# State of Louisiana

## Department of Environmental Quality

**BUDDY ROEMER**
Governor

**PAUL TEMPLET**
Secretary

October 19, 1989

Ms. Samantha Earnest
L.J. Earnest Company
P. O. Box 5339
Bossier City, Louisiana 71171-5339

Dear Ms. Earnest:

RE: Ramcon Particulate Emissions Test 05-10-89, Shreveport, Louisiana

The review of your report by Ramcon Environmental Corporation conducted 5-10-89 and entitled "Particulate Emissions Test: Shreveport, Louisiana" has been completed.

The test procedures and calculations appear satisfactory. There are, however, two items missing from the report:

1. Opacity report indicating that opacity did not exceed 20 percent as required in 40 CFR 60.92.

2. Certification letter by Ramcon that tests were conducted by certified personnel and reviewed by a professional engineer.

Please furnish opacity report or reason this test was not included, and letter of certification.

If you have any questions you may contact Carrol Clark, P.E. at (504) 342-0104.

Sincerely,

Thomas C. Coerver, P.E.
Engineering Supervisor

TCC:CC:pfv

Figure 6.1 SOURCE TEST REPORT REVIEW FORM

PLANT L. J. EARNEST CO. SOURCE ID NO. 0500-000[redacted]

DATE REPORT RECEIVED 6-05-89 RECEIVED FROM J. MAGEE

REVIEWER CARROL CLARK DATE REVIEWED 10-16-89

REPORT CONTENTS

| | YES | NO | OK | REF. |
|---|---|---|---|---|
| **A. Cover** | | | | |
| 1. Plant name and location | X | — | — | |
| 2. Source sampled | X | — | — | |
| 3. Testing company or agency | X | — | — | |
| **B. Certification** | | | | |
| 1. Certification by team leader | — | X | — | |
| 2. Certification by reviewer (e.g., P.E.) | — | X | — | |
| 3. Certification by owner, or facility management | — | X | — | |
| **C. Table of Contents** | | | | |
| **D. Introduction** | | | | |
| 1. Test purpose | X | — | — | |
| 2. Test location, type of process | X | — | — | |
| 3. Test dates | X | — | — | |
| 4. Pollutants tested | — | X | — | |
| 5. Observers' names (industry and agency) | X | — | — | |
| 6. Any other important background information | — | X | — | |
| **E. Summary of Results** | | | | |
| 1. Emissions results | X | — | X | |
| 2. Process data, as related to determination of compliance | X | — | X | |
| 3. Allowable emissions | X | — | X | |
| 4. Visible emissions summary | — | X | — | |
| 5. Discussion of errors, both real and apparent | — | X | — | |
| **F. Conclusions and Recommendations** | | | | |
| 1. Is test conclusive? | X | — | X | |
| 2. Were objectives met? | X | — | X | |
| 3. Status re regulatory requirements | X | — | X | |
| 4. Recommendations for future actions | — | X | — | |

Figure 6.2 SOURCE TEST REPORT REVIEW FORM (Continued)

REPORT CONTENTS

| | YES | NO | OK | REF |
|---|---|---|---|---|
| **G. Source Operation** | | | | |
| 1. Description of process and control devices | X | | X | |
| 2. Flow diagram | X | | X | |
| 3. Process data and results, with example calculations | X | | X | |
| 4. Representativeness of raw materials and products | X | | X | |
| 5. Any specially required operation demonstrated | | X | | |
| 6. Control equipment description | X | | X | |
| 7. Control equipment operating status | | X | | |
| **H. Sampling and Analytical Procedures** | | | | |
| 1. Sampling port location and dimensioned cross section | X | | | |
| 2. Sampling point description, including labeling system | X | | | |
| 3. Sampling train description | X | | | |
| 4. Description of sampling procedures that deviated from standard methods | | X | | |
| 5. Description of analytical procedures that deviated from standard methods | | X | | |
| **I. Documentation Appendix** | | | | |
| 1. Complete results with example calculations | X | | | |
| 2. Raw field data (original, not computer printouts) | X | | | |
| 3. Laboratory report, with chain of custody | X | | | |
| 4. Raw production data, signed by plant official | | X | | |
| 5. Test Log | X | | | |
| 6. Calibration procedures and results | X | | | |
| 7. Project participants and titles | X | | | |
| 8. Related correspondence | X | | | |
| 9. Pretest Agreements | | X | | |

Figure 6.3 SOURCE TEST REPORT REVIEW FORM (Continued)

REPORT COMMENTS

Review Comments

Were calculations validated ✓ yes ____ no

If yes, were any results greater than normal round off errors ____ yes ✓ no

Were any sampling or analytical procedures unacceptable ____ yes ✓ no

Were any process or control equipment operations unacceptable ____ yes ✓ no

List any unacceptable items opacity method 9 not included in report

List any additional items requested from the source or tester after report reviewed ✓ yes ____ no

List items and reason for request certification letter and opacity test

This report is ✓ acceptable, ____ unacceptable

give reason(s) for unacceptability ____

Comments reviewed by ____

# RAMCON

ENVIRONMENTAL CORPORATION



SOURCE SAMPLING
for
PARTICULATE EMISSIONS
**L.J. EARNEST COMPANY**
**SHREVEPORT, LOUISIANA**
MAY 10, 1989

Samantha Earnest
L.J. Earnest Company

G. Sumner Buck, III
President

Chuck Kuhn
Team Leader

RAMCON BUILDING, 223 SCOTT STREET, MEMPHIS, TENNESSEE 38112
TELEPHONE 800/458-4567 IN TENNESSEE 901/458-7000 FAX 901-458-3868

# RAMCON

ENVIRONMENTAL CORPORATION

May 23, 1989

Ms. Samantha Earnest
L.J. Earnest Company
P.O. Box 5339
Bossier City, LA 71171-5339

Re: Particulate Emissions Test: Shreveport, Louisiana

Dear Ms. Earnest:

Enclosed you will find four copies of our report on the particulate emissions test we conducted on your plant. Based on our test results, the average grain loading of both of the test runs is below the N.S.P.S. emissions standard set by EPA and the State of Louisiana. Therefore, the plant is operating in compliance with State and Federal Standards.

You will want to sign the report covers and send two copies to:

Mr. Richard Bromley
Louisiana DNR
1525 Fairfield Avenue
Shreveport, LA 71101

You will need to keep one copy of the report at the plant. We certainly have enjoyed working with you. Please let us know if we can be of further assistance.

Sincerely,

G. Sumner Buck, III
President

GSBIII:kr

Enclosures

RAMCON BUILDING, 223 SCOTT STREET, MEMPHIS, TENNESSEE 38112
TELEPHONE 800/458-4567 IN TENNESSEE 901/458-7000 FAX 901-458-3868

# TABLE OF CONTENTS

## I. INTRODUCTION

On May 10, 1989, personnel from RAMCON Environmental Corporation conducted a source emissions test for particulate emissions compliance at L.J. Earnest's drum mix asphalt plant located in Shreveport, Louisiana. RAMCON personnel conducting the test were Chuck Kuhn, Team Leader, and Dave Bailey. Bruce Shrader was responsible for the laboratory analysis including taring the beakers and filters and recording final data in the laboratory record books. Custody of the samples was limited to Mr. Kuhn and Mr. Shrader.

The purpose of the test was to determine if the rate of particulate emissions from this plant's baghouse is below or equal to the allowable N.S.P.S. emissions limit set by US EPA and the State of Louisiana.

## II. TEST RESULTS

Table I summarizes the test results. The grain loading limitation for EPA is .04 gr/dscf as specified in 39 FR 9314, March 8, 1974, 60.92 Standards for Particulate Matter (1), as amended. The allowable emissions for the State of Louisiana are the same as those set by EPA.

Mr. Richard Bromley of Louisiana's Department of Environmental Quality observed the testing conducted by RAMCON.

**TABLE I**
**SUMMARY OF TEST RESULTS**

May 10, 1989

| Test Run | Time | Grain Loading | Isokinetic Variation | Actual Emissions |
|---|---|---|---|---|
| 1 | 08:34 to 09:39 | 0.0446 gr/DSCF | 96.1% | 9.7 lbs/hr |
| 2 | 10:35 to 11:40 | 0.0140 gr/DSCF | 105.7% | 2.9 lbs/hr |
| 3 | 12:58 to 14:03 | 0.0331 gr/DSCF | 100.6% | 7.1 lbs/hr |
| | Average: | 0.0306 gr/DSCF | | 6.6 lbs/hr |

On the basis of these test results, the average grain loading of the three test runs was below the .04 gr/DSCF allowable emissions limitation set by EPA and the State of Louisiana. Therefore, the plant is operating in compliance with State and Federal Standards.

## III. TEST PROCEDURES

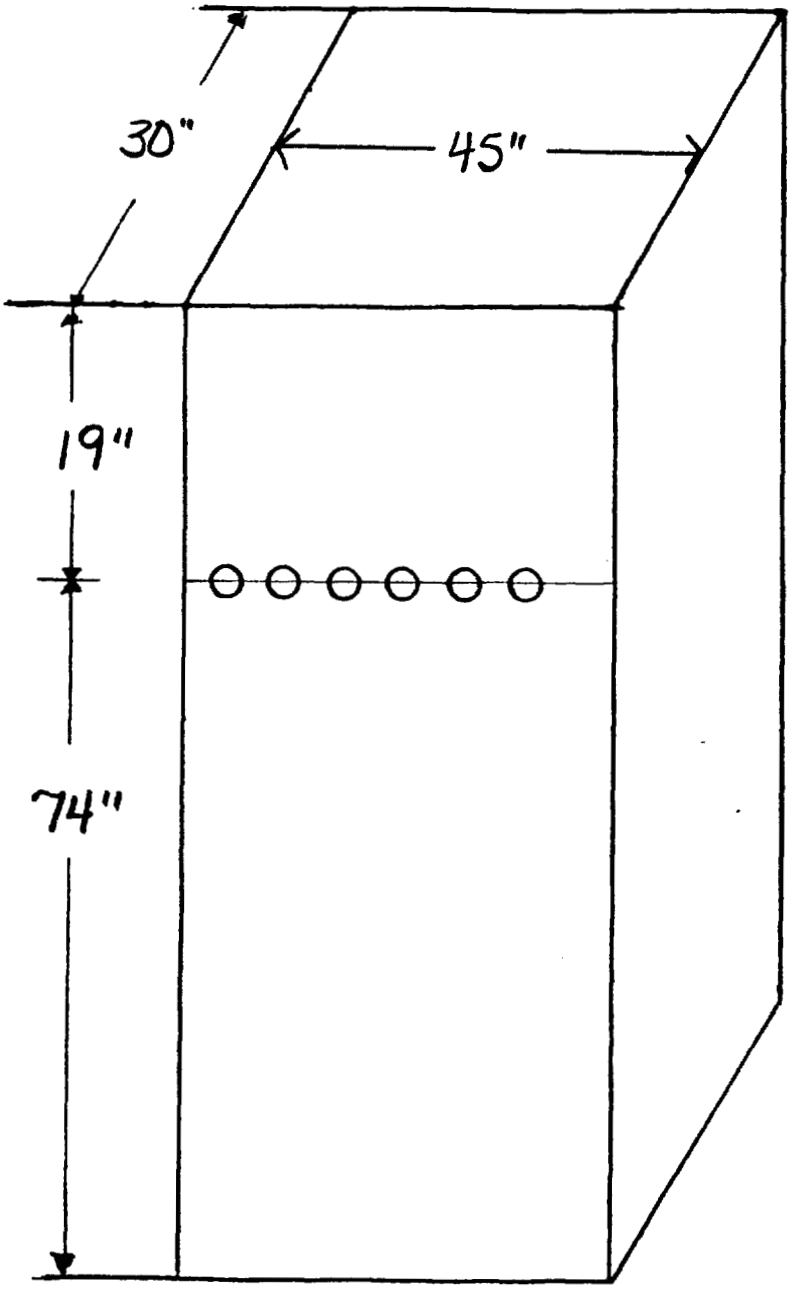
A. Method Used: Method 5 source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

B. Problems Encountered: No problems were encountered that affected testing.

C. Sampling Site: The emissions test was conducted after a baghouse on a rectangular stack measuring 45.0" x 30.0" with an equivalent diameter of 36.0". Six sampling ports were placed 19" down (0.53 diameters upstream) from the top of the stack and 74" up (2.1 diameters downstream) from the last flow disturbance. The ports were evenly spaced on 7.5" centers. The two outside ports are 3.75" from the side walls of the stack. Thirty points were sampled, five through each port for two minutes each.

| Points on a Diameter | Probe Mark |
|---|---|
| 1 | *9.0" |
| 2 | 15.0" |
| 3 | 21.0" |
| 4 | 27.0" |
| 5 | 33.0" |

*Measurements include a 6" standoff.



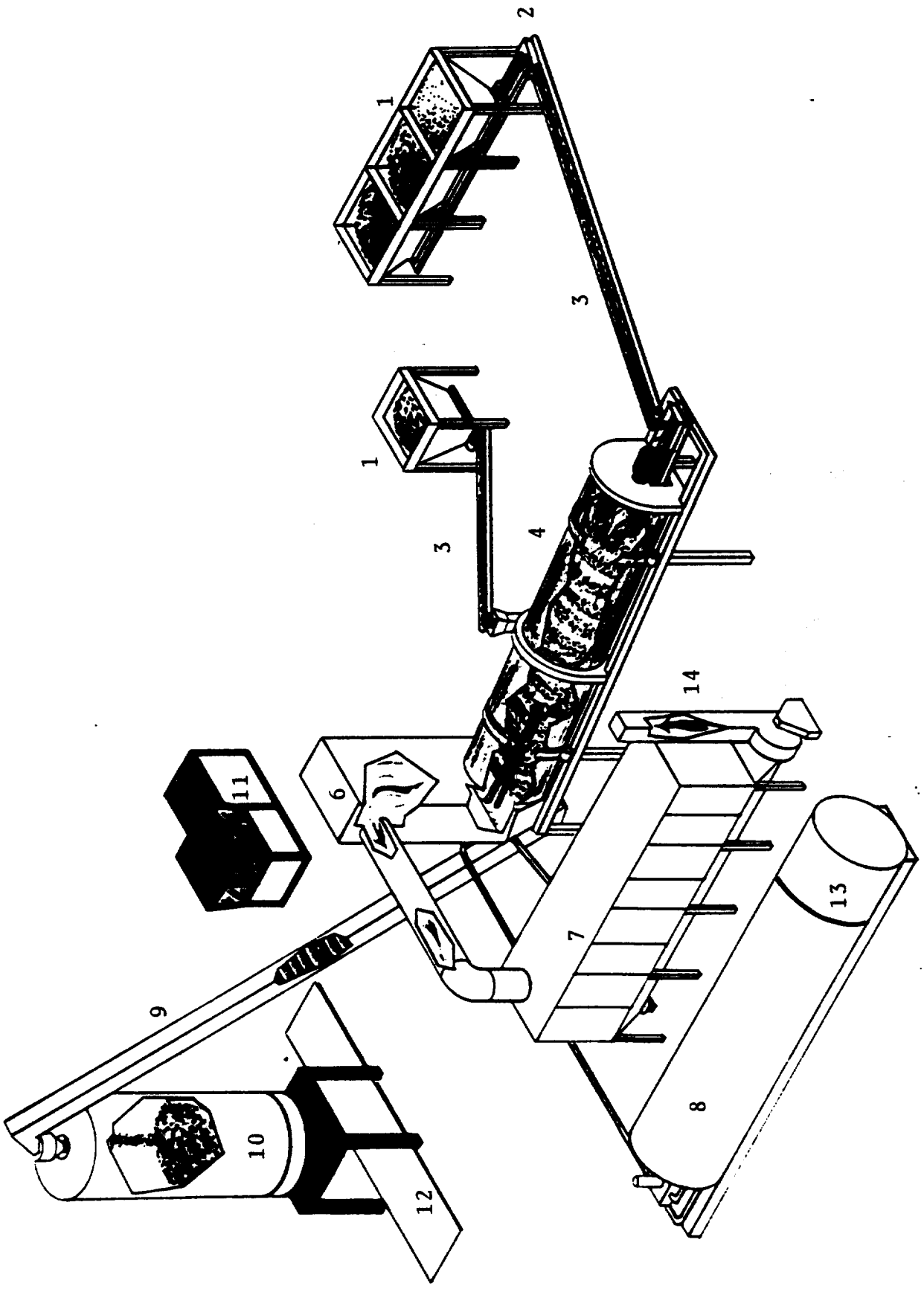
# IV. THE SOURCE

## IV. THE SOURCE

L.J. Earnest Company employs a Astec drum mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to bind the mixture together. After the hot asphalt mix is manufactured at the plant, it is transported to the location where it is to be applied. The hot asphalt mix is spread evenly over the surface with a paver then compacted with a heavy roller to produce the final product.

The following to a general description of the plant's manufacturing process: The cold feed materials (aggregate) are dumped into four separate bins which in turn feed a common continuous conveyor. The aggregate is dispensed from the bins in accordance with the desired formulation onto the cold feed system conveyor, to an inclined weigh conveyor, then to a rotating drum for continuous mixing and drying at approximately 300°F. When recycled asphalt mix is used it is added halfway down the drum through a seaparate weigh conveyor. The required amount of hot asphalt oil is then injected onto and mixed into the dried aggregate. The now newly formed hot asphalt mix is pulled to the top of a storage silo by a conveyor. The hot asphalt mix is then discharged from the storage silo through a slide gate into waiting dump trucks which transports the material to a final destination for spreading. The rated capacity of the plant will vary with each aggregate mix and moisture content with a 5% surface moisture removal.

The drum mixer used a burner fired with #2 fuel oil to heat air to dry the aggregate, and the motion of the rotating drum to blend the aggregate. The air is drawn into the system via an exhaust fan. After passing through the gas burner and the mixing drum, the air passes through a baghouse. The baghouse is manufactured by Astec. The exhaust gasses are drawn through the baghouse and discharged to the atmosphere through the stack. The design pressure drop across the tube sheet is 2-6 inches of water. The particulate matter, which is removed by the baghouse, is reinjected into the drum mixer.




ASTEC - DRUM MIX BAGHOUSE

1. Aggregate bins: Virgin aggregate is fed individually into each of four bins by type. It is metered onto a conveyor belt running under the bins to a shaker screen. The proporation of each aggregate type is determined by the job mix formula and pre-set to be metered out to meet these specifications.

2. Preliminary oversize screen: The aggregate is fed through a shaker screen where oversize rocks and foreign material is screened out of the mix.

3. Weigh conveyor belt: The aggregate is conveyed to the rotary drum dryer on a conveyor belt which weighs the material. The production rate is determined by this weight reading.

4. Rotary drum dryer/mixer: The aggregate is fed into the rotary drum dryer where it is tumbled by flighting into a veil in front of a flame which drives off the moisture. Further mixing is also accomplished in this drum. Hot liquid asphalt is injected approximately one-third of the way down the inclined drum where it is mixed with the aggregate.

5. Burner: The fuel fired burner is used to provide the flame which drys the aggregate.

6. Knock off baffleing: A baffeling plate is inserted in the "dirty" side plenum as a knock out for heavy particles in the air stream. These particles fall to the bottom of the baghouse.

7. Baghouse: The hot gases are pulled through the bags into the clean air plenum. The solid particulate matter is trapped on the dust coat buildup on the bags. A bag cleaning cycle consisting of jet burst of air from the inside (or clean air side) of the bags sends a large bubble of air down the inside of the bags shaking loose buildup on the bag surface. This particulate matter is collected at the bottom of the baghouse and reinjected into the drum mixer where it is used as part of the finished project.

8. Liquid asphalt storage: The liquid asphalt is stored in this heated tank until it is needed in the mixer. The amount of asphalt content and its temperature are pre-set for each different type job.

9. Conveyor to surge/storage bin: The finished product of aggregate mixed with liquid asphalt is conveyed to a surge bin.

10. Surge/Storage bin: The asphaltic cement is dumped into this surge bin and metered out to dump trucks which pull underneath a slide gate at the bottom of the bin.

11. Control/operators house: The entire plant operation is controlled from this operator's house.

12. Truck loading scale: As the trucks receive the asphalt from the storage/surge bin they are weighed on the loading scale which tells the plant operator the amount of asphalt that is being trucked on each individual load.

13. Fuel Storage

14. Stack

# DATA SUMMARY

## Plant

1. Manufacturer of plant Astec.
2. Designed maximum operating capacity 320 TPH @ 5 % moisture.
3. Actual operation rate 270.6 TPH @ 5 % moisture.
4. Startup date 4-3-89.
5. Type of fuel used in dryer #2 fuel oil.
6. Quanity of fuel consumption 1.8 gal per ton.

## Aggregate

7. Name/type of mix Wearing Course.
8. Percent asphalt in mix 4.8 %.
9. Temperature of asphalt 325.
10. Sieve/Screening analysis: % Passing:

| | | | | | |
|---|---|---|---|---|---|
| 1" | 100 | 3/8" | 78 | #40 | 22 |
| 3/4" | 100 | #4 | 55 | #80 | 11 |
| 1/2" | 86 | #10 | 40 | #200 | 6 |

## Baghouse

11. Manufacturer Astec
12. No. of bags 824. Type of bags Nomex.
13. Air to cloth ratio 6-1. Designed ACFM 50,000.
14. Square feet of bags 8333
15. Type of cleaning: pulse jet ____ reverse ____, plenum pulse ____, other ____.
16. Cleaning cycle time 1.5 seconds.
17. Interval between cleaning cycle 15 seconds.
18. Pressure drop across baghouse 1.5 psi.
19. Pulse pressure on cleaning cycle 65 psi.

COMPANY NAME L.J. Ernest DATE 5-10-89

COMPANY REPRESENTATIVE Roy Rash

# PLANT DATA (8)

COMPANY NAME J.D. Ernest

COMPANY REP. Ray Daft DATE 5-10-89 PHONE # 631-7714

DATA SOURCE Ray Daft

PLANT LOCATION Livingston, Tx.

PLANT MFG. Jay Ernest PLANT MODEL # PFM-427 PLANT TYPE Drum mix

MIX SPECIFICATION # Drum Coated OIL SPECIFICATION # 2 fuel oil

| Time 24 Hour | Fuel Oil / Nat. Gas / Propane / Coal | Burner Setting | Aggregate TPH | Recycle TPH | Liquid Asphalt TPH | Mix Temp. °F | Venturi Baghouse Pressure Drop Inches Water |
|---|---|---|---|---|---|---|---|
| 8:3 | | | | | | | |
| 8:30 | #2 fuel oil | 357 | 260 | 20.8 | 5.0 | 330 | 5 |
| 8:45 | " | 365 | 270 | 20.0 | 4.9 | 330 | 6 |
| 9:00 | " | 365 | 273 | 20.0 | 4.7 | 325 | 7 |
| 9:15 | " | 368 | 269 | 19.7 | 4.8 | 330 | 6 |
| 9:30 | " | 369 | 272 | 19.8 | 4.7 | 330 | 6 |
| 9:45 | " | 365 | 270 | 20.0 | 4.8 | 325 | 7 |
| | | | | | | | |
| 10:45 | " | 365 | 282 | 19.8 | 4.8 | 333 | 5 |
| 11:00 | " | 374 | 274 | 20.5 | 5.1 | 330 | 6 |
| 11:15 | " | 361 | 270 | 20.2 | 4.8 | 330 | 6 |
| 11:30 | " | 364 | 272 | 19.5 | 4.7 | 330 | 7 |
| 11:45 | " | 365 | 270 | 20.0 | 4.8 | 335 | 6 |
| | | | | | | | |
| 1:00 | " | 370 | 265 | 20.6 | 5.0 | 330 | 7 |
| 1:15 | " | 360 | 273 | 20.9 | 4.8 | 330 | 7 |
| 1:30 | " | 368 | 275 | 20.9 | 4.7 | 330 | 7 |
| 1:45 | " | 369 | 272 | 20.9 | 4.9 | 330 | 6 |
| 200 | " | 365 | 268 | 19.7 | 4.9 | 330 | 6 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

# V. EQUIPMENT USED

## V. EQUIPMENT USED

Equipment used on conducting the particulate emissions test was:

A. The Lear Siegler PM-100 stack sampler with appropriate auxillary equipment and glassware. The train was set up according to the schematic on the nex page.

B. An Airguide Instruments Model 211-B (uncorrected) aneroid barometer was used to check the barometric pressure.

C. Weston dial thermometers are used to check meter temperatures. An Analogic Model 2572 Digital Thermocouple is used for stack temperatures.

D. A Hays 621 Analyzer was used to measure the oxygen, carbon dioxide and carbon monoxide content of the stack gases. For non-combustion sources, A Bacharach Instrument Company Fyrite is used for the gas analysis.

E. Filters are mady by Schleicher and Schuell and are type 1-HV with a porosity of .03 microns.

F. The acetone is reagent grade or ACS grade with a residue of $\leq$ .001.

# VI. LABORATORY PROCEDURES & RESULTS

# LABORATORY PROCEDURES FOR PARTICULATE SAMPLING

I. Field Preparation

A. FILTERS: Fiberglass 4" sampling filters are prepared as follows:

Filters are removed from their box and numbered on the back side with a felt pen. The numbering system is continuous from job to job. The filters are placed in a desiccator to dry for at least 24 hours. Clean plastic petri dishes, also numbered, top and bottom, are placed in the desiccator with the filters. After desiccation, the filters are removed, one at a time, and weighed on the Sartorius analytical balance then placed in the correspondingly numbered petri dish. Weights are then recorded in the lab record books. Three filters are used for each complete particulate source emissions test and there should be several extra filters included as spares.

B. SILICA GEL: Silica Gel used for the test is prepared as follows:

Approximately 200 g of silica gel is placed in a wide mouth "Mason" type jar and dried in an oven at 175°C for two hours. The open jars are removed and placed in a desiccator until cool for two hours and then tightly sealed. The jars are then numbered and weighed on the triple beam balance to the closest tenth of a gram. This weight is recorded for each sealed jar. The number of silica gel jars used is the same as the number of filters. Silica gel should be indicating type, 6-16 mesh.

II. Post - Testing Lab Analysis

A. FILTERS: The filters are returned to the lab in their sealed petri dishes. In the lab, the dishes are opened and placed into a desiccator for at least 24 hours. Then the filters are weighed continuously every six hours until a constant weight is achieved. All data is recorded on the laboratory forms that will be bound in the test report.

B. SILICA GEL: The silica gel used in the stack test is returned to the appropriate mason jar and sealed for transport to the laboratory where it is reweighed to a constant weight on a triple beam balance to the nearest tenth of a gram.

C. PROBE RINSINGS: In all tests where a probe washout analysis is necessary, this is accomplished in accordance with procedures specified in "EPA Reference Method 5". These samples are returned to the lab in sealed mason jars for analysis. The front half of the filter holder is washed in accordance with the same procedures and included with the probe wash. Reagent or ACS grade acetone is used as the solvent. The backhalf of the filter holder is washed with deionized water into the impinger catch for appropriate analysis.

D. IMPINGER CATCH: In some testing cases, the liquid collected in the impingers must be analyzed for solid content. This involves a similar procedure to the probe wash solids determination, except that the liquid is deionized water.

E. ACETONE: A blank analysis of acetone is conducted from the one gallon glass container used in the field preparation. This acetone was used in the field for rinsing the probe, nozzle, and top half of the filter holder. A blank analysis is performed prior to testing on all new containers of acetone received from the manufacturer to insure that the quality of the acetone used will be exceed the .001% residual purity standard.

## SPECIAL NOTE

When sampling sources high in moisture content, (such as asphalt plants) the filter paper sometimes sticks to the filter holder. When removing the filter, it may tear. In order to maintain control of any small pieces of filter paper which may be easily lost, they are washed with acetone into the probe washing. This makes the filter weight light (sometimes negative) and the probe wash correspondingly heavier. this laboratory procedure is taught by EPA in the "Quality Assurance for Source Emissions Workshop" at Research Triangle Park and is approved by EPA.

## WEIGHING PROCEDURE - SARTORIUS ANALYTICAL BALANCE

The Sartorius balance is accurate to 0.1 mg and has a maximum capacity of 200 grams. The balance precision (standard deviation) is 0.05 mg. Before weighing an item, the balance should first be zeroed. This step should be taken before every series of weighings. To do this, the balance should have all weight adjustments at the "zero" position. The beam arrest lever (on the lower left hand side toward the rear of the balance) is then slowly pressed downward to the full release position. The lighted vernier scale on the front of the cabinet should align with the "zero" with the mark on the cabinet. If it is not so aligned, the adjustment knob on the right hand side (near the rear of the cabinet) should be turned carefully until the marks align. Now return the beam arrest to the horizontal arrest position. The balance is now "zeroed".

To weigh an item, it is first placed on the pan. And the sliding doors are closed to avoid air current disturbance. The weight adjustment knob on the right hand side must be at "zero". The beam arrest is then slowly turned upward. The lighted scale at the front of the cabinet will now indicate the weight of the item in grams. If the scale goes past the divided area, the item then exceeds 100 g weight (about 3 1/2 ounces) and it is necessary to arrest the balance (beam arrest lever) and move the lever for 100 g weight away from you. It is located on the left hand side of the cabinet near the front, and is the knob closest to the side of the cabinet. The balance will not weigh items greater than 200 grams in mass, and trying to do this might harm the balance. Remember, this is a delicate precision instrument.

After the beam is arrested in either weight range, the procedure is the same. When the weight of the item in grams is found, "dial in" that amount with the two knobs on the left hand side (near the 100 g lever) color coded yellow and green. As you dial the weight, the digits will appear on the front of the cabinet. When the proper amount is dialed, carefully move the arrest lever down with a slow, steady turn of the wrist. The lighted dial will appear, and the right hand side knob (front of cabinet) is turned to align the mark with the lower of the two lighted scale divisions which the mark appears between. when these marks are aligned, the two lighted digits along with the two indicated on the right hand window on the cabinet front are fractional weight in grams (the decimal would appear before the lighted digits) and the whole number of grams weight is the amount "dialed in" on the left.

In general, be sure that the beam is in "arrest" position before placing weight on or taking weight off of the pan. Don't "dial in" weight unless the beam is arrested. The balance is sensitive to even a hand on the table near the balance, so be careful and painstaking in every movement while weighing.

Form REC#8

**SAMPLE ANALYTICAL DATA FORM**

Plant Location L. J. EARNEST Relative humidity in lab 50 %

Sample Location _____ Density of Acetone (pa) .7857 mg/ml

Blank volume ($V_a$) 200 ml

Date/Time wt. blank 5-17-89 1:00pm Gross wt. 96.8349 mg

Date/Time wt. blank 5-18-89 2:00pm Gross wt. 96.8352 mg

Ave. Gross wt. 96.8350 mg

Tare wt. 96.8347 mg

Weight of blank ($m_{ab}$) 0.0003 mg

Acetone blank residue concentration ($C_a$) ($C_a$) = ($M_{ab}$) / ($V_a$) ($p_a$) = (0.000019 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} p_a$ = (0.000019)(300)(0.7857) = (0.0004)

| | | Run # 1 | Run # 2 | Run # 3 |
|---|---|---|---|---|
| Acetone rinse volume ($V_{aw}$) | ml | 300 | 300 | 300 |
| Date/Time of wt 5-17-89, 1:30pm Gross wt | g | 159.1756 | 155.6725 | 137.0848 |
| Date/Time of wt 5-18-89, 1:30pm Gross wt | g | 159.1760 | 155.6728 | 137.0850 |
| Average Gross wt | g | 159.1758 | 155.6726 | 137.0849 |
| Tare wt | g | 159.1188 | 155.6510 | 137.0462 |
| Less acetone blank wt ($W_a$) | g | 0.0004 | 0.0004 | 0.0004 |
| Wt of particulate in acetone rinse ($m_a$) | g | 0.0566 | 0.0212 | 0.0383 |

| | | | | |
|---|---|---|---|---|
| Filter Numbers | # | FK-3280 | FK3281 | FK3286 |
| Date/Time of wt 5-17-89, 2:30pm Gross wt | g | 0.5962 | 0.5415 | 0.5828 |
| Date/Time of wt 5-18-89 3:30pm Gross wt | g | 0.5962 | 0.5419 | 0.5827 |
| Average Gross wt | g | 0.5962 | 0.5417 | 0.5827 |
| Tare wt | g | 0.5227 | 0.5203 | 0.5213 |

| | | | | |
|---|---|---|---|---|
| Weight of particulate on filters(s) ($m_f$) | g | 0.0735 | 0.0214 | 0.0614 |
| Weight of particulate in acetone rinse | g | 0.0566 | 0.0212 | 0.0383 |
| Total weight of particulate ($m_n$) | g | 0.1301 | 0.0426 | 0.0997 |

Note: In no case should a blank residue greater than 0.01 mg/g (or 0.001% of the blank weight) be subtracted from the sample weight.

Remarks FILTER FK 3281 IS TORN IN THE CENTER

Signature of analyst Bruce Rhoades Signature of reviewer Sam Turner

L. J. EARNEST

**REFERENCE METHOD 3: GAS ANALYSIS BY FYRITE**

| FUEL | $F_o$ FACTORS |
|---|---|
| WOOD | 1.0540 |
| BARK | 1.0830 |
| ANTHRACITE | 1.0699 |
| BITUMINOUS | 1.1398 |
| LIGNITE | 1.0761 |
| OIL | 1.3465 |
| GAS | 1.7489 |
| PROPANE | 1.5095 |
| BUTANE | 1.4791 |

$O_2\% = 20.9 - [F_o \times CO_2\%]$

RUN #1: 13.95 = 20.9 - [1.3465 x 5.16]

RUN #2: ____ = 20.9 - [1.3465 x 5]

RUN #3 ____ = 20.9 - [1.3465 x ____]

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RUN 1: | $CO_{2\%}$ | 6 | $CO_{2\%}$ | 4.5 | $CO_{2\%}$ | 5 | AVG. | 5.16 |
| | $O_{2\%}$ | 12.82 | $O_{2\%}$ | 14.84 | $O_{2\%}$ | 14.17 | AVG. | 13.94 |
| | $N_{2\%}$ | 87.18 | $N_{2\%}$ | 85.16 | $N_{2\%}$ | 85.83 | AVG. | 86.06 |
| RUN 2: | $CO_{2\%}$ | 5 | $CO_{2\%}$ | 5 | $CO_{2\%}$ | 5 | AVG. | 5 |
| | $O_{2\%}$ | 14.17 | $O_{2\%}$ | 14.17 | $O_{2\%}$ | 14.17 | AVG. | 14.17 |
| | $N_{2\%}$ | 85.83 | $N_{2\%}$ | 85.83 | $N_{2\%}$ | 85.83 | AVG. | 85.83 |
| RUN 3: | $CO_{2\%}$ | 4 | $CO_{2\%}$ | 5 | $CO_{2\%}$ | 5 | AVG. | 4.66 |
| | $O_{2\%}$ | 15.51 | $O_{2\%}$ | 14.17 | $O_{2\%}$ | 14.17 | AVG. | 14.62 |
| | $N_{2\%}$ | 84.49 | $N_{2\%}$ | 85.83 | $N_{2\%}$ | 85.83 | AVG. | 85.38 |

# VII. CALCULATIONS

L.J. EARNEST
SHREVEPORT, LOUISIANA

## SUMMARY OF TEST DATA

| | | | 5-10-89 RUN #1 | 5-10-89 RUN #2 | 5-10-89 RUN #3 |
|---|---|---|---|---|---|
| **SAMPLING TRAIN DATA** | | | | | |
| | | start | 08:34 | 10:35 | 12:58 |
| | | finish | 09:39 | 11:40 | 14:03 |
| 1. | Sampling time, minutes | $\theta$ | 60.0 | 60.0 | 60.0 |
| 2. | Sampling nozzle diameter, in. | $D_n$ | .2300 | .2300 | .2300 |
| 3. | Sampling nozzle cross-sect. area, $ft^2$ | $A_n$ | .000289 | .000289 | .000289 |
| 4. | Isokinetic variation | I | 96.1 | 105.7 | 100.6 |
| 5. | Sample gas volume - meter cond., cf. | $V_m$ | 45.800 | 48.572 | 48.418 |
| 6. | Average meter temperature, $^oR$ | $T_m$ | 547 | 556 | 560 |
| 7. | Avg. oriface pressure drop, in. $H_2O$ | dH | 1.76 | 1.76 | 1.78 |
| 8. | Total particulate collected, mg. | $M_n$ | 130.10 | 42.60 | 99.70 |
| **VELOCITY TRAVERSE DATA** | | | | | |
| 9. | Stack area, $ft^2$ | A | 9.38 | 9.38 | 9.38 |
| 10. | Absolute stack gas pressure, in. Hg. | $P_s$ | 30.28 | 30.28 | 30.28 |
| 11. | Barometric pressure, in. Hg. | $P_{bar}$ | 30.28 | 30.28 | 30.28 |
| 12. | Avg. absolute stack temperature, $R^o$ | $T_s$ | 769 | 766 | 771 |
| 13. | Average $-\sqrt{\text{vel. head}}$, ( $C_p$= .82) | $-\sqrt{dP}$ | 1.31 | 1.24 | 1.29 |
| 14. | Average stack gas velocity, ft./sec. | $V_s$ | 88.41 | 83.63 | 87.41 |
| **STACK MOISTURE CONTENT** | | | | | |
| 15. | Total water collected by train, ml. | $V_{ic}$ | 349.60 | 366.70 | 360.40 |
| 16. | Moisture in stack gas, % | $B_{ws}$ | 26.75 | 26.96 | 26.82 |
| **EMISSIONS DATA** | | | | | |
| 17. | Stack gas flow rate, dscf/hr.(000's) | $Q_{sd}$ | 1519 | 1438 | 1497 |
| 18. | Stack gas flow rate, cfm | acfm | 49757 | 47067 | 49194 |
| 19. | Particulate concentration, gr/dscf | $C_s$ | 0.0446 | 0.0140 | 0.0331 |
| 20. | Particulate concentration, lb/hr | E | 9.68 | 2.88 | 7.08 |
| 21. | Particulate concentration, lb/mBtu | E' | 0.00000 | 0.00000 | 0.00000 |
| **ORSAT DATA** | | | | | |
| 22. | Percent $CO_2$ by volume | $CO_2$ | 5.16 | 5.00 | 4.66 |
| 23. | Percent $O_2$ by volume | $O_2$ | 13.94 | 14.17 | 14.62 |
| 24. | Percent CO by volume | CO | .00 | .00 | .00 |
| 25. | Percent $N_2$ by volume | $N_2$ | 86.06 | 85.83 | 85.38 |

Format: summryR3

**Dry Gas Volume**

$$V_{m(std)} = V_m \left[\frac{T_{(std)}}{T_m}\right]\left[\frac{P_{bar} + \frac{dH}{13.6}}{P_{(std)}}\right] = 17.64 \frac{^oR}{in.Hg} \; Y \; V_m \left[\frac{P_{bar} + \frac{dH}{13.6}}{T_m}\right]$$

Where:

$V_{m(std)}$ = Dry Gas Volume through meter at standard conditions, cu. ft.

$V_m$ = Dry Gas Volume measured by meter, cu. ft.

$P_{bar}$ = Barometric pressure at oriface meter, in. Hg.

$P_{std}$ = Standard absolute pressure,(29.92 in. Hg.).

$T_m$ = Absolute temperature at meter $^oR$.

$T_{std}$ = Standard absolute temperature ( $528^oR$).

dH = Average pressure drop across oriface meter, in. $H_2O$.

Y = Dry gas meter calibration factor.

13.6 = Inches water per inches Hg.

RUN 1:

$$V_{m(std)} = (17.64)(1.000)(45.800)\left[\frac{(30.28) + \frac{1.76}{13.6}}{547}\right] = 44.914 \text{ dscf}$$

RUN 2:

$$V_{m(std)} = (17.64)(1.000)(48.572)\left[\frac{(30.28) + \frac{1.76}{13.6}}{556}\right] = 46.862 \text{ dscf}$$

RUN 3:

$$V_{m(std)} = (17.64)(1.000)(48.418)\left[\frac{(30.28) + \frac{1.78}{13.6}}{560}\right] = 46.382 \text{ dscf}$$

**Total Contaminants by Weight: GRAIN LOADING**

Particulate concentration $C_s'$ gr./dscf.

$$C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{M_n}{V_{m(std)}}\right]$$

Where:

$C_s'$ = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, gr./dscf.

$M_n$ = Total amount of particulate matter collected, mg.

$V_{m(std)}$ = Dry gas volume through meter at standard conditions, cu. ft.

Run 1:

$$C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{130.10}{44.914}\right] = 0.0446 \text{ gr./dscf.}$$

Run 2:

$$C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{42.60}{46.862}\right] = 0.0140 \text{ gr./dscf.}$$

Run 3:

$$C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{99.70}{46.382}\right] = 0.0331 \text{ gr./dscf.}$$

## Dry Molecular Weight

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2)$$

Where:

$M_d$ = Dry molecular weight, lb./lb.-mole.
$\%CO_2$ = Percent carbon dioxide by volume (dry basis).
$\%O_2$ = Percent oxygen by volume (dry basis).
$\%N_2$ = Percent nitrogen by volume (dry basis).
%CO = Percent carbon monoxide by volume (dry basis).
0.264 = Ratio of $O_2$ to $N_2$ in air, v/v.
0.28 = Molecular weight of $N_2$ or CO, divided by 100.
0.32 = Molecular weight of $O_2$ divided by 100.
0.44 = Molecular weight of $CO_2$ divided by 100.

Run 1:

$$M_d = 0.44(\ 5.16\%) + 0.32(13.94\%) + 0.28(\ .00\% + 86.06\%) = 30.83 \ \frac{lb}{lb\text{-mole}}$$

Run 2:

$$M_d = 0.44(\ 5.00\%) + 0.32(14.17\%) + 0.28(\ .00\% + 85.83\%) = 30.77 \ \frac{lb}{lb\text{-mole}}$$

Run 3:

$$M_d = 0.44(\ 4.66\%) + 0.32(14.62\%) + 0.28(\ .00\% + 85.38\%) = 30.64 \ \frac{lb}{lb\text{-mole}}$$

**Water Vapor Condensed**

$$V_{wc_{std}} = \left[ V_f - V_i \right] \left[ \frac{p_w \, R \, T_{(std)}}{M_w \quad P_{(std)}} \right] = 0.04707 \left[ V_f - V_i \right]$$

$$V_{wsg_{std}} = \left[ W_f - W_i \right] \left[ \frac{R \quad T_{(std)}}{M_w \quad P_{(std)}} \right] = 0.04715 \left[ W_f - W_i \right]$$

Where:

0.04707 = Conversion factor, $ft.^3/ml.$

0.04715 = Conversion factor, $ft.^3/g.$

$V_{wc_{std}}$ = Volume of water vapor condensed (standard conditions), scf.

$V_{wsg_{std}}$ = Volume of water vapor collected in silica gel (standard conditions), ml.

$V_f - V_i$ = Final volume of impinger contents less initial volume, ml.

$W_f - W_i$ = Final weight of silica gel less initial weight, g.

$p_w$ = Density of water, 0.002201 lb/ml.

R = Ideal gas constant, 21.85 in.Hg. (cu.ft./lb.-mole)($^\circ$R).

$M_w$ = Molecular weight of water vapor, 18.0 lb/lb-mole.

$T_{std}$ = Absolute temperature at standard conditions, 528$^\circ$R.

$P_{std}$ = Absolute pressure at standard conditions, 29.92 inches Hg.

Run 1:

$V_{wc(std)}$ = (0.04707) ( 328.0) = 15.4 cu.ft
$V_{wsg(std)}$ = (0.04715) ( 21.6) = 1.0 cu.ft

Run 2:

$V_{wc(std)}$ = (0.04707) ( 341.0) = 16.1 cu.ft
$V_{wsg(std)}$ = (0.04715) ( 25.7) = 1.2 cu.ft

Run 3:

$V_{wc(std)}$ = (0.04707) ( 338.0) = 15.9 cu.ft
$V_{wsg(std)}$ = (0.04715) ( 22.4) = 1.1 cu.ft

**Moisture Content of Stack Gases**

$$B_{ws} = \frac{V_{wc_{std}} + V_{wsg_{std}}}{V_{wc_{std}} + V_{wsg_{std}} + V_{m_{std}}} \times 100$$

Where:

$B_{ws}$ = Proportion of water vapor, by volume, in the gas stream.

$V_m$ = Dry gas volume measured by dry gas meter,(dcf).

$V_{wc_{std}}$ = Volume of water vapor condensed corrected to standard conditions (scf).

$V_{wsg_{std}}$ = Volume of water vapor collected in silica gel corrected to standard conditions (scf).

Run 1:

$$B_{ws} = \frac{15.4 + 1.0}{15.4 + 1.0 + 44.914} \times 100 = 26.75\ \%$$

Run 2:

$$B_{ws} = \frac{16.1 + 1.2}{16.1 + 1.2 + 46.862} \times 100 = 26.96\ \%$$

Run 3:

$$B_{ws} = \frac{15.9 + 1.1}{15.9 + 1.1 + 46.382} \times 100 = 26.82\ \%$$

## Molecular Weight of Stack Gases

$$M_s = M_d ( 1 - B_{ws}) + 18 ( B_{ws} )$$

Where:

$M_s$ = Molecular weight of stack gas, wet basis, (lb./lb.-mole).

$M_d$ = Molecular weight of stack gas, dry basis, (lb./lb.-mole).

Run 1:

$M_s = 30.83 ( 1 - 26.75 ) + 18 ( 26.75\% = 27.40$ (lb./lb.-mole)

Run 2:

$M_s = 30.77 ( 1 - 26.96 ) + 18 ( 26.96\% = 27.33$ (lb./lb.-mole)

Run 3:

$M_s = 30.64 ( 1 - 26.82 ) + 18 ( 26.82\% = 27.25$ (lb./lb.-mole)

**Stack Gas Velocity**

$$V_s = K_p\, C_p \left[ -\sqrt{dP} \right]_{avg.} \sqrt{\frac{T_{s(avg.)}}{P_s\ M_s}}$$

**Where:**

$V_s$ = Average velocity of gas stream in stack, ft./sec.

$K_p$ = 85.49 ft/sec $\left[\text{(g/g-mole)-(mm Hg) / ($^{o}$K)( mm } \underline{H_2O}\right]^{1/2}$

$C_p$ = Pitot tube coefficient, (dimensionless).

dP = Velocity head of stack gas, in. $H_2O$.

$P_{bar}$ = Barometric pressure at measurement site, (in. Hg).

$P_g$ = Stack static pressure, (in. Hg).

$P_s$ = Absolute stack gas pressure, (in. Hg) = $P_{bar} + P_g$

$P_{std}$ = Standard absolute pressure, ( 29.92 in. Hg ).

$t_s$ = Stack temperature, ($^{o}$f).

$T_s$ = Absolute stack temperature, ($^{o}$R). = 460 + $t_s$.

$M_s$ = Molecular weight of stack gas, wet basis, (lb/lb-mole).

Run 1:

$$V = (85.49)\ (\ .82)\ (\ 1.31) \sqrt{\frac{769}{(30.28)(27.40)}} = 88.41 \text{ ft/sec.}$$

90.57

Run 2:

$$V = (85.49)\ (\ .82)\ (\ 1.24) \sqrt{\frac{766}{(30.28)(27.33)}} = 83.63 \text{ ft/sec.}$$

Run 3:

$$V = (85.49)\ (\ .82)\ (\ 1.29) \sqrt{\frac{771}{(30.28)(27.25)}} = 87.41 \text{ ft/sec.}$$

**Stack Gas Flow Rate**

$$Q_{sd} = 3600 \left[ 1 - B_{wc} \right] V_s A \left[ \frac{T_{std}}{T_{stk}} \right] \left[ \frac{P_s}{P_{std}} \right]$$

Where:

$Q_{sd}$ = Dry volumetric stack gas flow rate corrected to standard conditions, (dscf/hr).

A = Cross sectional area of stack, ($ft.^2$).

3600 = Conversion factor, (sec./hr.).

$t_s$ = Stack temperature, ($^oF$).

$T_s$ = Absolute stack temperature, ($^oR$).

$T_{std}$ = Standard absolute temperature, ($528^oR$).

$P_{bar}$ = Barometric pressure at measurement site, (in.Hg.).

$P_g$ = Stack static pressure, (in.Hg.).

$P_s$ = Absolute stack gas pressure, (in.Hg.); = $P_{bar} + P_g$

$P_{std}$ = Standard absolute pressure, (29.92 in.Hg.).

Run 1:

$$Q_{sd}=3600(1-\ .2675\ )(\ 88.41)(\ 9.38)\left[\frac{528}{769}\right]\left[\frac{30.28}{29.92}\right]=\ 1519554.3\ \frac{dscf}{hr}$$

Run 2:

$$Q_{sd}=3600(1-\ .2696\ )(\ 83.63)(\ 9.38)\left[\frac{528}{766}\right]\left[\frac{30.28}{29.92}\right]=\ 1438890.1\ \frac{dscf}{hr}$$

Run 3:

$$Q_{sd}=3600(1-\ .2682\ )(\ 87.41)(\ 9.38)\left[\frac{528}{771}\right]\left[\frac{30.28}{29.92}\right]=\ 1497037.5\ \frac{dscf}{hr}$$

**Emissions Rate from Stack**

$$E = \frac{(C_s)\ (Q_{sd})}{7000\ gr./lb.} = \text{lb. / hr.}$$

Where:

$E$ = Emissions rate, lb/hr.

$C_s$ = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, gr/dscf.

$Q_{sd}$ = Dry volumetric stack gas flow rate corrected to standard conditions, dscf/hr.

Run 1:

$$E = \frac{(0.0446)\ (1519554.3)}{7000} = 9.68 \text{ lb. / hr.}$$

Run 2:

$$E = \frac{(0.0140)\ (1438890.1)}{7000} = 2.88 \text{ lb. / hr.}$$

Run 3:

$$E = \frac{(0.0331)\ (1497037.5)}{7000} = 7.08 \text{ lb. / hr.}$$

$$I = 100\ T_s \left[ \frac{0.002669\ V_{ic} + (V_m / T_m)\ (P_{bar} + dH / 13.6)}{60\ \Theta\ V_s\ P_s\ A_n} \right]$$

Where:

| | | |
|---|---|---|
| $I$ | = | Percent isokinetic sampling. |
| 100 | = | Conversion to percent. |
| $T_s$ | = | Absolute average stack gas temperature, $^{o}R$. |
| 0.002669 | = | Conversion factor, Hg - $ft^3/ml$ - $^{o}R$. |
| $V_{ic}$ | = | Ttl vol of liquid collected in impingers and silica gel, ml. |
| $T_m$ | = | Absolute average dry gas meter temperature, $^{o}R$. |
| $P_{bar}$ | = | Barometric pressure at sampling site, (in. Hg). |
| dH | = | Av pressure differential across the oriface meter, (in.$H_2O$). |
| 13.6 | = | Specific gravity of mercury. |
| 60 | = | Conversion seconds to minutes. |
| $\Theta$ | = | Total sampling time, minutes. |
| $V_s$ | = | Stack gas velocity, ft./sec. |
| $P_s$ | = | Absolute stack gas pressure, in. Hg. |
| $A_n$ | = | Cross sectional area of nozzle, $ft^2$. |

Run 1:

$$I = (100)(769)\left[ \frac{(0.002669)(349.60) + \frac{45.800}{547}\left[30.28 + \frac{1.76}{13.6}\right]}{60\ (\ 60.0\ )\ (\ 88.41\ )\ (\ 30.28\ )\ (\ .000289\ )} \right] = 96.1\%$$

Run 2:

$$I = (100)(766)\left[ \frac{(0.002669)(366.70) + \frac{48.572}{556}\left[30.28 + \frac{1.76}{13.6}\right]}{60\ (\ 60.0\ )\ (\ 83.63\ )\ (\ 30.28\ )\ (\ .000289\ )} \right] = 105.7\%$$

Run 3:

$$I = (100)(771)\left[ \frac{(0.002669)(360.40) + \frac{48.418}{560}\left[30.28 + \frac{1.78}{13.6}\right]}{60\ (\ 60.0\ )\ (\ 87.41\ )\ (\ 30.28\ )\ (\ .000289\ )} \right] = 100.6\%$$

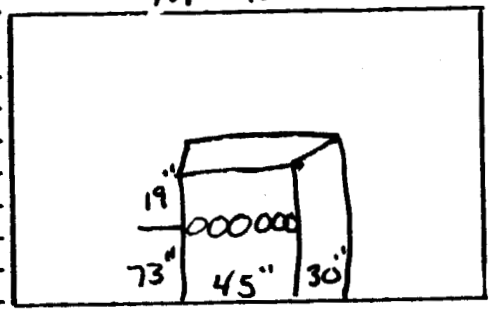
# VIII. FIELD DATA

RAMCON ENVIRONMENTAL CORPORATION

Plant L. J. EARNEST

Location SHREVEPORT, LA.
Operator F. C. KUHN
Date 5-10-89
Run No. 1
Sample Box No. 1
Meter Box No. 689836 C-100
Meter H @ 1.54
C Factor 1.002
Pitot Tube Coefficient Cp .824

M = 1.02




Schematic of Stack Cross Section

| | | SILICA GEL WEIGHT, g |
|---|---|---|
| Ambient Temperature | 62 °F | |
| Barometric Pressure | 30.28 FINAL | 528 582.6 |
| Assumed Moisture, % | 28 INITIAL | 200 561 |
| Probe Length, m(ft) | 3 FT DIFFERENCE | 328 21.6 |
| Nozzle Identification No. | .000 2885 | |
| Avg. Calibrated Nozzle Dia., (in.) | .230, .230, .230 | |
| Probe Heater Setting | 5 | |
| Leak Rate, $m^3$/min. (cfm) | .003 @ 6" | |
| Probe Liner Material | .316 STAINLESS | |
| Static Pressure, mm Hg (in. Hg) | ~~.003 @ 7.6 0.003~~ | |
| Filter No. | FK-3280 .5227 | |

| TRAV. PT NO. | SAMPLING TIME (θ) min. | VACUUM in. Hg | STACK TEMP (Ts) °F | VELOCITY HEAD (Ps) in $H_2O$ | PRESSURE DIFF. ORF. MTR in $H_2O$ | GAS SAMPLE VOLUME $ft^3$ | GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet | Outlet | FILTER HOLDER TEMP °F | GAS TEMP LVG CONDENSER OR LAST IMPINGER °F |
|---|---|---|---|---|---|---|---|---|---|---|
| A) 1 | 8:34 / 8:36 | 2.5 | 290 | 2.1 | 2.1 | 285.400 / 286.83 | 76 | 72 | 240 | 50 |
| 2 | 8:38 | 1.5 | 305 | .53 | .54 | 287.43 | 82 | 72 | 245 | 50 |
| 3 | 8:40 | 2 | 310 | 1.7 | 1.7 | 288.49 | 84 | 72 | 240 | 50 |
| 4 | 8:42 | 2 | 310 | 2.0 | 2.0 | 289.58 | 86 | 72 | 240 | 50 |
| 5 | 8:44 | 2.5 | 305 | 2.6 | 2.7 | 290.81 | 86 | 72 | 240 | 50 |
| B) 1 | 8:45 / 8:47 | 2 | 310 | 1.8 | 1.8 | 292.26 | 86 | 72 | 240 | 50 |
| 2 | 8:49 | 2 | 310 | 2.0 | 2.0 | 294.17 | 88 | 72 | 240 | 50 |
| 3 | 8:51 | 2 | 310 | 2.0 | 2.0 | 295.95 | 94 | 74 | 245 | 50 |
| 4 | 8:53 | 2.5 | 310 | 2.1 | 2.1 | 297.74 | 98 | 74 | 250 | 50 |
| 5 | 8:55 | 3 | 310 | 2.3 | 2.3 | 299.63 | 100 | 74 | 250 | 50 |
| C) 1 | 8:56 / 8:58 | 2.5 | 305 | 1.7 | 1.7 | 301.26 | 94 | 76 | 260 | 50 |
| 2 | 9:00 | 2.5 | 305 | 1.5 | 1.5 | 302.81 | 100 | 76 | 260 | 50 |
| 3 | 9:02 | 3 | 310 | 2.2 | 2.2 | 304.63 | 102 | 76 | 260 | 50 |

CO = 6%  CO = 4.5%  CO = 5%

Form #REC-06

L. J. EARNEST

**RAMCON** emissions test log sheet, cont. DATE 5-10-89 LOCATION Shreveport, LA TEST NO. 1

| TRAVERSE POINT | SAMPLING TIME θ (min) | VACUUM mm Hg (in. Hg) | STACK TEMP $T_s$ (°F) | VELOCITY HEAD $\Delta P_s$ (in. $H_2O$) | ORFICE DIFF. PRESSURE $\Delta H$ (in. $H_2O$) | GAS VOLUME $V_m$ ($ft^3$) | GAS SAMPLE TEMP. (°F) | | SAMPLE BOX TEMP. (°F) | IMPINGER TEMP (°F) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | in | out | | |
| 4 | 9:04 | 3 | 310 | 1.8 | 1.8 | 306.45 | 104 | 76 | 260 | 50 |
| 5 | 9:06 | 3.5 | 310 | 2.3 | 2.3 | 308.35 | 104 | 78 | 260 | 50 |
| D) 1 | 9:07 / 9:09 | 2.5 | 290 | 1.1 | 1.1 | 309.79 | 96 | 78 | 255 | 50 |
| 2 | 9:11 | 2.5 | 315 | 1.5 | 1.5 | 311.21 | 102 | 78 | 255 | 50 |
| 3 | 9:13 | 3 | 315 | 1.9 | 1.9 | 312.96 | 104 | 78 | 260 | 50 |
| 4 | 9:15 | 2.5 | 315 | 1.7 | 1.7 | 314.64 | 104 | 78 | 260 | 50 |
| 5 | 9:17 | 3 | 315 | 1.8 | 1.8 | 316.22 | 104 | 80 | 260 | 50 |
| E) 1 | 9:18 / 9:20 | 2.5 | 310 | 1.4 | 1.4 | 317.69 | 100 | 80 | 260 | 50 |
| 2 | 9:22 | 2.5 | 315 | 1.7 | 1.7 | 319.17 | 104 | 80 | 260 | 50 |
| 3 | 9:24 | 2.5 | 310 | 1.8 | 1.8 | 320.69 | 106 | 80 | 260 | 50 |
| 4 | 9:26 | 2.5 | 310 | 1.6 | 1.6 | 322.27 | 106 | 80 | 260 | 50 |
| 5 | 9:28 | 2.5 | 310 | 1.6 | 1.6 | 323.51 | 106 | 80 | 260 | 50 |
| F) 1 | 9:29 / 9:31 | 2.5 | 310 | 1.4 | 1.4 | 324.99 | 100 | 80 | 260 | 50 |
| 2 | 9:33 | 2.5 | 310 | 1.6 | 1.6 | 326.49 | 106 | 80 | 260 | 50 |
| 3 | 9:35 | 3.5 | 310 | 2.4 | 2.4 | 328.48 | 108 | 80 | 260 | 50 |
| 4 | 9:37 | 2.5 | 310 | 1.5 | 1.5 | 329.89 | 106 | 80 | 260 | 50 |
| 5 | 9:39 | 2.5 | 310 | 1.1 | 1.1 | 331.200 | 108 | 80 | 260 | 50 |

RAMCON ENVIRONMENTAL CORPORATION

Plant L. J. EARNEST

Location SHREVEPORT, LA.
Operator F C KUHN
Date 5-10-89
Run No. 2
Sample Box No. 3
Meter Box No. 689836 C-100
Meter H @ 1.54
C Factor 1.002
Pitot Tube Coefficient Cp .824

n=1.09

| | | Orifice Volume, ml | Silica Gel Weight, g |
|---|---|---|---|
| Ambient Temperature | 68 °F | | |
| Barometric Pressure | 30.28 FINAL | 541 | 584.9 |
| Assumed Moisture, % | 28 INITIAL | 200 | 559.2 |
| Probe Length, m(ft) | 3FT DIFFERENCE | 341 | 25.7 |

Nozzle Identification No. .1000 2885
Avg. Calibrated Nozzle Dia., (in.) .230 / .230 / .230
Probe Heater Setting 5
Leak Rate, $m^3$/min. (cfm) .002 @ 6"
Probe Liner Material .316 STAINLESS STEEL
Static Pressure, mm Hg (in. Hg) .003
Filter No. FK-3281 .5203

Schematic of Stack Cross Section

| TRAV. PT NO. | SAMPLING TIME (θ) min. | VACUUM in. Hg | STACK TEMP (Ts) °F | VELOCITY HEAD (Ps) in $H_2O$ | PRESSURE DIFF. ORF. MTR in $H_2O$ | GAS SAMPLE VOLUME $ft^3$ | GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet | GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet | FILTER HOLDER TEMP °F | GAS TEMP LVG CONDENSER OR LAST IMPINGER °F |
|---|---|---|---|---|---|---|---|---|---|---|
| A) 1 | 10:35 / 10:37 | 2.5 | 290 | 2.8 | 3.1 | 331.351 / 333.30 | 90 | 84 | 260 | 50 |
| 2 | 10:39 | 2 | 310 | 1.6 | 1.7 | 335.42 | 98 | 84 | 260 | 50 |
| 3 | 10:41 | 1.5 | 310 | .77 | .84 | 336.57 | 100 | 84 | 260 | 50 |
| 4 | 10:43 | 1 | 310 | .39 | .43 | 337.42 | 104 | 84 | 260 | 50 |
| 5 | 10:45 | 1 | 305 | .17 | .19 | 337.94 | 104 | 84 | 260 | 50 |
| B) 1 | 10:46 / 10:48 | 3 | 295 | 2.3 | 2.5 | 339.93 | 104 | 84 | 260 | 50 |
| 2 | 10:50 | 2.5 | 310 | 1.4 | 1.5 | 341.52 | 106 | 84 | 240 | 50 |
| 3 | 10:52 | 2 | 310 | .96 | ~~1.0~~ 1.0 | 342.97 | 108 | 84 | 235 | 50 |
| 4 | 10:54 | 1.5 | 310 | .55 | .60 | 343.93 | 108 | 84 | 240 | 50 |
| 5 | 10:56 | 1.5 | 305 | .61 | .66 | 344.95 | 108 | 84 | 240 | 50 |
| C) 1 | 10:57 / 10:59 | 2.5 | 305 | 2.3 | 2.5 | 346.98 | 102 | 84 | 240 | 50 |
| 2 | 1101 | 2.5 | 310 | 2.1 | 2.3 | 348.82 | 106 | 84 | 240 | 50 |
| 3 | 1103 | 2 | 315 | 1.6 | 1.7 | 350.48 | 108 | 84 | 240 | 50 |

CO = 5%  CO = 5%  CO = 5

Form #REC-06 L.J. EARNEST

**RAMCON** emissions test log sheet, cont. DATE 5-10-89 LOCATION Shoveport, La TEST NO. 2

| TRAVERSE POINT | SAMPLING TIME θ (min) | VACUUM mm Hg (in. Hg) | STACK TEMP $T_s$ (°F) | VELOCITY HEAD $\Delta P_s$ (in. $H_2O$) | ORFICE DIFF. PRESSURE $\Delta H$ (in. $H_2O$) | GAS VOLUME $V_m$ ($ft^3$) | GAS SAMPLE TEMP. (°F) | | SAMPLE BOX TEMP. (°F) | IMPINGER TEMP (°F) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | in | out | | |
| 4 | 1105 | 2 | 310 | 1.6 | 1.7 | ~~352.58~~ 352.15 | 110 | 84 | 240 | 50 |
| 5 | 1107 | 2 | 305 | 2.0 | 2.2 | 353.98 | 110 | 84 | 240 | 50 |
| 1 | 1108 / 1110 | 3 | 305 | 2.4 | 2.6 | 355.93 | 106 | 84 | 240 | 50 |
| 2 | 1112 | 3 | 305 | 2.5 | 2.7 | 358.03 | 108 | 84 | 240 | 50 |
| 3 | 1114 | 3 | 310 | 2.1 | 2.3 | 359.87 | 110 | 84 | 240 | 50 |
| 4 | 1116 | 2.5 | 305 | 1.3 | 1.4 | 361.45 | 110 | 84 | 240 | 50 |
| 5 | 1118 | 3 | 305 | 1.8 | 2.0 | 363.20 | 112 | 84 | 240 | 50 |
| 1 | 1119 / 1121 | 3 | 300 | 2.0 | 2.2 | 365.03 | 106 | 84 | 240 | 50 |
| 2 | 1123 | 3.5 | 310 | 3.1 | 3.4 | 367.21 | 110 | 84 | 240 | 50 |
| 3 | 1125 | 3 | 305 | 2.7 | 2.9 | 369.32 | 112 | 86 | 240 | 50 |
| 4 | 1127 | 2.5 | 305 | 1.3 | 1.4 | 370.87 | 112 | 86 | 240 | 50 |
| 5 | 1129 | 2 | 305 | 1.1 | 1.2 | ~~372.25~~ 372.25 | 112 | 86 | 240 | 50 |
| 1 | 1130 / 1132 | 2.5 | 300 | 1.6 | 1.7 | 373.88 | 106 | 86 | 240 | 50 |
| 2 | 1134 | 2.5 | 310 | 1.6 | 1.7 | 375.50 | 112 | 86 | 240 | 50 |
| 3 | 1136 | 2.5 | 310 | 1.4 | 1.5 | 377.06 | 114 | 86 | 240 | 50 |
| 4 | 1138 | 2.5 | 310 | 1.6 | 1.7 | 378.60 | 114 stack | 88 | 240 | 50 |
| 5 | 1140 | 2 | 305 | 1.1 | 1.2 | 379.923 | 114 | 88 | 240 | 50 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

RAMCON ENVIRONMENTAL CORPORATION

Plant L.J. EARNEST — M 1.04

Location Shreveport, La.
Operator F.C. KUHN.
Date 5-10-89
Run No. 3
Sample Box No. 1
Meter Box No. 689836 C-100
Meter H @ 1.54
C Factor 1.002
Pitot Tube Coefficient Cp .824

| | | IMPINGER VOLUME, ml | SILICA GEL WEIGHT, g |
|---|---|---|---|
| Ambient Temperature | 73°F | | |
| Barometric Pressure | 30.28 FINAL | 538 | 570.4 |
| Assumed Moisture, % | 28 INITIAL | 200 | 548.0 |
| Probe Length, m(ft) | 3FT DIFFERENCE | 338 | 22.4 |

Nozzle Identification No. .000 2885
Avg. Calibrated Nozzle Dia., (in.) .230/.230/.230
Probe Heater Setting 5
Leak Rate, $m^3$/min. (cfm) .002 @ 6"
Probe Liner Material .316 STAINLESS
Static Pressure, mm Hg (in.Hg) .003
Filter No. FK-3286 .5213

Schematic of Stack Cross Section

| TRAV. PT NO. | SAMPLING TIME (θ) min. | VACUUM in. Hg | STACK TEMP (Ts) °F | VELOCITY HEAD (Ps) in $H_2O$ | PRESSURE DIFF. ORF. MTR in $H_2O$ | GAS SAMPLE VOLUME ft³ | GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet | Outlet | FILTER HOLDER TEMP °F | GAS TEMP LVG CONDENSER OR LAST IMPINGER °F |
|---|---|---|---|---|---|---|---|---|---|---|
| A) 1 | 12:58 / 1300 | 3 | 305 | 2.5 | 2.6 | 380.300 / 382.05 | 90 | 90 | 265 | 60 |
| 2 | 1302 | 2.5 | 310 | 1.7 | 1.8 | 383.52 | 100 | 90 | 265 | 60 |
| 3 | 1304 | 2 | 315 | 1.4 | 1.5 | 385.00 | 102 | 90 | 265 | 60 |
| 4 | 1306 | 2 | 315 | 1.4 | 1.5 | 386.60 | 102 | 88 | 265 | 60 |
| 5 | 1308 | 2 | 315 | 1.6 | 1.7 | 388.37 | 104 | 88 | 265 | 60 |
| B) 1 | 1309 / 1311 | 3 | 310 | 2.0 | 2.1 | 390.14 | 104 | 88 | 260 | 60 |
| 2 | 1313 | 3 | 310 | 2.1 | 2.2 | 391.93 | 108 | 88 | 260 | 60 |
| 3 | 1315 | 2 | 310 | 1.4 | 1.5 | 393.51 | 110 | 88 | 260 | 60 |
| 4 | 1317 | 2 | 310 | 1.1 | 1.1 | 394.83 | 112 | 88 | 260 | 60 |
| 5 | 1319 | 2 | 310 | 1.3 | 1.4 | 396.31 | 114 | 88 | 260 | 60 |
| C) 1 | 1320 / 1322 | 2.5 | 305 | 1.8 | 1.9 | 398.02 | 110 | 90 | 265 | 60 |
| 2 | 1324 | 3 | 305 | 2.2 | 2.3 | 399.82 | 110 | 90 | 270 | 60 |
| 3 | 1326 | 2.5 | 310 | 1.9 | 2.0 | 401.58 | 110 | 90 | 270 | 60 |

CO = 4%  CO = 5%  CO = 5%

Form #REC-06

L. J. EARNEST

**RAMCON** emissions test log sheet, cont. DATE 5-10-89 LOCATION Shreveport, La TEST NO. 3

| TRAVERSE POINT | SAMPLING TIME θ (min) | VACUUM mm Hg (in. Hg) | STACK TEMP $T_s$ (°F) | VELOCITY HEAD $\Delta P_s$ (in. $H_2O$) | ORFICE DIFF. PRESSURE $\Delta H$ (in. $H_2O$) | GAS VOLUME Vm ($ft^3$) | GAS SAMPLE TEMP. (°F) | | SAMPLE BOX TEMP. (°F) | IMPINGER TEMP (°F) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | in | out | | |
| 4 | 1328 | 3 | 310 | 1.5 | 1.6 | 403.20 | 110 | 90 | 270 | 60 |
| 5 | 1330 | 2 | 310 | 1.3 | 1.4 | 404.73 | 112 | 90 | 270 | 60 |
| D) 1 | 1331 / 1333 | 3 | 315 | 1.6 | 1.7 | 406.25 | 108 | 90 | 270 | 60 |
| 2 | 1335 | 3,5 | 315 | 1.9 | 2.0 | 407.90 | 112 | 90 | 270 | 60 |
| 3 | 1337 | 4 | 315 | 2.5 | 2.6 | 409.69 | 112 | 90 | 270 | 60 |
| 4 | 1339 | 3 | 310 | 1.6 | 1.7 | 411.37 | 112 | 90 | 265 | 60 |
| 5 | 1341 | 2.5 | 310 | 1.1 | 1.1 | 412.89 | 112 | 90 | 265 | 60 |
| E) 1 | 1342 / 1344 | 2.5 | 305 | 1.5 | 1.6 | 414.32 | 106 | 90 | 260 | 60 |
| 2 | 1346 | 3.5 | 315 | 2.3 | 2.4 | 416.12 | 112 | 90 | 260 | 60 |
| 3 | 1348 | 3 | 315 | 2.2 | 2.3 | 417.86 | 112 | 90 | 260 | 60 |
| 4 | 1350 | 2.5 | 315 | 1.5 | 1.6 | 419.51 | 112 | 90 | 260 | 60 |
| 5 | 1352 | 2 | 310 | 1.0 | 1.0 | 420.91 | 114 | 92 | 260 | 60 |
| F) 1 | 1353 / 1355 | 3 | 310 | 2.0 | 2.1 | 422.62 | 110 | 92 | 260 | 60 |
| 2 | 1357 | 3,5 | 310 | 2.3 | 2.4 | 424.32 | 112 | 92 | 260 | 60 |
| 3 | 1359 | 3 | 315 | 1.6 | 1.7 | 425.88 | 112 | 92 | 260 | 60 |
| 4 | 1401 | 2.5 | 315 | 1.3 | 1.4 | 427.38 | 114 | 92 | 260 | 60 |
| 5 | 1403 | 2.5 | 310 | 1.2 | 1.3 | 428.718 | 116 | 92 | 255 | 60 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

-131-

# IX. CALIBRATION

## POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number 1 Date 5-18-89 Meter box number C-100 Plant T+T Materials

Barometric pressure, $P_b$ = 29.93 in. Hg Dry gas meter number 689836 Pretest Y 1.004

| Orifice manometer setting, ($\Delta H$), in. $H_2O$ | Gas volume: Wet test meter ($V_w$), $ft^3$ | Gas volume: Dry gas meter ($V_d$), $ft^3$ | Temperature: Wet test meter ($t_w$), °F | Temperature: Dry gas meter: Inlet ($t_{d_i}$), °F | Temperature: Dry gas meter: Outlet ($t_{d_o}$), °F | Temperature: Dry gas meter: Average[a] ($t_d$), °F | Time ($\theta$), min | Vacuum setting, in. Hg | $Y_i$ | $\frac{Y_i V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| .5 | 10 | 680.702 / 691.088 | 74 | 94 / 104 | 78 / 84 | 90. | 23.65 | 1 | .990 | |
| 1.0 | 10 | 691.400 / 701.893 | 74 | 96 / 110 | 84 / 84 | 93.5 | 16.73 | 1 | .986 | |
| 2.0 | 10 | 703.501 / 713.991 | 74 | 100 / 110 | 86 / 86 | 95.5 | 11.93 | 1 | .986 | |
| | | | | | | | | | Y = .987 | |

[a] If there is only one thermometer on the dry gas meter, record the temperature under $t_d$

where

$V_w$ = Gas volume passing through the wet test meter, $ft^3$.

$V_d$ = Gas volume passing through the dry gas meter, $ft^3$.

$t_w$ = Temperature of the gas in the wet test meter, °F.

$t_{d_i}$ = Temperature of the inlet gas of the dry gas meter, °F.

$t_{d_o}$ = Temperature of the outlet gas of the dry gas meter, °F.

$t_d$ = Average temperature of the gas in the dry gas meter, obtained by the average of $t_{d_i}$ and $t_{d_o}$, °F.

$\Delta H$ = Pressure differential across orifice, in. $H_2O$.

$Y_i$ = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y $\pm 0.05Y$.

$P_b$ = Barometric pressure, in. Hg.

$\theta$ = Time of calibration run, min.

# METER BOX CALIBRATION DATA AND CALCULATION FORM

## (English units)

C100

Date 3-20-89 Meter box number 689836

Barometric pressure, $P_b$ = 29.90 in. Hg Calibrated by F. Kuhn

| Orifice manometer setting ($\Delta H$), in. $H_2O$ | Gas volume: Wet test meter ($V_w$), $ft^3$ | Gas volume: Dry gas meter ($V_d$), $ft^3$ | Temperature: Wet test meter ($t_w$), °F | Temperature: Dry gas meter: Inlet ($t_{d_i}$), °F | Temperature: Dry gas meter: Outlet ($t_{d_o}$), °F | Temperature: Dry gas meter: Avg[a] ($t_d$), °F | Time ($\theta$), min | $Y_i$ | $\Delta H@_i$ in. $H_2O$ | CFM |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | 5 | 345.180 / 350.355 | 68 | 94 / 102 | 78 / 78 | 88 | 11.78 | 1.001 | 1.497 | 0.439 |
| 1.0 | 5 | 339.462 / 344.631 | 68 | 94 / 102 | 78 / 78 | 88 | 8.33 | 1.001 | 1.497 | 0.6205 |
| 1.5 | 10 | 328.821 / 339.114 | 68 | 99 / 102 | 76 / 78 | 86.5 | 13.73 | 1.002 | 1.530 | 0.749 |
| 2.0 | 10 | 318.001 / 328.274 | 68 | 88 / 100 | 76 / 76 | 85 | 11.92 | 1.000 | 1.541 | 0.862 |
| 3.0 | 10 | 294.151 / 304.284 | 68 | 86 / 96 | 70 / 72 | 81 | 9.8 | 1.004 | 1.574 | 1.034 |
| 4.0 | 10 | 305.551 / 315.620 | 68 | 84 / 94 | 76 / 76 | 82.5 | 8.57 | 1.006 | 1.601 | 1.181 |
| | | | | | | | Avg | 1.002 | 1.540 | |

| $\Delta H$, in. $H_2O$ | $\frac{\Delta H}{13.6}$ | $Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t + 460)}$ | $\Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$ |
|---|---|---|---|
| 0.5 | 0.0368 | | |
| 1.0 | 0.0737 | | |
| 1.5 | 0.110 | | |
| 2.0 | 0.147 | | |
| 3.0 | 0.221 | | |
| 4.0 | 0.294 | | |

[a] If there is only one thermometer on the dry gas meter, record the temperature under $t_d$.

Quality Assurance Handbook M4-2.3A (front side)

Form #REC-02

# STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-7-89 Thermocouple number Hotbox

Ambient temperature 20 °C Barometric pressure 29.88 in. Hg

Calibrator Turner Reference: mercury-in-glass ✓

other _____

| Reference point number | Source[a] (specify) | Reference thermometer temperature, °C | Thermocouple potentiometer temperature, °C | Temperature difference,[b] % |
|---|---|---|---|---|
| A | Ice Bath | 32°F | 32 | 0 |
| B | Boiling water | 212 | 212 | 0 |
| C | Boiling oil | 381 | 381 | 0 |
| D | Ambient 5-10-89 | 62 | 62 | 0 |

[a] Type of calibration system used.

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

# STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-7-89 Thermocouple number mild/outlet

Ambient temperature 20 °C Barometric pressure 29.88 in. Hg

Calibrator Tenny Reference: mercury-in-glass ✓

other _____

| Reference point number | Source[a] (specify) | Reference thermometer temperature, °C | Thermocouple potentiometer temperature, °C | Temperature difference,[b] % |
|---|---|---|---|---|
| A | Ice Bath | 32 | 32 | 0 |
| B | Boiling water | 212 | 212 | 0 |
| C | Boiling oil | 381 | 381 | 0 |
| D | Ambient 5-10-89 | 62 | 62 | 0 |

[a] Type of calibration system used.

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

RAMCON ENVIRONMENTAL CORPORATION

(36)

Lear Siegler Stack Sampler

## Nozzle Diameter Calibration

Date _____ Signature _____

| Nozzle No. | Average Diameter | Nozzle No. | Average Diameter |
|---|---|---|---|
| 1 | | 7 | |
| 2 | | 8 | |
| 3 | | 9 | |
| 4 | | 10 | |
| 5 | | 11 | |
| 6 | | 12 | |

## Pitot Tube Calibration (S Type)

Pitot Tube Identification No. 31 Date 5-6-89

Calibrated by: Sam T. Turner

"A" SIDE CALIBRATION

| Run No. | Δp std cm $H_2O$ (in. $H_2O$) | Δp (s) cm $H_2O$ (in. $H_2O$) | $C_p(s)$ | DEVIATION $C_{p(s)}-\bar{C}_p(A)$ |
|---|---|---|---|---|
| 1 | 0.90 | 1.3 | .832 | < .01 |
| 2 | 0.60 | .87 | .830 | < .01 |
| 3 | 0.41 | .60 | .826 | < .01 |
| | | $\bar{C}_p$ (SIDE A) | .829 | |

"B" SIDE CALIBRATION

| Run No. | Δp std cm $H_2O$ (in. $H_2O$) | Δp(s) cm $H_2O$ in. $H_2O$) | $C_p(s)$ | DEVIATION $C_{p(s)}-\bar{C}_p(B)$ |
|---|---|---|---|---|
| 1 | 0.90 | 1.3 | .832 | < .01 |
| 2 | 0.60 | .88 | .826 | < .01 |
| 3 | 0.41 | .59 | .833 | < .01 |
| | | $\bar{C}_p$ (SIDE B) | .830 | |

$$\text{AVERAGE DEVIATION} = \sigma(\text{A OR B}) = \frac{\left(\sum_{1}^{3} |C_p(s)-\bar{C}_p(\text{A OR B})|\right)}{3} \leftarrow \text{MUST BE} \leq 0.01$$

$$|\bar{C}_p(\text{SIDE A})-\bar{C}_p(\text{SIDE B})| \leftarrow \text{MUST BE} \leq 0.01$$

$$C_{p(s)} = C_{p(std)}\sqrt{\frac{\Delta p\ std}{\Delta p_s}}$$

Form No. EED-17-1

RAMCON

Lear Siegler Stack Sampler

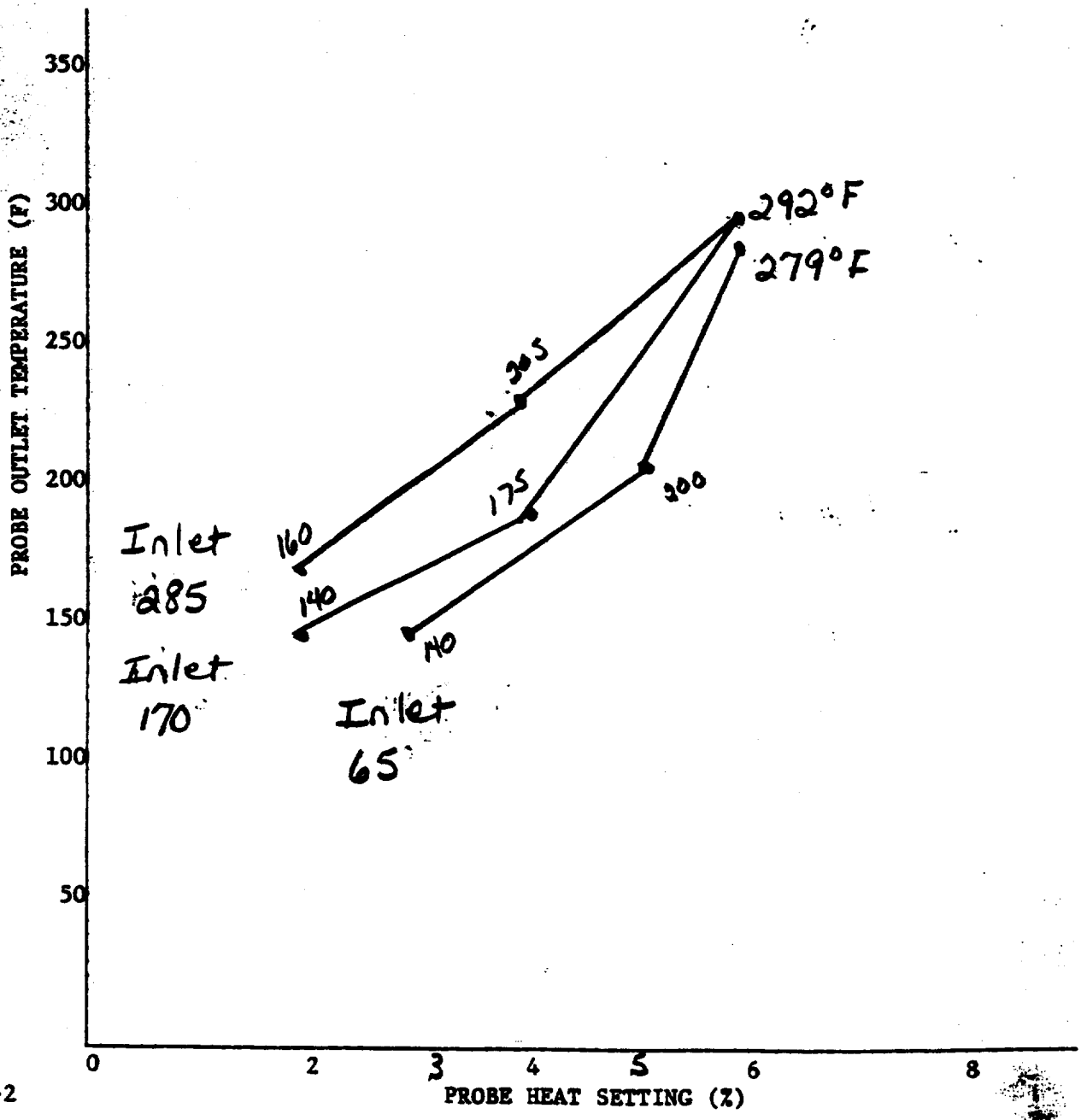
Heating Probe Calibration

Probe No. 31 Probe Length 3'

Date of Calibration 5-8-89 Signature Sam T. Turney

Name of Company to be tested _____

Note: 3 ft. probe - 5 min. warmup
6 ft. probe - 15 min. warmup
10 ft. probe - 30 min. warmup
Calibration flow rate = .75 CFM



# STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-5-89 Thermocouple number 31

Ambient temperature 20 °C Barometric pressure 29.88 in. Hg

Calibrator Turner Reference: mercury-in-glass ✓

other _____

| Reference point number | Source[a] (specify) | Reference thermometer temperature, °F | Thermocouple potentiometer temperature, °F | Temperature difference,[b] % |
|---|---|---|---|---|
| A | Ice water | 32 | 32 | 0 |
| B | Boiling water | 212 | 212 | 0 |
| C | Oil Boiling | 381 | 381 | 0 |
| D | Ambient 5-10-89 | 62 | 62 | 0 |

[a] Type of calibration system used.

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