298 .297	.298
308	.304 .304 .304 .304	.304
309	.303 .303 .306 .306	.305
310	.367 .367 .367 .367	.367
311	.369 .373 .370 .371	.371
312	.372 .373 .373 .372	.373

Date 12/15/77 Box Nutech #3 P_B 29.75 Initials TI

ORIFICE SETTING	TEST METER VOLUME	ROOM TEMP °F	TIME MINUTES	ΔH@	BOX METER VOLUME	BOX METER TEMP	Y
0.3	2	66	6.43	1.72	1.99	70	1.01
0.5	3	66	7.48	1.72	3.015	71	1.00
0.7	3	66	6.42	1.77	3.023	72	1.00
1.0	3	66	5.40	1.70	3.035	73	1.00
1.5	5	66	7.43	1.77	5.09	74	.99
2.0	5	66	6.43	1.78	5.077	75	1.00
4.0	5	66	4.43	1.72	5.075	77	1.00
6.0	5	66	3.65	1.74	5.07	80	1.00

$$\Delta H@ = \frac{(0.0317)\Delta H}{P_B(T_{Box} + 460)} \left(\frac{(T_{Room} + 460)\theta}{V_{Test\ Meter}} \right)^2$$

$$Y = \frac{V_{Test}\ (P_B)(T_{Box} + 460)}{V_{Box}(P_B + \frac{\Delta H}{13.6})\ (T_{Room} + 460)}$$

ΔH@ 1.74

Y 1.00

Nutech

Date 1-27-78 Box #7 P_B 29.50 Initials MH

AVG. = 1.84 AVG. = 0.9978738

ORIFICE SETTING	TEST METER VOLUME	ROOM TEMP °F	TIME MINUTES	ΔH@	BOX METER VOLUME	BOX METER TEMP	Y
0.3	2	56	6.66	1.77	2.032	64	0.9987649
0.5	3	56	7.76	1.78	3.078	70	0999857
0.7	3	57	6.63	1.83	3.1	74	0.9978223
1.0	3	58	5.50	1.71	3.119	78	0.9971393
1.5	5	58	7.66	1.83	5.212	80	0.996343
2.0	5	59	6.70	1.89	5.216	82	0.9961042
4.0	5	59	4.78	1.94	5.188	83	0.9983757
6.0	5	60	3.92	1.96	5.161	84	0.9985846

$$\Delta H@ = \frac{(0.0317)\Delta H}{P_B(T_{Box} + 460)} \left(\frac{(T_{Room} + 460)\theta}{V_{Test\ Meter}} \right)^2$$

$$Y = \frac{V_{Test}\ (P_B)(T_{Box} + 460)}{V_{Box}\left(P_B + \frac{\Delta H}{13.6}\right)(T_{Room} + 460)}$$