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

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

**REPORT OF**

# AN INVESTIGATION OF EMISSIONS AT THE TDPS ERIE ST. DRUM MIX ASPHALT PLANT

Rose
Save for file
Jim

**PREPARED BY**

ENGINEERING-SCIENCE, INC.
10521 ROSEHAVEN ST.
FAIRFAX, VA 22030

ENGINEERING-SCIENCE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

JAN 8 1989

SUBJECT: Stack Test Review of TDPS Erie Street, Drum Mix Asphalt Plant, Philadelphia, Pa.
CDS# 39-7160-90006
42-101-

FROM: Jim Gouvas 3ES-11
POS

TO: Susan Insetta, Chief 3AM-21
EP&SCS

THRU: Vic Guide, Chief 3ES-11
POS

A review of the stationary source stack sampling report titled "An Investigation of Emissions at the TDPS Erie St. Drum Mix Asphalt Plant" submitted by Engineering-Science, Fairfax, Virginia has been completed.

The tests (Particulates and Total Hydrocarbons Concentration [THC]) were conducted on the Drum Mix Asphalt Plant Baghouse Stack emissions on 4-28-88 and 5-2-88. The test were not done in accordance with EPA emission testing methods. The tests were done as a diagnostic tool rather than emission compliance testing. Therefore the tests are not acceptable for demonstrating compliance with any agency regulation governing this source.

Advance Copy Faxed to ~~ED~~ ESD

5-25-89

# REQUEST FOR REVIEW

**SUBJECT:** Air Compliance Report Review Request

**FROM:** Susan M. Insetta, Chief
Enforcement Policy & State Coordination Section

**TO:** Robert Kramer, Chief
Environmental Monitoring and Surveillance Branch

**THRU:** Benard E. Turlinski, Chief
Air Enforcement Branch

waiting report from G. Jim

**NAME OF FACILITY:** TDPS

**CDS NUMBER:** 39 7160-00006 and 39-7160-90006

**FACILITY TYPE:** Asphalt Plant

**FACILITY ADDRESS/LOCATION:** 800 West Olney Ave Phila. Pa.

**FACILITY CONTACT:**

**TELEPHONE NUMBER:**

**IDENTIFY ALL APPLICABLE REGULATIONS:** 25 Pa. Code § 123.13(c)(i) (SIP)
40 CFR Subpart I § 60.90 NSPS
No concentration of particulate matter 0.04 gdscf when exhaust gas volume < 150,000 dscf/min.

**IDENTIFY SOURCE TEST REPORT TO BE REVIEWED AND ANY SPECIAL INSTRUCTIONS:**
Source test conducted by Engineering-Science on (no date on report)
(Please return the report its AEB only copy.)

**IDENTIFY AN ACCEPTABLE TIMEFRAME FOR CONDUCTING THE REVIEW:**
6/30/89

cc: Vic Guide
Betty Harris

Advance Copy
forwarded to ESD

# REQUEST FOR REVIEW

**SUBJECT:** Air Compliance Report Review Request 5-25-89

**FROM:** Susan M. Insetta, Chief
Enforcement Policy & State
Coordination Section

**TO:** Robert Kramer, Chief
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and Surveillance Branch

**THRU:** Benard E. Turlinski, Chief
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cc: Vic Guide
Betty Harris

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## EXECUTIVE SUMMARY

This report discusses the results of testing for particulate matter and hydrocarbon emissions from the drum mixer stack at the T.D.P.S. Materials Erie Street asphalt plant. The testing was conducted by Engineering-Science, Inc. as part of a continuing investigation into the cause and nature of visible emissions (VE) which intermittently occur at the facility.

Prior to testing, ES conducted a preliminary inspection of the facility and made some measurements of stack gas constituents using portable monitoring equipment. During this inspection, ES determined that improper drum burner adjustments and aggregate veiling characteristics contributed to low combustion efficiency. ES recommended burner adjustments and flight modifications which increased combustion efficiency and reduced hydrocarbon emissions. The baghouse was also inspected and tested for leaks, and an analysis of a bag removed from the baghouse was conducted to determine bag condition. The results of these efforts indicated that the baghouse was maintained and operated properly.

ES then recommended that emissions measurements be conducted using EPA reference methods to quantify the particulate matter and condensible hydrocarbon components. The results of this testing, as discussed in the report, indicate the following:

- measured particulate matter emissions were less than the state and federal emissions standards;
- particulate matter emissions were well controlled;
- condensible hydrocarbon emissions were a significant, and sometimes predominant, portion of the overall emissions;
- combustion efficiency and burner flame characteristics were improved by the burner adjustments and flight modifications;

- the majority of the remaining hydrocarbon emissions are caused by asphalt cement (AC) volatilization or distillation.

ES recommends further study of the facility's operation by monitoring hydrocarbon concentrations and gas temperature both upstream and downstream of the AC injection location. Other operating characteristics such as AC temperature and production rate will also be recorded. This information will allow identification of those operating conditions which minimize hydrocarbon emissions. If the monitoring demonstrates that condensible hydrocarbon emissions can be minimized by adhering to specific operating procedures, monitoring results can be used to define the operating procedures to be followed. Review and evaluation of other emissions control strategies will be necessary if the monitoring results do not indicate that this approach can be successful.

# REPORT ON AN INVESTIGATION OF THE EMISSIONS FROM THE TDPS ERIE STREET DRUM MIX ASPHALT PLANT

## INTRODUCTION

In response to a request by TDPS, Engineering-Science, Inc. (ES), assisted by Energy Control and Services, Inc. (ECS), conducted an investigation of the cause of visible emissions from the company's Erie Street Plant drum mixer stack. This investigation has been conducted in phases designed to: first, identify the nature and cause of the emissions opacity; and second, develop recommended corrective action to reduce or eliminate the visible emissions. Three reasons for the visible emissions were thought to be possible: excessive particulate matter penetration of the baghouse; condensed hydrocarbons from poor fuel combustion efficiency; and asphalt cement volatilization. Hydrocarbon emissions often have detectable odor. Hence if visible emissions are due to hydrocarbons, the reduction of emissions should also reduce any odor.

An initial inspection and data collection were conducted on April 6, 11 and 12, 1988 to determine whether the visible emissions were caused by particulate matter or by condensed hydrocarbons. The results of this inspection were reported to TDPS in a letter dated April 19, 1988, which is found in Appendix A. This inspection, and subsequent analysis, included preliminary measurement of drum exhaust gas constituents (THC, CO, $O_2$ and temperature), an inspection and leak check of the baghouse, and bag analysis for permeability, tensile strength and microscopic characteristics.

The results of these efforts indicated that the baghouse is being maintained properly but that excessive hydrocarbon emissions were occurring. Burner and drum modifications were recommended to improve combustion efficiency and reduce hydrocarbon emissions due to products of incomplete combustion. ES further recommended that additional tests be performed after the modifications were completed to test their effectiveness and to verify that asphalt cement volatilization is the cause of any visible emissions. This

report summarizes the additional data collection efforts completed after the drum and burner modifications were performed. Recommendations contained in this report for further work are based upon observations made as a result of the inspections and data collection activities conducted to date.

## SAMPLING AND ANALYSIS PROCEDURES

Sampling for particulate matter, condensible and total hydrocarbon emissions was conducted on April 28 and May 2, 1988. A preliminary velocity traverse of the stack was conducted prior to actual testing in order to generate velocity and temperature profiles within the stack. A point of average velocity was then selected and testing was conducted according to US EPA Reference Method 5 as outlined in 40 CFR Part 60, Appendix A. The gas was sampled to determine particulate and organic condensible emission rates. Four test runs were attempted. However, during test run number 2, a thunderstorm occurred causing abandonment of test activities. The results of this test are therefore not included in the report.

Particulate matter was collected on a heated filter. The sampled gas was cooled and collected in a series of impingers and the percent moisture of the flue gas was determined from the amount of liquid collected in the impingers. This back-half impinger catch was then collected and sealed for analysis at the ES Fairfax, Virginia air laboratory to determine the concentration of organic condensibles present in the gas and their emission rate. The filter samples were analyzed according to Reference Method 5 and the impinger samples were analyzed using procedures described in Appendix B. Measurement of the total hydrocarbon (THC) concentration was conducted using a Scott 116 THC analyzer. The sampling system consisted of a probe which was inserted into the stack and a heated filter to catch suspended particulates, a heated sample line, and a condenser to remove moisture from the gas stream. The hydrocarbon concentration was then measured by the flame ionization detector (FID) located in the THC analyzer. The output was converted to an electrical signal and was recorded on the strip chart recorder. For test 1, the output scale was 0-100 ppm full scale, and for tests 3 and 4, the output was 0-500 ppm full scale.

Copies of the velocity traverse data sheets, field data sheets, laboratory analysis sheets as well as copies of the hydrocarbon analyzer recordings are presented in Appendix B of this report.

## SUMMARY OF RESULTS

### Particulate Matter

Based upon the initial baghouse inspection ES tentatively concluded that particulate matter emissions were not contributing significantly to the emissions opacity. Baghouse bag analysis was recommended to verify that no particulate emissions were penetrating the baghouse due to bag deterioration. The bag test results are found in Appendix C. The results of this analysis indicate that the bags are in good condition. A slight brown discoloration was observed on the clean side of the bag, but no particles were observed in the cross section during microscopic analysis. This indicates that no significant bag penetration by dust particles had occurred. The discoloration was probably due to dust which penetrated some eroded bags during April, 1988 and was blown into the clean side bag tubes during the cleaning cycles. The discoloration does not affect the particulate matter collection efficiency of the baghouse, as indicated by the test results shown below, and by the low pressure drop of the combustion gases flowing through the baghouse.

ES conducted single point particulate matter emissions measurements using EPA Method 5 procedures and conducted gravimetric determinations of condensible matter by analysis of the sampling train impinger catch. Single point sampling was used because the tests were conducted as a diagnostic tool rather than an emissions compliance determination. Measurements of hydrocarbon emissions concentration were also performed using a total hydrocarbon (THC) analyzer. These tests were conducted on April 29, 1988 and May 2, 1988.

Testing was conducted at a variety of operating conditions to evaluate the effect of these conditions on emissions. The range of conditions is summarized below.

| | |
|---|---|
| Production Rate | 150-300 tph |
| Drum Exit Temperature | 250-310°F |
| Aggregate Moisture Content | 3.2-3.7 $H_2O$ |
| Exhaust Gas CO Content | 100-1800 ppm |
| Percent R.A.P. | 0-25% |

The particulate matter and condensible matter measurements are within both State and Federal emissions standards. The State standard requires the emission rate calculation be made using both the particulate matter filter weight and the condensible matter impinger catch, and the standard is based on production rate. A copy of the regulation and emission calculation procedure is found in Appendix D. The Federal New Source Performance Standard (NSPS) is a concentration based standard. Summaries of the test results and the emissions standards for both regulations are found below.

PARTICULATE MATTER EMISSIONS MEASUREMENTS
PENDER STANDARD
(Pounds per Hour)

| Test Run | Filter | Impinger (back half condensibles) | Total | PENDER Standard |
|---|---|---|---|---|
| 1 | 4.06 | 1.45 | 5.51 | 16.0 |
| 3 | 2.49 | 3.06 | 5.54 | 15.3 |
| 4 | 2.34 | 8.76 | 11.10 | 16.8 |

PARTICULATE MATTER
EMISSIONS MEASUREMENTS
NSPS STANDARD
(Grains per Standard Cubic Foot)

| Test Run | Emissions Concentration (filter only) | NSPS Standard |
|---|---|---|
| 1 | 0.03 | 0.04 |
| 3 | 0.01 | 0.04 |
| 4 | 0.01 | 0.04 |
| Average | 0.017 | 0.04 |

## Hydrocarbon Emissions

Hydrocarbon emissions were measured using two methods: by analysis of the EPA Method 5 impinger catch which measures condensible hydrocarbons which may contribute to visible emissions; and by sampling stack gas continuously and analyzing it using a total hydrocarbon (THC) analyzer. Hydrocarbons present in the gas stream as unburned fuel are not measured by Method 5, but are measured by the THC analyzer. The condensible hydrocarbon concentrations calculated from the impinger catch and Method 5 gas volume (shown in the table below), and the THC analyzer measurements show that hydrocarbon emissions vary considerably between test runs, and contribute significantly to the overall Method 5 sample weight. From 25% to 80% of the overall measured emissions were condensible matter, primarily condensed hydrocarbons.

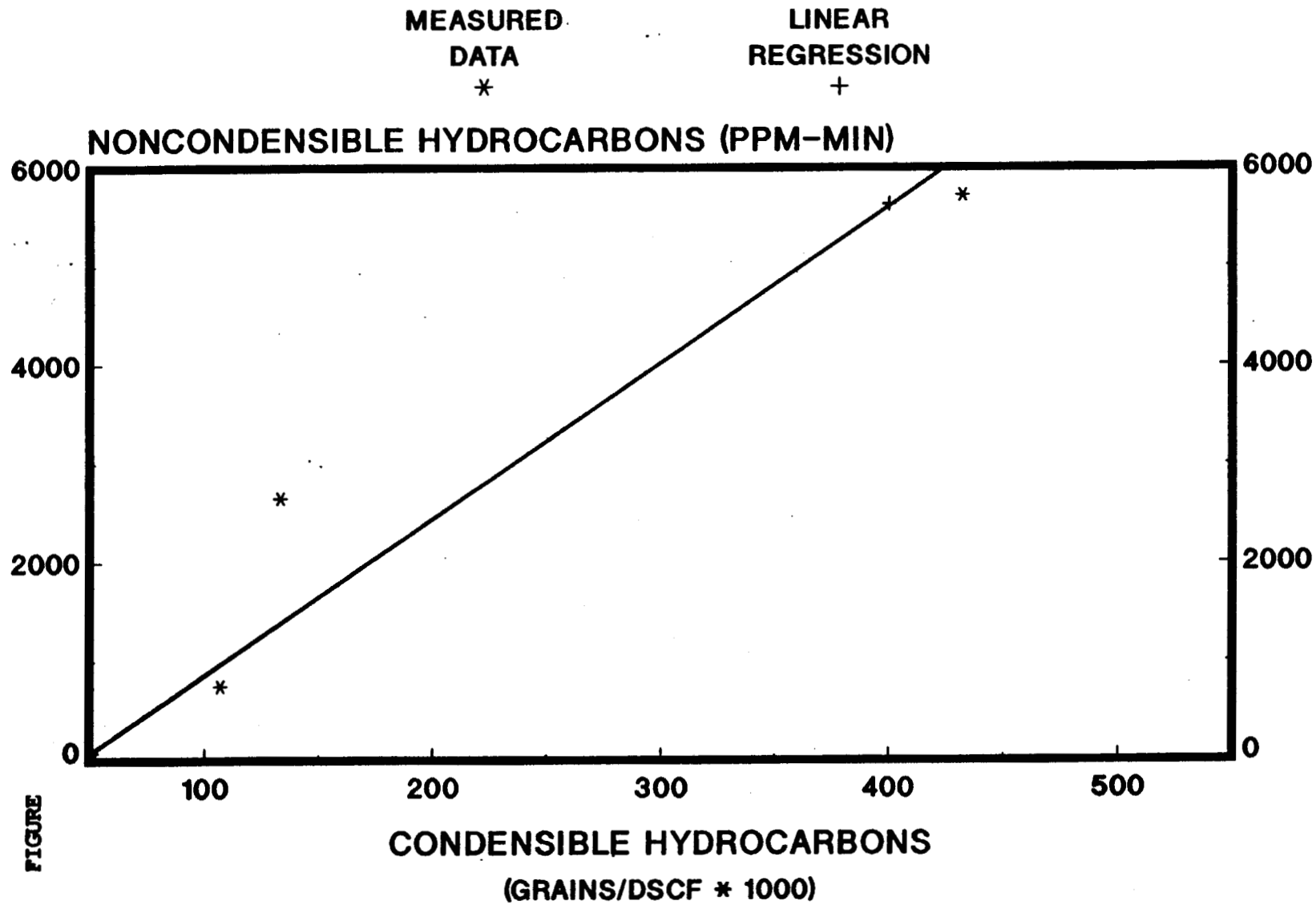
The average and integrated THC analyzer results (shown below) correlate with the condensible matter measurements and, therefore, the THC analyzer measurements are used to evaluate THC emissions concentration. The THC analyzer measurements represent hydrocarbons which were not collected in the condenser of the continuous sampling system. The uncondensed hydrocarbon measurements made by the THC analyzer are correlated with the condensible hydrocarbons collected in the Method 5 impinger as shown in Figure 1 where the data are plotted along with the linear regression line ($r^2 = 0.9$). The correlation demonstrates that measurements of uncondensed hydrocarbons concentration increase with measurements of condensed hydrocarbons and therefore, the analyzer measurements are used to indicate increases and decreases in the total hydrocarbon concentration of the drum exit gas later in this report.

HYDROCARBON EMISSIONS MEASUREMENTS

| Test Run | Condensible Hydrocarbons (grains/dscf) (backhalf) | THC Analyzer | |
|---|---|---|---|
| | | Average (ppm) | Integrated (ppm-min) |
| 1 | 0.0107 | 13 | 750 |
| 3 | 0.0133 | 58 | 2648 |
| 4 | 0.0432 | 117 | 5718 |

# CONDENSIBLE VS NONCONDENSIBLE HYDROCARBONS

## FIGURE 1




FIGURE



MISC 15:21

Energy Control and Services, Inc. (ECS), represented by Mr. Robert Safarik, conducted combustion process measurements concurrent with the tests conducted by ES to verify that the drum and burner modifications had improved combustion efficiency to the desired level. A copy of the ECS report is found in Appendix B. Figures 2, 3 and 4 show the comparison of drum exit gas temperature to THC concentration; Figures 5, 6 and 7 show the THC/production rate correlation; Figures 8, 9 and 10 show THC/percent RAP; and Figures 11, 12 and 13 show THC/CO content results. These graphs show that no consistent correlation between THC concentration and operating parameters exists.

The ECS measurements indicate that combustion efficiency has improved to levels typical of well-operated drum mix facilities. Unburned fuel or products of incomplete combustion resulting from unstable or poor combustion would be measured as THC. Increases and decreases in THC concentration would then correspond with increases and decreases in CO concentration. Since such a correlation does not appear to exist (see Figures 10, 11 and 12), ES concludes that THC measured by the analyzer consists mostly of volatilized or distilled hydrocarbons from the asphalt cement (AC). After reviewing the combustion efficiency results, both the THC and condensed hydrocarbon measurements, and the fact that the particulate matter emissions measured are well controlled, ES concludes that when the occasional elevation in visible emissions occurs, it is caused by hydrocarbons produced from volatilized or distilled AC. The ECS report states that the baghouse is undersized. This conclusion was reached before the results of the bag testing and of the emission tests conducted by ES were known. When these results were discussed with Mr. Safarik, he agreed that hydrocarbons were the source of any visible emissions.

ES believes that the volatilization or distillation is caused by high gas temperatures at the AC injection location, high AC temperature, or both. Temperature measurements taken immediately downstream of the AC injection location and THC measurements taken simultaneously are shown in Figures 2, 3 and 4. Although no apparent correlation of THC concentration with temperature variation is shown, a more pronounced correlation may be demonstrated by using the gas temperature upstream of AC injection, since the gas temperatures at this location directly influence the volatilization rate.

RECOMMENDATIONS

The recommendations discussed herein are based on the conclusions drawn from the investigation results discussed above.

The first recommendation is to optimize drum operation by monitoring emissions while varying operating conditions which affect AC volatilization and distillation. The optimization of operation will include evaluation of THC concentration and gas temperature both upstream and downstream of AC injection while varying production rate, AC temperature and gas temperature between a minimum of three levels each. Samples of the AC will be drawn for analysis by ASTM D-2887 (Steam Distillate Boiling Point) and D-1754 (Thin Layer Oven Test) to confirm AC volatility characteristics. The purpose of this effort will be to define which operating conditions produce the lowest hydrocarbon emissions for use as guidelines for plant operators. The proposed conditions for the study are:

| Production Rate | Asphalt Cement Temperature | Drum Exit Gas Temperature |
|---|---|---|
| 200 tph | 310°F | 310°F |
| 250 tph | 300°F | 300°F |
| 300 tph | 290°F | 290°F |

If this approach is unsuccessful, i.e., no operating conditions produce THC emissions reduction, or the operating conditions adversely affect product quality, ES recommends communication with drum mix plant manufacturers, the NAPA, and other consultants to determine what other corrective actions might be successful. Prior to selection of a specific corrective action, ES proposes that personnel at the facilities where these approaches have been attempted be interviewed to determine if the problems or symptoms and operating characteristics are similar to those experienced at TDPS. Once an approach has been identified which has corrected volatilization problems at a facility similar to the TDPS plant, that approach should be evaluated for applicability to the TDPS facility. If the evaluation shows the approach to be appropriate, it will be recommended.

# TEMPERATURE VS THC CONCENTRATION
## TEST RUN NO. 1

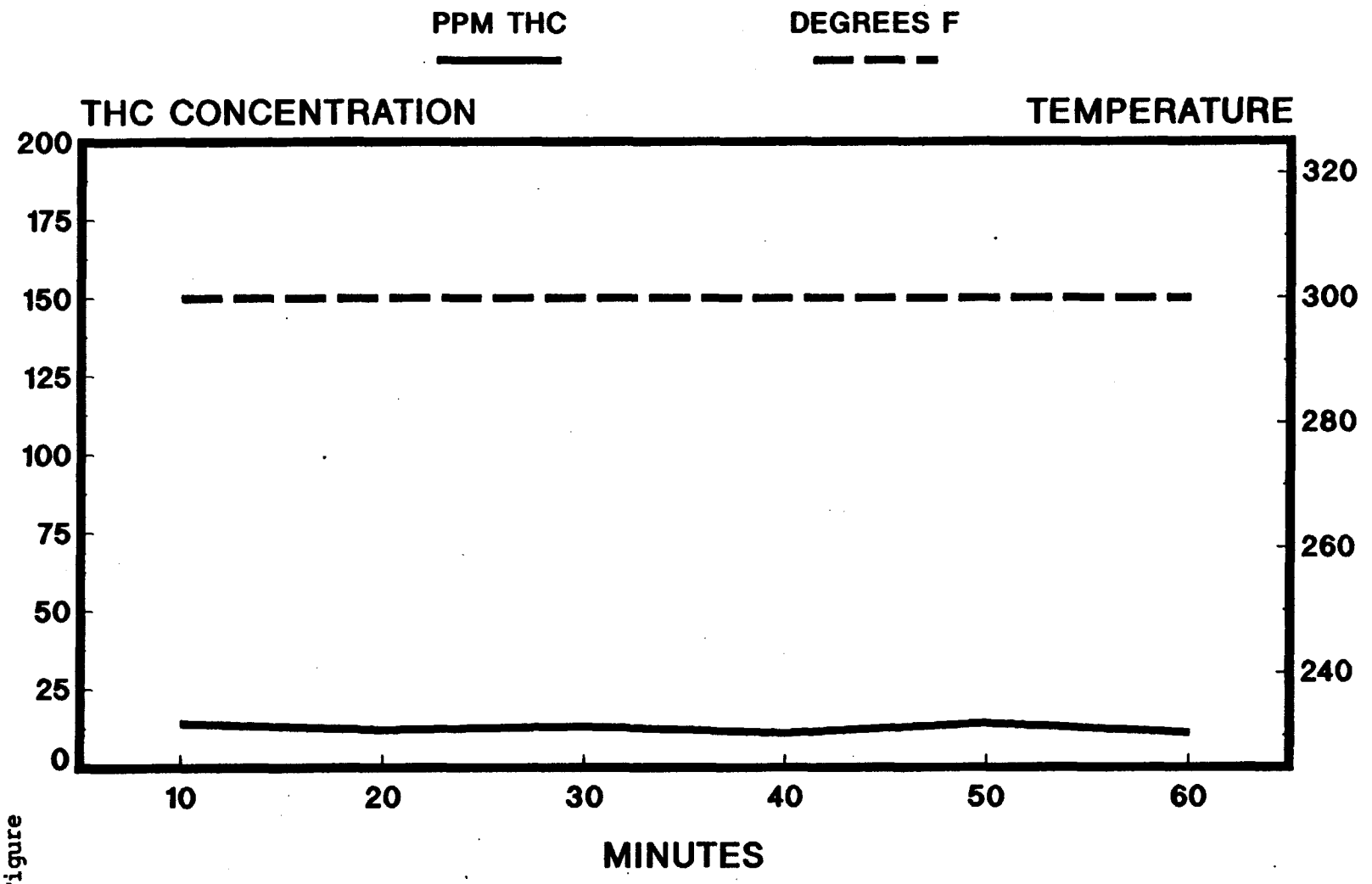



FIGURE 2

Figure

# TEMPERATURE VS THC CONCENTRATION
## TEST RUN NO. 3

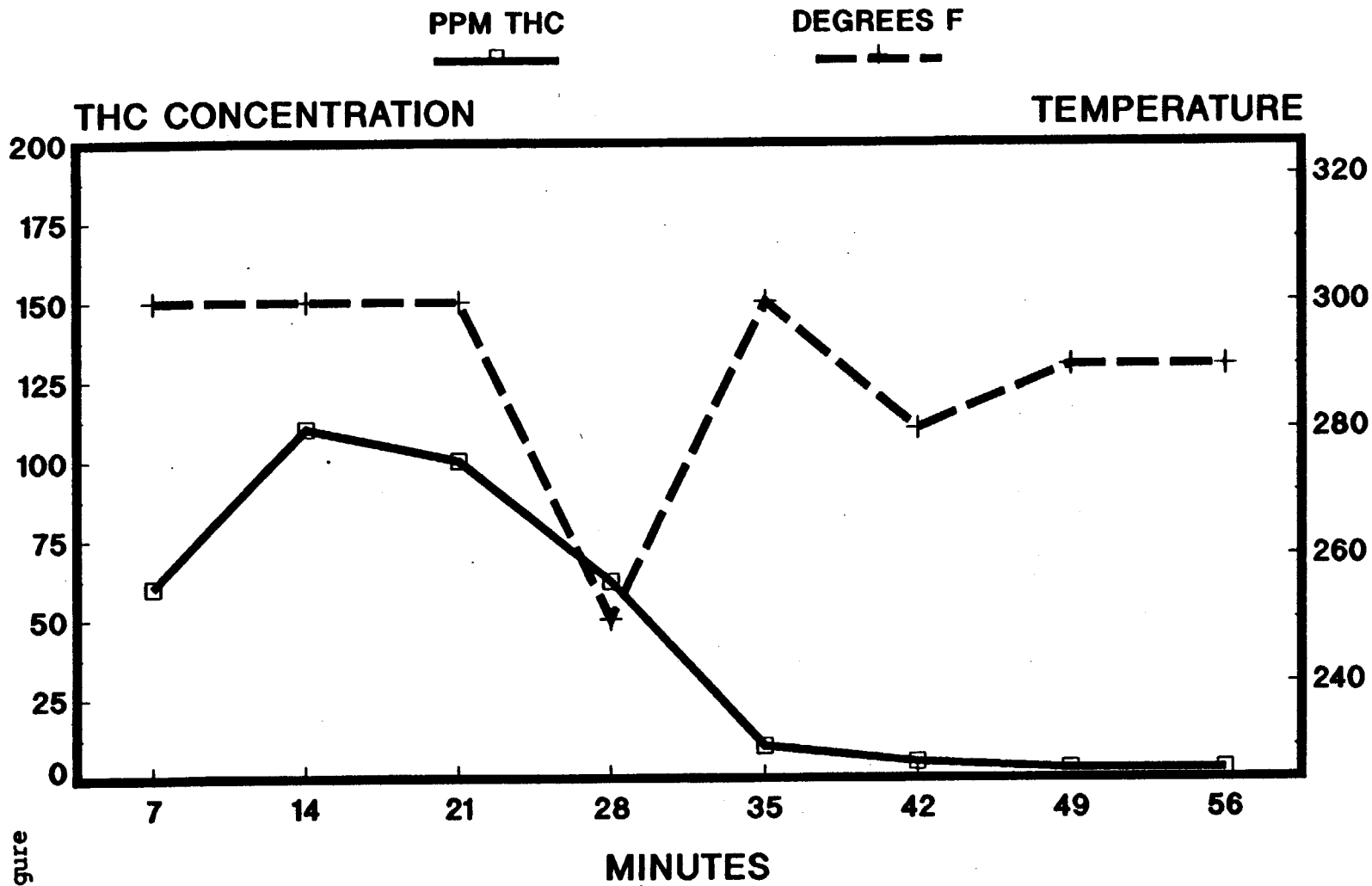
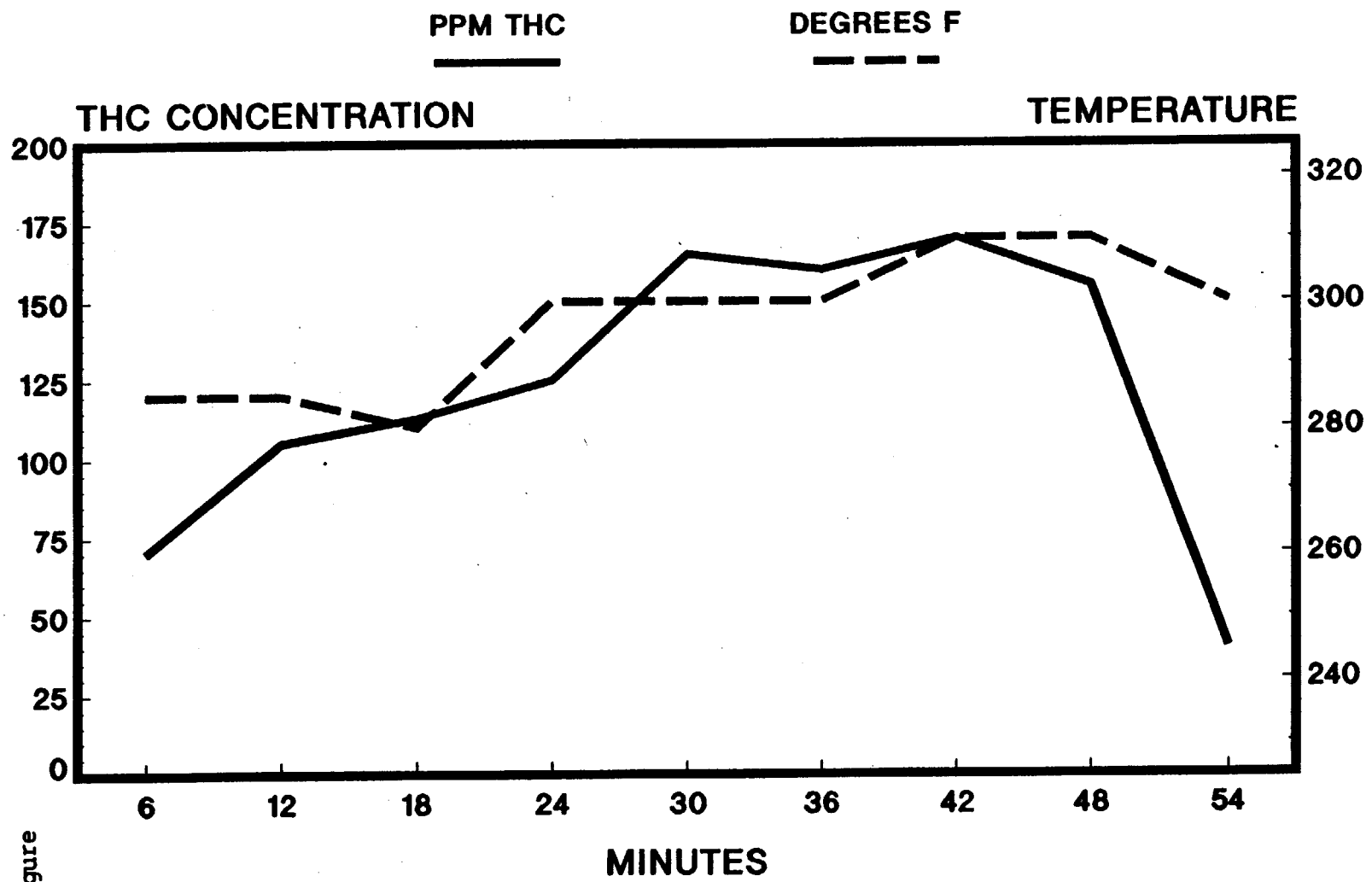


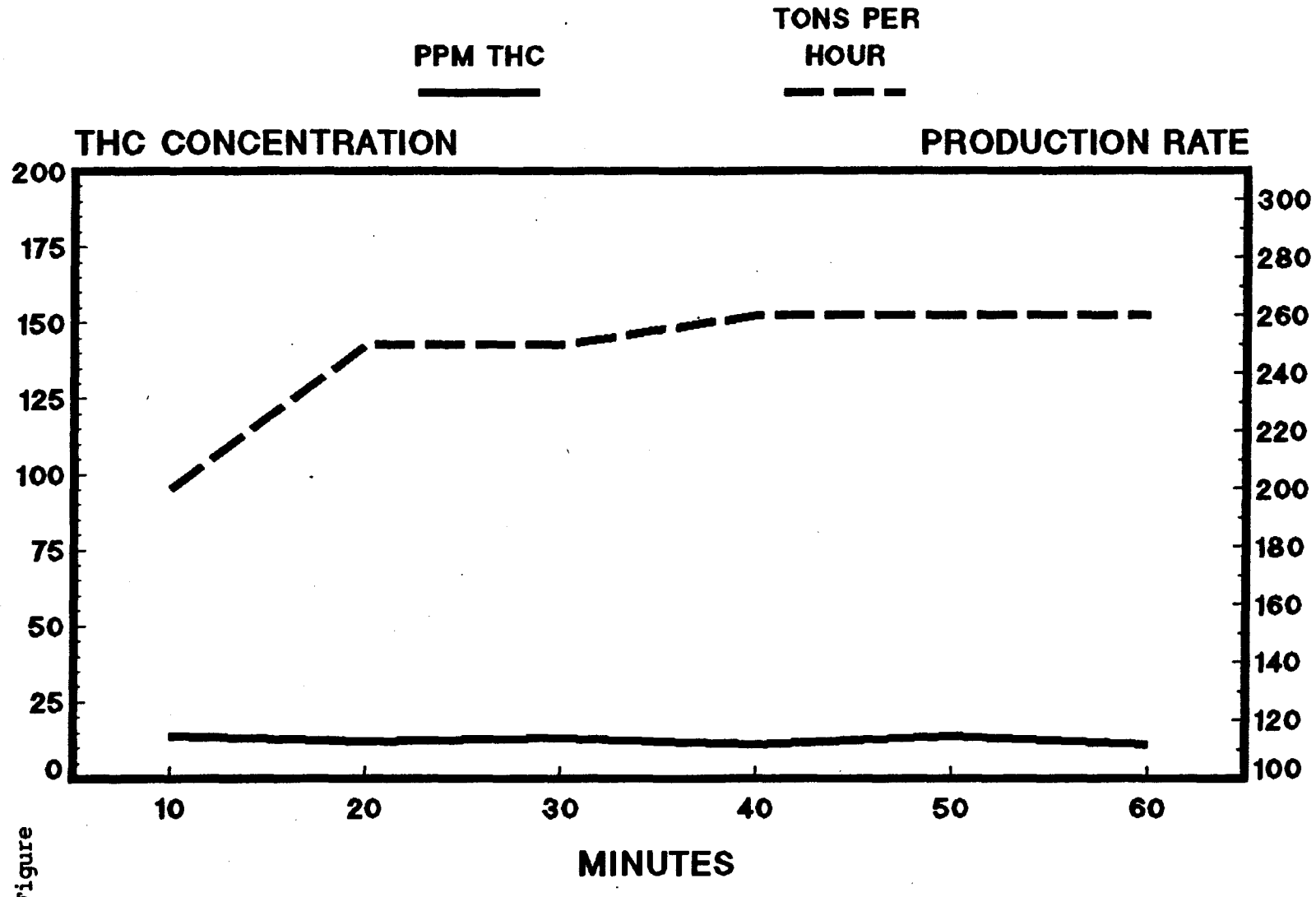

FIGURE 3

# TEMPERATURE VS THC CONCENTRATION
## TEST RUN NO. 4




Figure

FIGURE 4

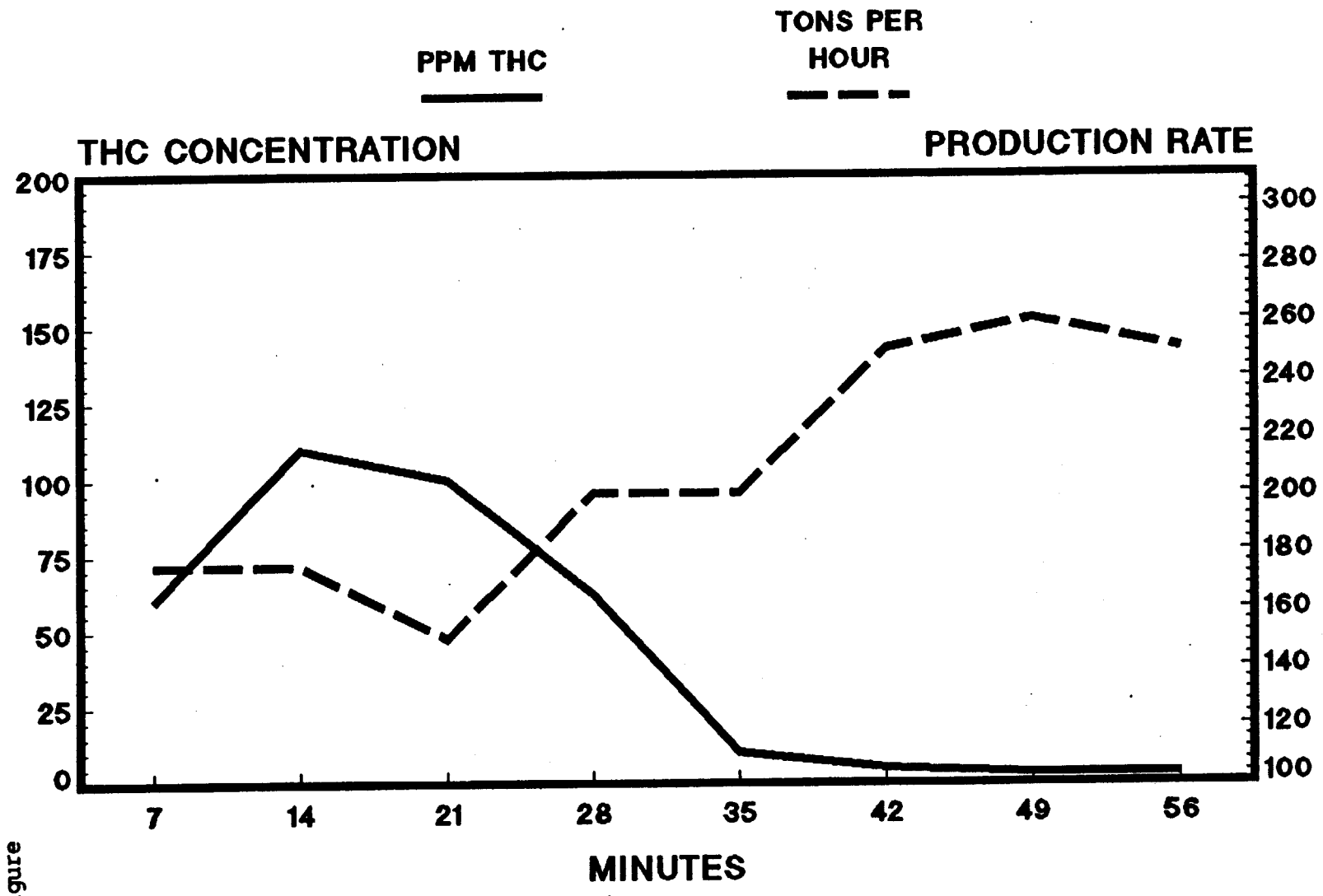



Figure

FIGURE 5

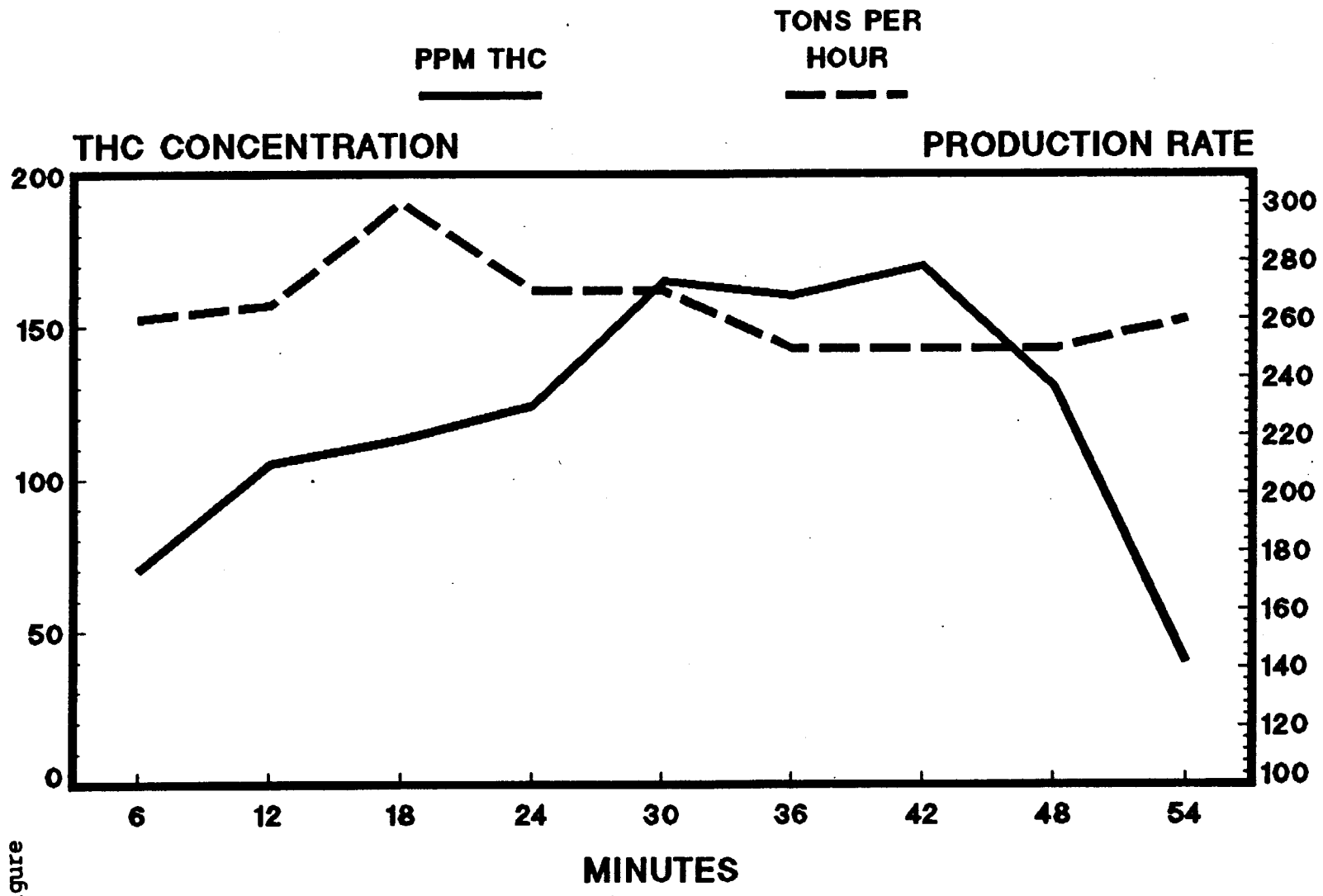
# PRODUCTION RATE VS. THC CONCENTRATION

## TEST RUN NO. 3




Figure

FIGURE 6

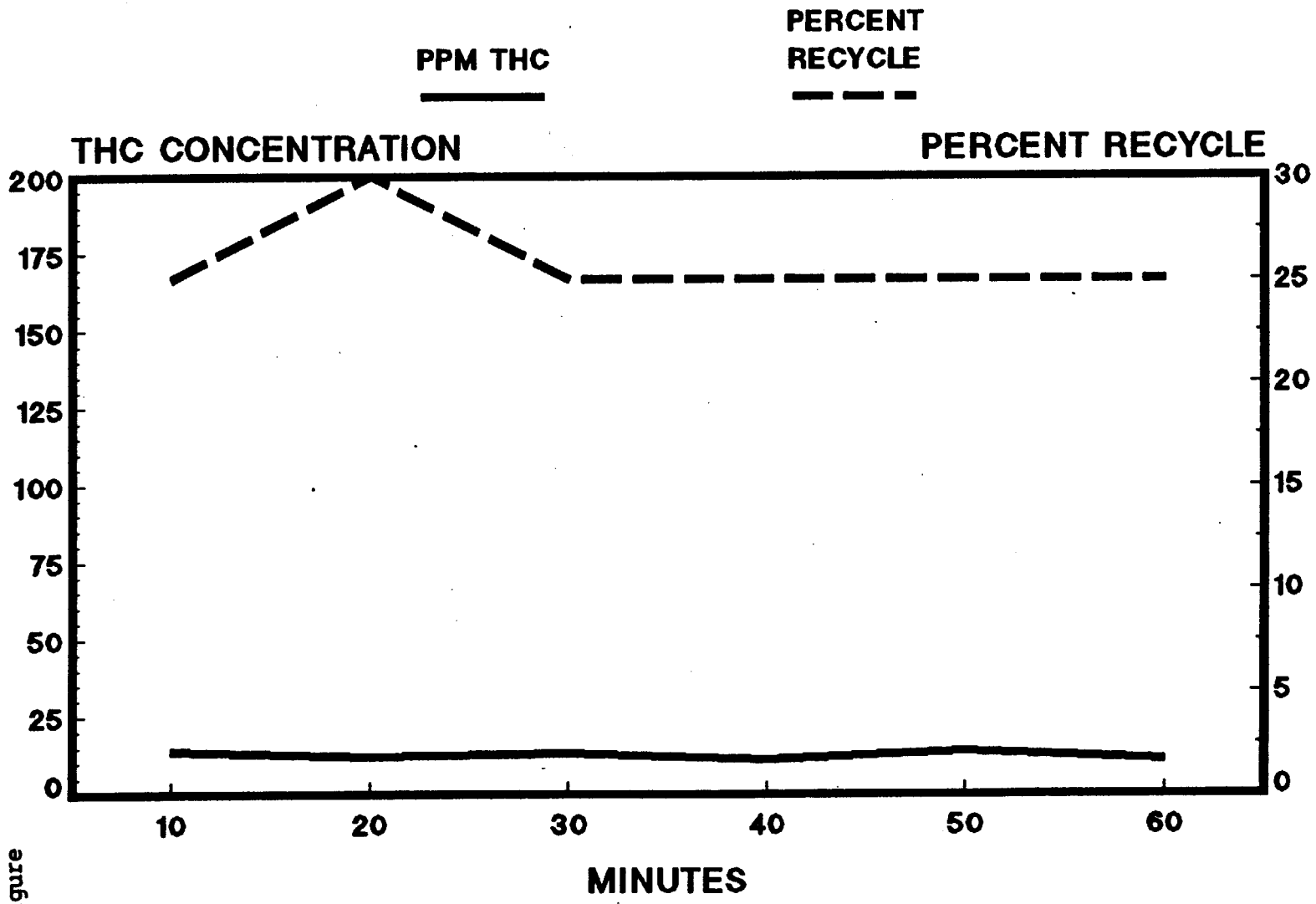



Figure

FIGURE 7

# PERCENT RECYCLE VS. THC CONCENTRATION

## TEST RUN NO. 1

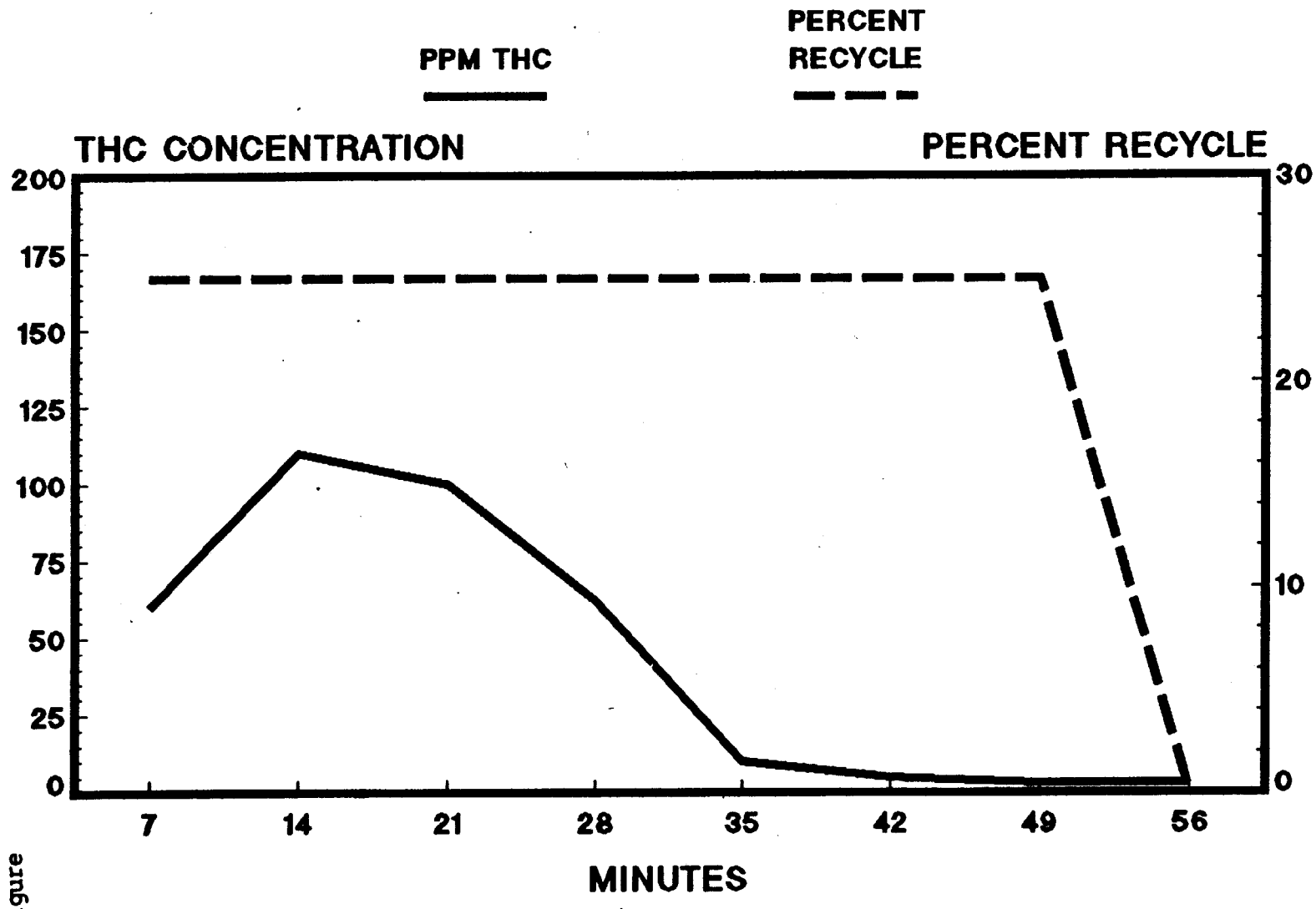



Figure

FIGURE 8

# PERCENT RECYCLE VS. THC CONCENTRATION

## TEST RUN NO. 3




Figure

FIGURE 9

# PERCENT RECYCLE VS. THC CONCENTRATION
## TEST RUN NO. 4

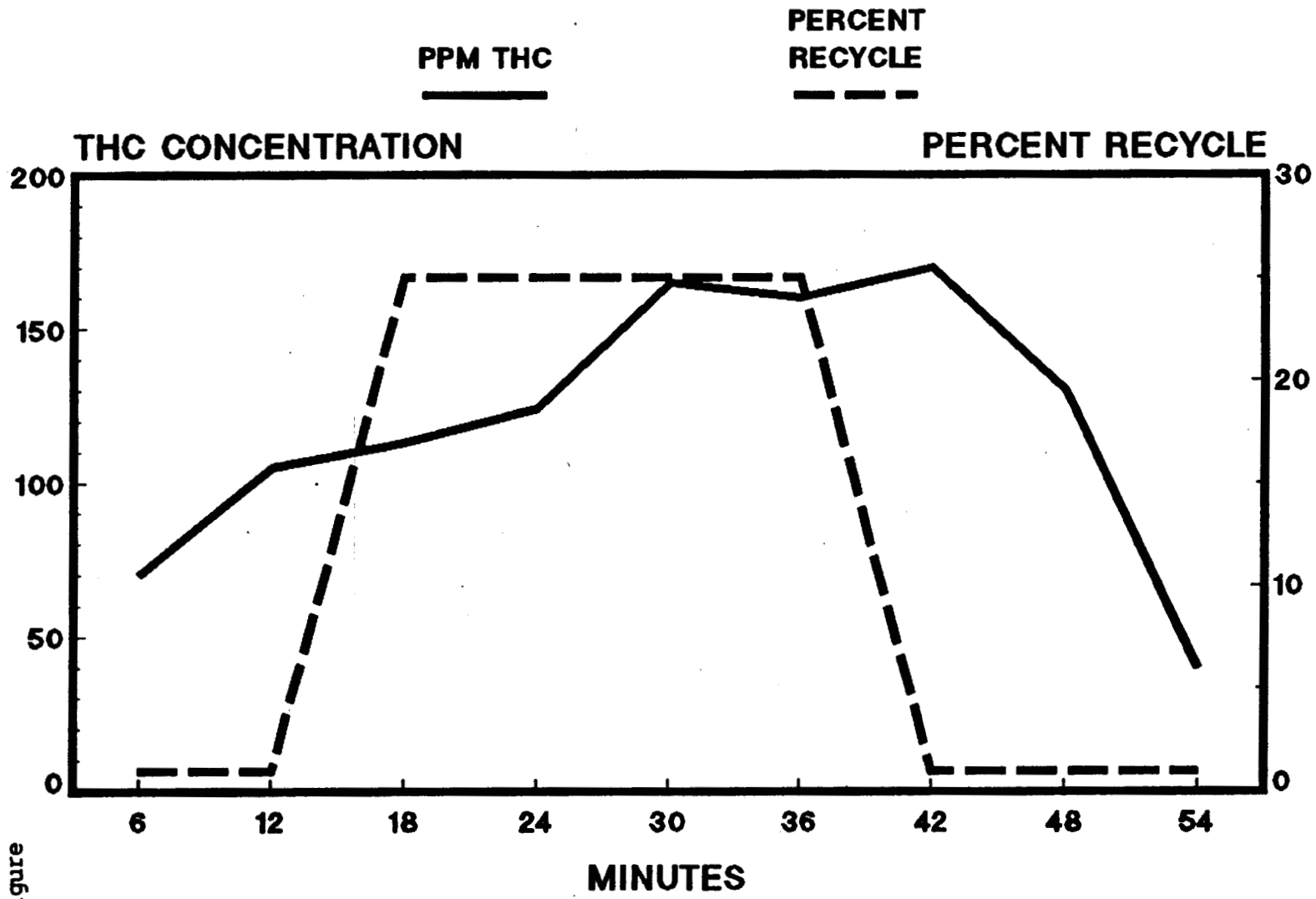
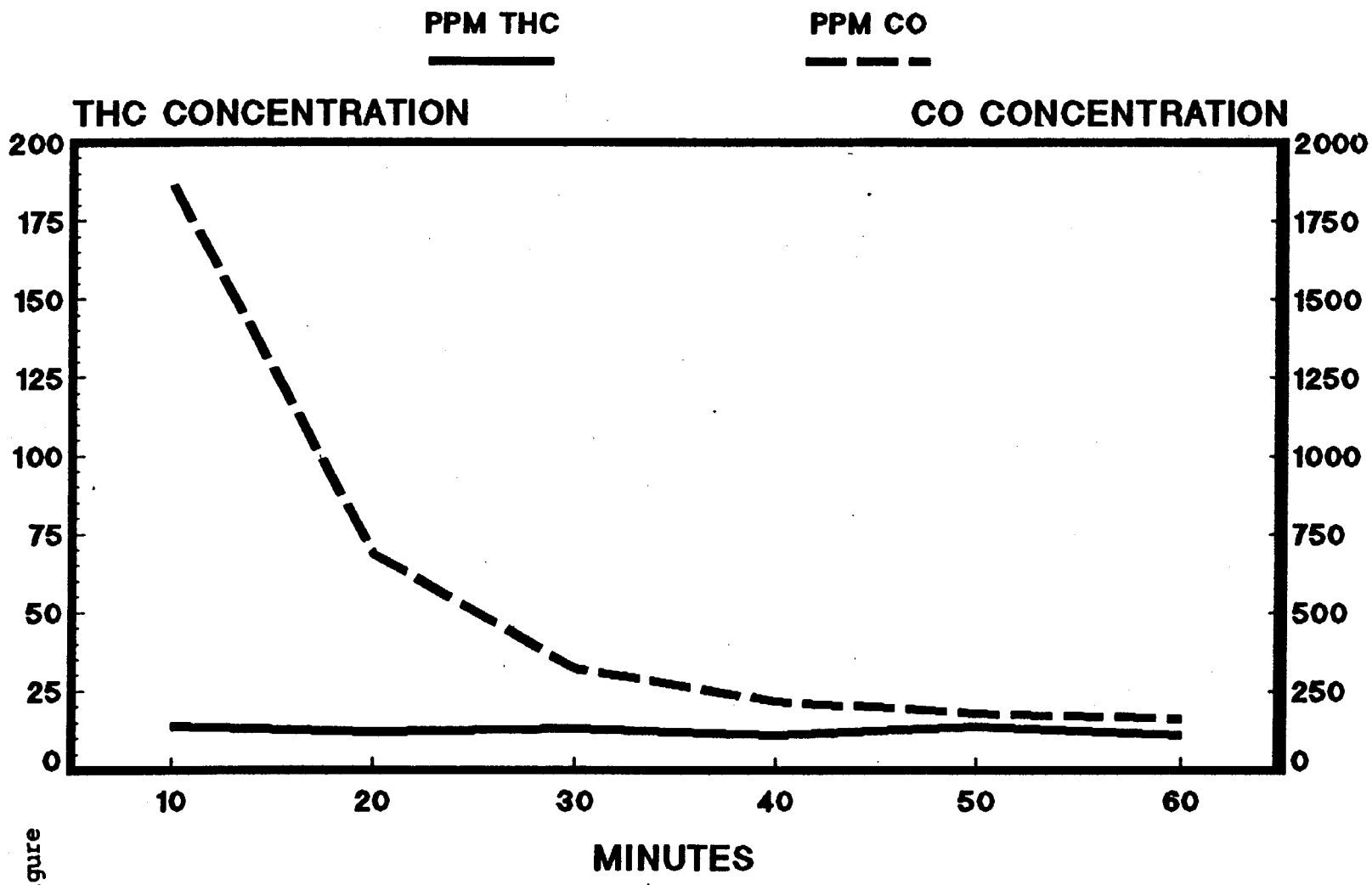



FIGURE 10

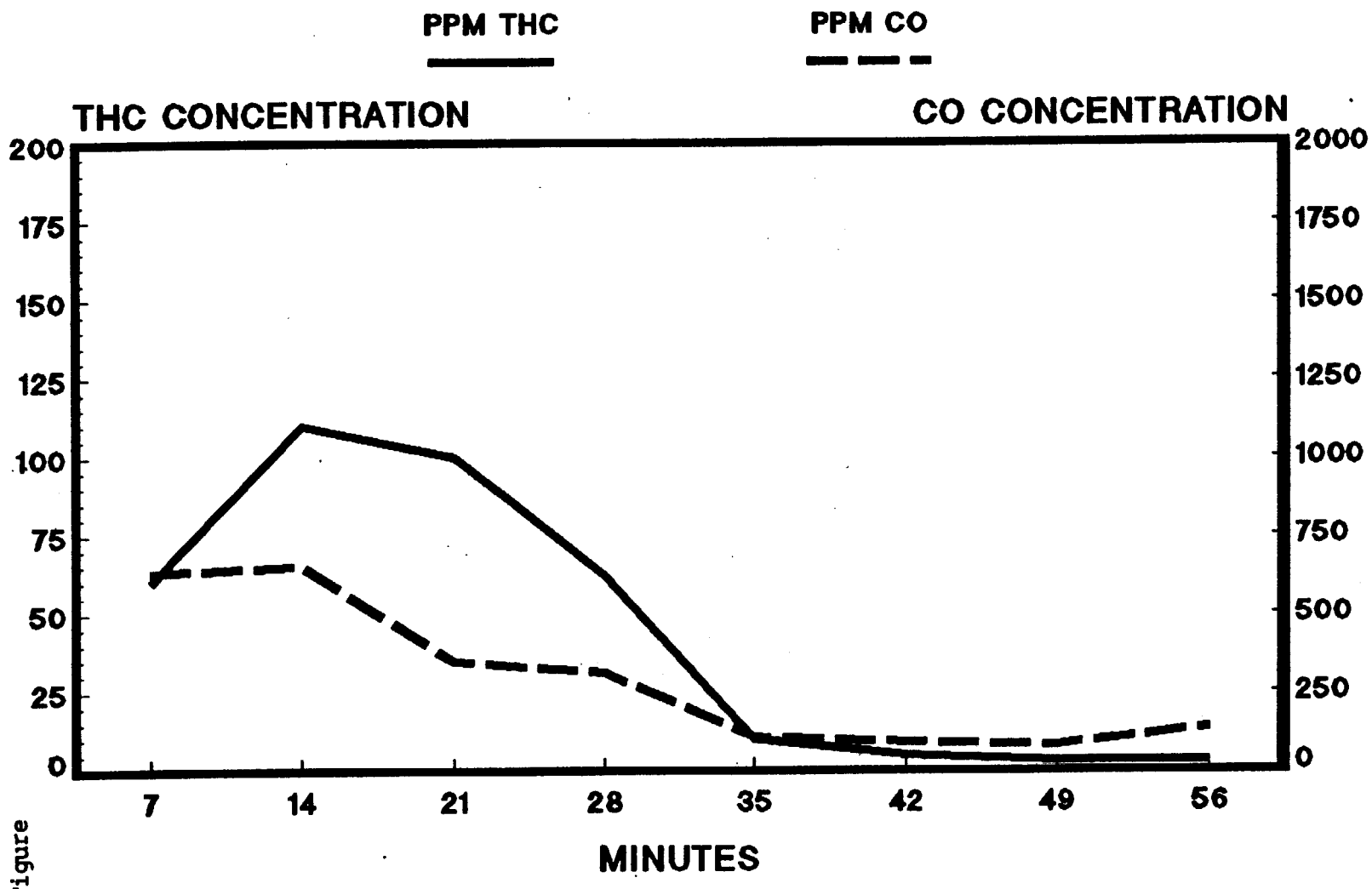
# CO CONCENTRATION VS. THC CONCENTRATION
## TEST RUN NO. 1




Figure

FIGURE 11

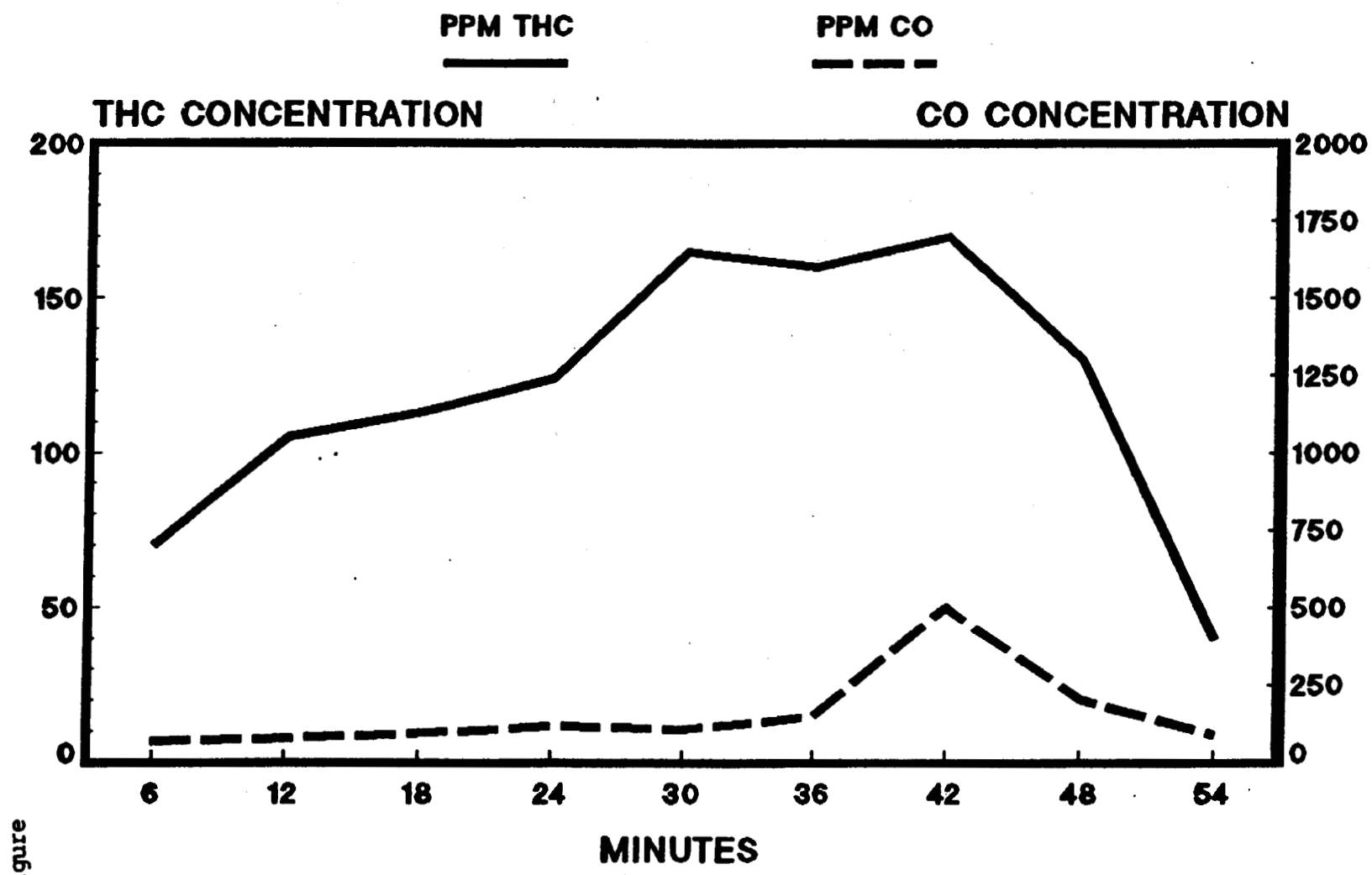
# CO CONCENTRATION VS. THC CONCENTRATION
## TEST RUN NO. 3




Figure

FIGURE 12

# CO CONCENTRATION VS. THC CONCENTRATION
## TEST RUN NO. 4




Figure

FIGURE 13

RECOMMENDATIONS

The recommendations discussed herein are based on the conclusions drawn from the investigation results discussed above.

The first recommendation is to optimize drum operation by monitoring emissions while varying operating conditions which affect AC volatilization and distillation. The optimization of operation will include evaluation of THC concentration and gas temperature both upstream and downstream of AC injection while varying production rate, AC temperature and gas temperature between a minimum of three levels each. Samples of the AC will be drawn for analysis by ASTM D-2887 (Steam Distillate Boiling Point) and D-1754 (Thin Layer Oven Test) to confirm AC volatility characteristics. The purpose of this effort will be to define which operating conditions produce the lowest hydrocarbon emissions for use as guidelines for plant operators. The proposed conditions for the study are:

| Production Rate | Asphalt Cement Temperature | Drum Exit Gas Temperature |
|---|---|---|
| 200 tph | 310°F | 310°F |
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If this approach is unsuccessful, i.e., no operating conditions produce THC emissions reduction, or the operating conditions adversely affect product quality, ES recommends communication with drum mix plant manufacturers, the NAPA, and other consultants to determine what other corrective actions might be successful. Prior to selection of a specific corrective action, ES proposes that personnel at the facilities where these approaches have been attempted be interviewed to determine if the problems or symptoms and operating characteristics are similar to those experienced at TDPS. Once an approach has been identified which has corrected volatilization problems at a facility similar to the TDPS plant, that approach should be evaluated for applicability to the TDPS facility. If the evaluation shows the approach to be appropriate, it will be recommended.

## APPENDIX A

## LETTER FROM D.A. TOOTHMAN TO V.P. ANGELO DATED APRIL 19, 1988

ES
ENGINEERING-SCIENCE, INC.

TWO FLINT HILL, 10521 ROSEHAVEN STREET
FAIRFAX, VIRGINIA 22030-2899
(703) 591-7575

April 19, 1988

Mr. Vincent P. Angelo
TDPS Materials
800 West Olney Avenue
Philadelphia, Pennsylvania 19120

Re: Report of Site Visits on April 6, 11, and 12, 1988

Dear Mr. Angelo:

Under contract to TDPS Materials, Engineering-Science, Inc. (ES), represented by Mr. Joseph Van Gieson, supervising Engineer, and Mr. Robert Safarik of Energy Control and Services, Inc. (ECS), subcontractor to ES, conducted inspections and measurements to determine the cause of visible emissions from the baghouse stack at the TDPS asphalt plant located at Erie Avenue and Second Street in Philadelphia, PA. This letter and the attached report from ECS serve to summarize the observations, conclusions and recommendations associated with the site visits. The work and attached report from ECS relate only to the drum and burner equipment and their impact on the visible emissions. This letter shall reference some of the information contained in that report; however, ES was concerned mostly with the baghouse and the overall emissions.

ES and ECS representatives met with TDPS, Philadelphia Air Management Services (AMS), and US Environmental Protection Agency (EPA) representatives. The EPA and AMS were present to conduct an inspection of the facility and to record process operating information. After the inspection was completed, the group, along with ES, ECS and TDPS representatives, visited the Roberto Clemente Middle School which had been complaining of odors and citing the TDPS asphalt plant as the source. The AMS, using a Century Organic Vapor Analyzer, was unable to detect any significant concentration of organic vapors. In the opinion of the ES representative, the instrument was not operated properly. Mr. Van Gieson voiced this opinion to the AMS representatives who did not change their operating procedures. Additional comments are included in the letter from ES to you concerning the NOV which was issued to TDPS based on the April 6 AMS inspection.

After the EPA and AMS representatives returned to their offices, ES and ECS began a comprehensive evaluation of the drum and baghouse. This evaluation was initiated on April 6 and continued on April 11 and 12, 1988, after sampling ports were installed in the drum.

An internal inspection of the baghouse revealed no obvious particulate matter penetration. No tubesheet or bag failures were observed. A Visi-Light inspection was performed after introducing fluorescent dust to the dirty side of the baghouse through an access hatch located in the baghouse inlet duct. This inspection revealed no evidence of dust penetration. The procedures discussed in this paragraph are used to determine only if there is a loss of

integrity in the bags or tubesheet such as holes or cracks. Dust penetration by seepage or pinhole penetration due to deteriorated or improperly designed bags cannot be detected using these methods.

ES observed that the pressure drop across the bags and tubesheet was 1 inch W.C. (water column) as compared to the manufacturer's recommended 2 to 4 inches W.C. Twice during the investigation the bag cleaning system was turned off to see if an increase in the pressure drop, caused by an increase in the filter cake thickness, would have any effect on the visible emissions. Even at pressure drops of 2 to 4 inches W.C., no reduction in opacity was observed; however, these were short evaluations at higher drum capacities, so the pressure drop may have been caused by higher gas velocities, rather than thicker filter cake. These results are therefore inconclusive.

It is possible that fine particulate matter is penetrating the baghouse because of poor bag condition or design. The bags were installed in the latter part of the last operating season, and unless they have been subjected to temperatures exceeding 450 degress fahrenheit, it is unlikely they are in poor condition. The plant is equipped with a baghouse inlet gas high temperature cutoff, so exposure of the bags to high temperature is unlikely. An inspection of a spare bag showed the bag to be of good quality. In order to assure that every possible method of evaluation is utilized, ES recommends that quantitative testing of a bag taken from the baghouse be undertaken. The tests include a Mullen Burst Test, Tensile Strength Test, Permeability Test, and Microscopic Test.

ES also measured photo-ionizable hydrocarbons during the diagnostic tests conducted by ECS. The measurements were taken both upstream and downstream of introduction of recycle material and asphalt cement to the drum. The measurements, shown below, indicate that a relatively small amount of hydrocarbons, not attributable to incomplete combustion, were present in the gas stream. Preliminary calculations indicate that this amount may contribute to the visible emissions of condensed hydrocarbons prior to or at the stack exit.

| ECS Run Number | Photo-Ionizable Hydrocarbon Concentration (ppm)* | | |
|---|---|---|---|
| | Lower Limit | Most Probable | Upper Limit |
| 9 | 15 | 60 | 90 |
| 11 | 8 | 30 | 45 |
| 17 | 4 | 17 | 27 |

*The photoionization detector (PID) used to make these measurements responds differently to different organic compounds. Since we don't know exactly which compounds were present, we have given the theoretical range of possible concentrations. Based on what we know of asphalt plant emissions, we believe the "most probable" concentration to be accurate to ± 25%. The PID does not respond to methane.

Based on the information gathered to date, and the lack of quantitative measurements of stack emission constituents, ES cannot identify whether particulate matter, condensed hydrocarbons, or a combination of both are contributing to the visible emissions exiting the baghouse stack. In addition to the drum and burner modifications and the recommended bag testing, ES suggests that in-stack measurements of particulate matter and non-volatile hydrocarbons be made to qualify and quantify the cause of the visible emissions. The procedures used do not have to be EPA reference methods and therefore can be somewhat less costly than typical compliance tests and still be used by ES for diagnostic purposes. The cost of these tests is estimated at $5,700.

In summary, ES recommends that TDPS take the following actions:

- Complete the drum modifications and burner adjustments recommended by ECS and have ECS conduct measurements to verify that these actions are effective in increasing combustion efficiency and reducing hydrocarbon emissions.

- Send a bag which was removed from the baghouse to ETS, Inc., in Roanoke, Virginia, for the tests recommended above.

- Conduct stack measurements for particulate matter and non-volatile hydrocarbon concentration determination.

It is our understanding from discussions with you on April 14, 1988, that you approve of these recommendations. ES is preparing to conduct testing in concert with ECS verification of drum and burner modification effectiveness. These efforts will be conducted on April 28-29, 1988.

Based on your verbal approval of the above recommendations, ES will send you a revised estimate for the services required to complete them. If you have any questions or comments, please call.

Sincerely,

ENGINEERING-SCIENCE, INC.

Douglas A. Toothman, Manager
Environmental Studies

Enclosure

cc: Joe Van Gieson

DAT:jle
MISC 14:10

# APPENDIX B

## TEST DATA, CALCULATIONS AND RESULTS

# FIELD DATA

Plant TDPS
Date 1-28-88
Sampling Location Baghouse Outlet
Sample Type Particle (M5)
Run Number M5-1
Operator MDG/EJM
Ambient Temperature
Barometric Pressure 29.8
Static Pressure ($P_s$) 0.06
Filter Number(s) 001
Pretest Leak Rate = 0.003 cfm @ 16 in. Hg
Pretest Pitot Leak Check ok
Pretest Orsat Leak Check ok
Read and Record all Data Every 10 Minutes

Schematic of Traverse Point Layout

Probe Length and Type 8' SS w/ incoloy/ 1.m
Pitot Tube I.D. No. 84
Nozzle I.D. 0.249
Assumed Moisture, % 11
Temp. Readout S/N ES-7
Meter Box Number ES-7
Meter $H_@$ 1.577
C Factor 0.75
Meter Gamma 1.001
Heater Box Setting ~248 ± 25
Reference $\Delta p$ .8 K = 2.25
Post Test Leak Rate = 0.002 cfm @ 5 in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check

| Traverse Point Number | Sampling Time, (min) / Clock Time (24-hour clock) | Gas Meter Reading ($V_m$) $ft^3$ | Velocity Head ($P_s$) in. $H_2O$ | Orifice Pres. Differential (H) in. $H_2O$ Desired | Orifice Pres. Differential (H) in. $H_2O$ Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Impinger Temp. °F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 / 1021 | 581.417 | 0.30 | 0.68 | 0.68 | 250 | 58 | 57 | 2 | 242 | 62 |
| | 10 / 1031 | 586.3 | 0.29 | 0.65 | 0.65 | 258 | 60 | 59 | 2 | 244 | 57 |
| | 20 / 1041 | 591.1 | 0.30 | 0.68 | 0.68 | 256 | 63 | 60 | 2 | 251 | 58 |
| | 30 / 1051 | 596.3 | 0.28 | 0.63 | 0.63 | 257 | 66 | 63 | 2 | 252 | 64 |
| | 40 / 1101 | 601.0 | 0.30 | 0.68 | 0.68 | 256 | 69 | 65 | 2 | 251 | 68 |
| | 50 / 1111 | 606.2 | 0.30 | 0.68 | 0.68 | 259 | 72 | 68 | 2 | 252 | 62 |
| | 60 / 1121 | 611.125 | Stop - end test | | | | | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |
| | / 60 min | 29.708 | | | | | | | | | |
| | / | x1.001 | | | | 256 | 63.5 | | | | |
| | / | 29.738 | .548 | | .68 | 716 | 523.5 | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |
| | / | | | | | | | | | | |

## SAMPLE RECOVERY DATA

Plant: TDPS

Date: 4.28.88

Sampling Location:

Sample Type: Particulate

Run Number: M5-1

Sample Box Number:

Clean-up Man: EJM

Job Number: FA170

Comments: Yo BUD

**FRONT HALF**

Filter Number: 001

Description of Filter: 3" Glass Fibre Filter

**MOISTURE**

Impingers

| | | | |
|---|---|---|---|
| Final Volume: | 335 + 160 ml | ml | ml |
| Initial Volume: | 200 ml | ml | ml |
| Net Volume: | 295 ml | ml | ml |
| Total $H_2O$: | | | |

Silica Gel

| | | | |
|---|---|---|---|
| Final Volume: | 519.8 g | g | g |
| Initial Volume | 506.07 g | g | g |
| Net Volume | 13.7 g | g | g |
| Total Moisture: | | | 308.7 |

Description of Impinger Catch: cloudy - slight oil sheen on surface

# DRY MOLECULAR WEIGH. DETERMINATION

ANT TDPS

TE 4-28-88

PLING TIME (24 hr CLOCK) 1108

PLING LOCATION outlet stack

PLE TYPE (BAG, INTEGRATED, CONTINUOUS)

ALYTICAL METHOD Orsat

IENT TEMPERATURE

ERATOR MAG

COMMENTS:

| RUN / GAS | 1 | | 2 | | 3 | | AVERAGE NET VOLUME | MULTIPLIER | MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) $M_d$, lb/lb-mole |
|---|---|---|---|---|---|---|---|---|---|
| | ACTUAL READING | NET | ACTUAL READING | NET | ACTUAL READING | NET | | | |
| $O_2$ | 4.7 | 4.7 | 4.7 | 4.7 | | | | 44/100 | |
| (NET IS ACTUAL $O_2$ ADING MINUS ACTUAL $_2$ READING) | 17.0 | 12.3 | 17.0 | 12.3 | | | | 32/100 | |
| (NET IS ACTUAL CO ADING MINUS ACTUAL READING) | | | | | | | | 28/100 | |
| (NET IS 100 MINUS TUAL CO READING) | | | | | | | | 28/100 | |
| | | | | | | | | TOTAL | |

(DJI) 230
4/12

# ISOKINETIC CALCULATION

PLANT TDPS

RUN # M5-1 DATE 4-28-88

LOCATION outlet stack INITIALS MDG

**MOISTURE**

Dry gas meter gamma $\gamma$ = 1.001

Volume of liquid collected in impingers and silica gel $V_L$ = 308.7 ml

Net volume of gas through dry gas meter at meter conditions $V$ = 29.708 cu.ft.

Barometric pressure - absolute BP = 29.8 in.Hg.

Average absolute meter temperature (°F + 460) $T_m$ = 523.3 °R

Net volume of gas through dry gas meter corrected for gamma $V \times \gamma = Vm$ = 29.738 cu.ft.

Percent moisture = M

$$M = \frac{100}{1 + \frac{374.95\ (Vm)\left(B_p + \frac{\Delta H}{13.6}\right)}{(T_m)\ (V_L)}}$$

$$\frac{100}{1 + \frac{374.95\ (29.738)\left(29.8 + \frac{.68}{13.6}\right)}{(523.3)\ (308.7)}}$$

M = 32.7 %

ISOKINETIC CALCULATION—Continued

RUN # M5-1

MOLECULAR WEIGHT

Percent $O_2$ by volume dry basis $O_2$ = 12.3 %

Percent CO by volume dry basis CO = – %

Percent $CO_2$ by volume dry basis $CO_2$ = 4.7 %

$N_2$ = 100 – ($O_2$ + $CO_2$ + CO) =

100 – ( + + )

Percent $N_2$ by volume dry basis $N_2$ = 83 %

Dry molecular weight = MD

MD = 0.44 ( $CO_2$ ) + 0.32 ( $O_2$ ) + 0.28 ( $N_2$ + CO )

MD = 0.44 ( 4.7 ) + 0.32 ( 12.3 ) + 0.28 ( 83 + )

MD = 29.244

Stack gas molecular weight = MS

MS = (MD ) [1 – (M x $10^{-2}$)] + 18 (M x $10^{-2}$)

MS = (29.24 ) [1 – ( .327 )] + 18 ( .327 ) = 25.56

VELOCITY

Static pressure of stack p = 0.06 in.$H_2O$

Pitot tube coefficient, type S CP = 0.84

Average absolute stack temperature (°F + 460) $T_s$ = 716 °R

Average of the square root of $\Delta p$ $\overline{\sqrt{\Delta p}}$ = .548 in.$H_2O^{1/2}$

Absolute pressure of stack $\left(3p + \frac{p}{13.6}\right)$ $P_s$ = 29.80 in.Hg.

Stack gas velocity = $V_s$

$$V_s = (85.48)\,(CP)\left[\sqrt{\frac{(T_s)}{(P_s)(MS)}}\right]\left[\overline{\sqrt{\Delta p}}\right]$$

$$V_s = (85.48)\,(.84)\left[\sqrt{\frac{(716)}{(\ \ )(\ \ )}}\right]\left[.548\right]$$

38.15

ISOKINETIC CALCULATION--Continued

RUN # M5-1

ISOKINETIC PERCENT

Average pressure drop across orifice $\Delta H$ = .68 in.$H_2O$

Total sampling time $T$ = 60 min.

Diameter of nozzle (use micrometer value) $d$ = .249 in.

Area of nozzle = $\lambda$

$\lambda = 54.54 \times 10^{-4} (d^2) = 54.54 \times 10^{-4} (\quad)^2 =$ _____ sq.ft.

I = percent isokinetic

$$I = \frac{(1.667)(T_s)\left[0.002667(V_L) + \left(\frac{V_m}{T_m}\right)\left(P_m + \frac{(\Delta H)}{13.6}\right)\right]}{(T)(V_s)(P_s)(\lambda)}$$

$$I = \frac{(1.667)(716)\left[0.002667(308.7) + \left(\frac{29.739}{523.3}\right)\left(29.8 + \frac{(.68)}{13.6}\right)\right]}{(60)(38.15)(29.80)(.249)(.249)(.005454)}$$

I = 130.38 %

adjust K factor to 1.57 from 2.25

# FIELD DATA

Plant TDPS
Date 4-28-88
Sampling Location Baghouse Outlet
Sample Type Particle (MS)
Run Number MS-2
Operator MDG / EJM
Ambient Temperature
Barometric Pressure 29.80
Static Pressure ($P_s$) 0.06
Filter Number(s) 002
Pretest Leak Rate = 0.002 cfm @ 15 in. Hg
Pretest Pitot Leak Check ok
Pretest Orsat Leak Check ok
R l and Record all Data Every 10 Minutes

Schematic of Traverse Point Layout

Probe Length and Type 5' SS w inconel liner
Pitot Tube I.D. No. .84
Nozzle I.D. 0.249
Assumed Moisture, % 33
Temp. Readout S/N ES-7
Meter Box Number ES-7
Meter $\Delta H_@$ 1.577
C Factor 0.45
Meter Gamma 1.001
Heater Box Setting 248
Reference $\Delta p$ K = 1.57
Post Test Leak Rate = 0.00 cfm @ 5 in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check

| Traverse Point Number | Sampling Time, (min) | Clock Time (24-hour clock) | Gas Meter Reading ($V_m$) $ft^3$ | Velocity Head ($\Delta P_s$) in. $H_2O$ | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Desired | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Impinger Temp. °F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1426 | 611.510 | 0.58 | 0.91 | 0.91 | 269 | 82 | 81 | 2 | 242 | 66 |
| | 10 | 1436 | 617.2 | 0.69 | 1.00 | 1.00 | 261 | 85 | 83 | 2 | 246 | 62 |
| | 20 | 1446 | 623.3 | 0.59 | 0.93 | 0.93 | 258 | 85 | 83 | 2 | 248 | 67 |
| | 21 | 1457 | [illegible] | | Stop - time | | | Windy | | | | |
| | | | [illegible] | <-630.85 | | | | | | | | |
| | | | | 0.7765 | | .147 | 262.667 | 84 | 82.33 | | | |

## SAMPLE RECOVERY DATA

Plant: TDPS

Date: 4.28.88

Sampling Location: Baghouse Outlet

Sample Type: Particulate

Run Number: Run 2

Sample Box Number:

Clean-up Man: EJM

Job Number:

Comments:

**FRONT HALF**

Filter Number: 002

Description of Filter: 3" Glass Fibre Filter

**MOISTURE**

| | | | |
|---|---|---|---|
| **Impingers** | | | |
| Final Volume: | 306 ml | ml | ml |
| Initial Volume: | 200 ml | ml | ml |
| Net Volume: | 106 ml | ml | ml |
| Total $H_2O$: | | | |
| **Silica Gel** | | | |
| Final Volume: | 500.7 g | g | g |
| Initial Volume | 487.02 g | g | g |
| Net Volume | 13.7 g | g | g |
| Total Moisture: | | | 119.7 |

Description of Impinger Catch:

# ISOKINETIC CALCULATION

PLANT TDPS

RUN # 2-M5 DATE 4-28-88

LOCATION [redacted] Outer Stack INITIALS

**MOISTURE**

Dry gas meter gamma $\gamma$ = 1.001

Volume of liquid collected in impingers and silica gel $V_L$ = 119.7 ml

Net volume of gas through dry gas meter at meter conditions $V$ = 12.722 cu.ft.

Barometric pressure - absolute BP = 29.80 in.Hg.

Average absolute meter temperature (°F + 460) $T_m$ = ~~[illegible]~~ 543.165 °R

Net volume of gas through dry gas meter corrected for gamma $V \times \gamma = V_m$ = 12.735 cu.ft.

Percent moisture = M

$$M = \frac{100}{1 + \frac{374.95\ (V_m)\left(B_p + \frac{\Delta H}{13.6}\right)}{(T_m)\ (V_L)}}$$

$$\frac{100}{1 + \frac{374.95\ (12.735)\left(29.80 + \frac{.941}{13.6}\right)}{(\cancel{83.165}\ 543.165)\ (119.7)}}$$

M = 31.3 %

ISOKINETIC CALCULATION—Continued

RUN # MS-2

MOLECULAR WEIGHT

Percent $O_2$ by volume dry basis $O_2$ = 12.3 %

Percent CO by volume dry basis CO = _____ %

Percent $CO_2$ by volume dry basis $CO_2$ = 4.7 %

$N_2$ = 100 - ($O_2$ + $CO_2$ + CO) =

100 - ( + + )

Percent $N_2$ by volume dry basis $N_2$ = 83 %

Dry molecular weight = MD

MD = 0.44 ( $CO_2$ ) + 0.32 ( $O_2$ ) + 0.28 ( $N_2$ + CO )

MD = 0.44 ( 4.7 ) + 0.32 ( 12.3 ) + 0.28 ( 83 + )

MD = 29.244

Stack gas molecular weight = MS

MS = (MD ) [1 - (X x $10^{-2}$)] + 18 (X x $10^{-2}$)

MS = ( 29.244 ) [1 - ~~80~~ .313 )] + 18 ( .313 ) = 25.72

VELOCITY

Static pressure of stack p = 0.06 in.$H_2O$

Pitot tube coefficient, type S CP = .84

Average absolute stack temperature (°F + 460) $T_s$ = 722.7 °R

Average of the square root of $\Delta p$ $\overline{\sqrt{\Delta p}}$ = .7765 in.$H_2O^{1/2}$

Absolute pressure of stack $\left(BP + \frac{p}{13.6}\right)$ $P_s$ = _____ in.Hg.

Stack gas velocity = $V_s$

$$V_s = (85.48)\ (\ CP\ )\left[\sqrt{\frac{(\ T_s\ )}{(\ P_s\ )\ (\ MS\ )}}\right]\left[\overline{\sqrt{\Delta p}}\right]$$

$$V_s = (85.48)\ (\ .84\ )\left[\sqrt{\frac{(722.7\ )}{(\ \ )\ (\ \ )}}\right]\left[.7765\right]$$ 54.1

ISOKINETIC CALCULATION--Continued

RUN # _____

ISOKINETIC PERCENT

Average pressure drop across orifice $\Delta H$ = .947 in.$H_2O$

Total sampling time $T$ = 31 min.

Diameter of nozzle (use micrometer value) $d$ = .249 in.

Area of nozzle = $A$

$A = 54.54 \times 10^{-4} (d^2) = 54.54 \times 10^{-4} (\quad)^2$ = _____ sq.ft.

$I$ = percent isokinetic

$$I = \frac{(1.667)(T_s)\left[0.002667(V_L) + \left(\frac{V_m}{T_m}\right)\left(P_B + \frac{(\Delta H)}{13.6}\right)\right]}{(T)(V_s)(P_s)(A)}$$

$$I = \frac{(1.667)(722.7)\left[0.002667(119.7) + \left(\frac{12.735}{543.2}\right)\left(29.8 + \frac{(.947)}{13.6}\right)\right]}{(31)(54.1)(29.8)(.249)(.249)(.005454)}$$

$I$ = 7.6 %

# FIELD DATA

Plant: TDPS
Date: ~~4.21.88~~ 5.2.88
Sampling Location: Baghouse Outlet
Sample Type: Particulate
Run Number: 3
Operator: EJM
Ambient Temperature:
Barometric Pressure:
Static Pressure ($P_s$):
Filter Number(s): 003
Pretest Leak Rate = ~~0.045~~ .003 cfm @ ~~16~~ 15 in. Hg
Pretest Pitot Leak Check:
Pretest Orsat Leak Check:
R 1 and Record all Data Every ___ Minutes

Schematic of Traverse Point Layout

Probe Length and Type:
Pitot Tube I.D. No.:
Nozzle I.D.: 0.249
Assumed Moisture, %: 30
Temp. Readout S/N:
Meter Box Number:
Meter $\Delta H_@$: 1.577
C Factor: 1.8
Meter Gamma: 1.001
Heater Box Setting:
Reference $\Delta p$:
Post Test Leak Rate = ~~0.008~~ cfm @ 5 in. Hg
Post Test Pitot Leak Check:
Post Test Orsat Leak Check:

| Traverse Point Number | Sampling Time, (min) | Clock Time (24-hour clock) | Gas Meter Reading ($V_m$) $ft^3$ | Velocity Head ($\Delta P_s$) in. $H_2O$ | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Desired | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Impinger Temp. °F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ~~632.997~~ | | | | | | | | | |
| | 0 | 10836 | 633.202 | 0.72 | 1.30 | 1.30 | 259 | 56 | 56 | 3 | 250 | 62 |
| | 10 | 10846 | 640.1 | 0.71 | 1.28 | 1.28 | 269 | 59 | 56 | 3 | 252 | 58 |
| | 20 | 10856 | 646.7 | 0.78 | 1.40 | 1.40 | 254 | 61 | 58 | 3 | 248 | 55 |
| | 30 | 10906 | 653.4 | 0.52 | 0.94 | 0.94 | 250 | 64 | 59 | 3 | 251 | 53 |
| | 31 | 10908 | | Lost power | | | | | | | | |
| | 32 | 10910 | 653.4 | 0.72 | 1.30 | 1.30 | | | | | | |
| | 40 | 10919 | 658.8 | 0.72 | 1.30 | 1.30 | 256 | 64 | 60 | 3 | 248 | 52 |
| | 50 | 10929 | 665.5 | 0.74 | 1.33 | 1.33 | 262 | 66 | 63 | 3 | 248 | 52 |
| | 55 | 10934 | 668.940 | Stop and test | | | | | | | | |
| | | | 35.638 | | | | | | | | | |
| | | | $\bar{x}\sqrt{\Delta P}$ = | | $\bar{x}$ = 1.2643 | | $\bar{x}$ = 258.33 | $\bar{x}$ = 60.17 | | | | |

## SAMPLE RECOVERY DATA

Plant: TDPS

Date: 5-2-88

Sampling Location: outlet stack

Sample Type: M5

Run Number: 3

Sample Box Number: —

Clean-up Man: EJM/MOG

Job Number: FA170.10

Comments:

**FRONT HALF**

Filter Number: 003

Description of Filter: light

**MOISTURE**

| | | | |
|---|---|---|---|
| **Impingers** | | | |
| Final Volume: | ~~518~~ 430 ml | ml | ml |
| Initial Volume: | 200 ml | ml | ml |
| Net Volume: | 230 ml | ml | ml |
| Total $H_2O$: | | | |
| **Silica Gel** | | | |
| Final Volume: | 518.8 g | g | g |
| Initial Volume | 246.24 g | 258.19 g | g |
| Net Volume | ~~272.56~~ g | 14.37 g | g |
| Total Moisture: | ~~[illegible]~~ 56 | | |

Description of Impinger Catch: cloudy

# DRY MOLECULAR WEIGHT DETERMINATION

ANT TDPS

TE 4-24-84

PLING TIME (24-hr CLOCK) M5-3

PLING LOCATION Baghouse outlet Stack

PLE TYPE (BAG, INTEGRATED, CONTINUOUS)

ALYTICAL METHOD orsat

BIENT TEMPERATURE

ERATOR MOGallagher

COMMENTS:

| RUN / GAS | 1 | | 2 | | 3 | | AVERAGE NET VOLUME | MULTIPLIER | MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) $M_d$, lb/lb-mole |
|---|---|---|---|---|---|---|---|---|---|
| | ACTUAL READING | NET | ACTUAL READING | NET | ACTUAL READING | NET | | | |
| $O_2$ | 3.4 | 3.4 | 3.4 | 3.4 | | | | 44/100 | |
| (NET IS ACTUAL $O_2$ ADING MINUS ACTUAL $_2$ READING) | 17.0 | 13.6 | 17.0 | 13.6 | | | | 32/100 | |
| (NET IS ACTUAL CO ADING MINUS ACTUAL READING) | | | | | | | | 28/100 | |
| (NET IS 100 MINUS TUAL CO READING) | | 83 | | 83 | | | | 28/100 | |
| | | | | | | | | TOTAL | |

(Dual) 230
4/12

# ISOKINETIC CALCULATION

PLANT TDPS

RUN # 3 DATE 5.2.88

LOCATION Baghouse Outlet INITIALS EJM

**MOISTURE**

Dry gas meter gamma $\gamma$ = 1.001

Volume of liquid collected in impingers and silica gel $V_L$ = ~~502.56~~ 244.37 ml

Net volume of gas through dry gas meter at meter conditions $V$ = 35.638 cu.ft.

Barometric pressure - absolute BP = _____ in.Hg.

Average absolute meter temperature (°F + 460) $T_m$ = 520.17 °R

Net volume of gas through dry gas meter corrected for gamma $V \times \gamma = V_m$ = 35.6736 cu.ft.

Percent moisture = M

$$M = \frac{100}{1 + \frac{374.95\ (V_m)\left(B_p + \frac{\Delta H}{13.6}\right)}{(T_m)\ (V_L)}}$$

$$\frac{100}{1 + \frac{374.95\ (35.6736)\left(29.80 + \frac{1.2463}{13.6}\right)}{(520.17)\ (\cancel{502.56})}}$$

244.37

M = ~~39.5~~ 24.1 %

ISOKINETIC CALCULATION—Continued

RUN # 3

MOLECULAR WEIGHT

Percent $O_2$ by volume dry basis $O_2$ = 13.6 %

Percent CO by volume dry basis CO = ~~13.6~~ %

Percent $CO_2$ by volume dry basis $CO_2$ = 3.4 %

$N_2 = 100 - (O_2 + CO_2 + CO) =$

$100 - ( \quad + \quad + \quad )$

Percent $N_2$ by volume dry basis $N_2$ = 83 %

Dry molecular weight = MD

$MD = 0.44 ( \quad CO_2 \quad ) + 0.32 ( \quad O_2 \quad ) + 0.28 ( \quad N_2 \quad + \quad CO \quad )$

$MD = 0.44 ( 3.4 ) + 0.32 ( \cancel{13.6} ) + 0.28 ( 83 \quad + \quad )$

MD = 29.09

Stack gas molecular weight = MS

$MS = (MD \quad ) [1 - (M \times 10^{-2})] + 18 (M \times 10^{-2})$

$MS = (29.09) [1 - ( \cancel{.395} .241 )] + 18 ( \cancel{.395} .241 ) =$ ~~24.71~~ 26.42

VELOCITY

Static pressure of stack p = .06 in.$H_2O$

Pitot tube coefficient, type S CP = 0.84

Average absolute stack temperature (°F + 460) $T_s$ = 718.33 °R

Average of the square root of $\Delta p$ $\overline{\sqrt{\Delta p}}$ = .836 in.$H_2O^{1/2}$

Absolute pressure of stack $\left(BP + \frac{p}{13.6}\right)$ $P_s$ = 29.8 in.Hg.

Stack gas velocity = $V_s$

$V_s = (85.48) ( \quad CP \quad ) \left[\sqrt{\frac{( \quad T_s \quad )}{( \quad P_s \quad ) ( \quad MS \quad )}}\right] \left[\overline{\sqrt{\Delta p}}\right]$ ~~59.7828~~

$V_s = (85.48) ( .84 ) \left[\sqrt{\frac{( 718.3 )}{( 29.8 ) ( 26.4 )}}\right] \left[ .836 \right]$ 57.34

ISOKINETIC CALCULATION--Continued

RUN # 3

ISOKINETIC PERCENT

Average pressure drop across orifice $\Delta H$ = 1.2463 in.$H_2O$

Total sampling time $T$ = 55 min.

Diameter of nozzle (use micrometer value) $d$ = 0.249 in.

Area of nozzle = A

$A = 54.54 \times 10^{-4} (d^2) = 54.54 \times 10^{-4} (.062001)^2$ = .000338153 sq.ft.

I = percent isokinetic

$$I = \frac{(1.667)(T_s)\left[0.002667(V_L) + \left(\frac{V_m}{T_m}\right)\left(P_B + \frac{(\Delta H)}{13.6}\right)\right]}{(T)(V_s)(P_s)(A)}$$

$$I = \frac{(1.667)(718.33)\left[0.002667(244.37) + \left(\frac{35.6736}{520.17}\right)\left(29.80 + \frac{(1.2463)}{13.6}\right)\right]}{(55)(\cancel{1836})(29.8)(.000338153)(.249)(.249)(.005454)}$$

~~259.2868~~

57.34

I = ~~123.57~~ 105.02 %

# FIELD DATA

Plant TDPS
Date 5.2.88
Sampling Location Baghouse Outlet
Sample Type Particulate
Run Number Run 4
Operator GJM
Ambient Temperature
Barometric Pressure
Static Pressure ($P_s$)
Filter Number(s)
Pretest Leak Rate = 0.004 cfm @ 15 in. Hg
Pretest Pitot Leak Check
Pretest Orsat Leak Check
R and Record all Data Every ___ Minutes

Schematic of Traverse Point Layout

Probe Length and Type
Pitot Tube I.D. No.
Nozzle I.D.
Assumed Moisture, %
Temp. Readout S/N
Meter Box Number
Meter $\Delta H_@$ 1.577
C Factor ~~1.4~~ 1.71
Meter Gamma 1.001
Heater Box Setting
Reference $\Delta p$
Post Test Leak Rate = 0.004 cfm @ 15 in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check

| Traverse Point Number | Sampling Time, (min) / Clock Time (24-hour clock) | Gas Meter Reading ($V_m$) $ft^3$ | Velocity Head ($\Delta P_s$) in. $H_2O$ | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Desired | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Impinger Temp. °F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 / 1329 | 669.061 | 0.42 | 0.72 | 0.72 | 211 | ~~74~~ 65 | ~~74~~ 65 | 2 | 246 | 61 |
| | 10 / 1339 | 673.7 | 0.46 | 0.79 | 0.79 | 237 | 66 | 65 | 3 | 248 | 59 |
| | 20 / 1349 | 678.9 | 0.57 | 0.97 | 0.97 | 241 | 68 | 66 | 4 | 251 | 61 |
| | 30 / 1359 | 684.6 | 0.66 | 1.13 | 1.13 | 245 | 71 | 68 | 4 | 252 | 60 |
| | 40 / 1409 | 691.4 | 0.66 | 1.13 | 1.13 | 245 | 73 | 70 | 4 | 251 | 62 |
| | 50 / 1419 | 697.4 | 0.68 | 1.16 | 1.16 | 245 | 75 | 71 | 4 | 252 | 63 |
| | 60 / 1429 | 703.703 | Stop - end test | | | | | | | | |
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| | / | 34.642 | | | | | | | | | |
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## SAMPLE RECOVERY DATA

Plant: TBPS

Date: 5·2·88

Sampling Location:

Sample Type: Particulate

Run Number: 4

Sample Box Number:

Clean-up Man:

Job Number:

Comments:

**FRONT HALF**

Filter Number: 004

Description of Filter: 3" Glass Fibre

**MOISTURE**

| | | | |
|---|---|---|---|
| **Impingers** | | | |
| Final Volume: | 446 ml | ml | ml |
| Initial Volume: | 200 ml | ml | ml |
| Net Volume: | 246 ml | ml | ml |
| Total $H_2O$: | | | |
| **Silica Gel** | | | |
| Final Volume: | 544.9 g | g | g |
| Initial Volume | 511.41 g | g | g |
| Net Volume | 33.49 g | g | g |
| Total Moisture: | 279.49 | | |

Description of Impinger Catch:

# DRY MOLECULAR WEIGH. DETERMINATION

ANT TDPS
E 5·2·88
PLING TIME (24 hr CLOCK) Run 4
PLING LOCATION Baghouse Outlet
PLE TYPE (BAG, INTEGRATED, CONTINUOUS) Bag
ALYTICAL METHOD Orsat
IENT TEMPERATURE
ERATOR MDG

COMMENTS:

| RUN / GAS | 1 | | 2 | | 3 | | AVERAGE NET VOLUME | MULTIPLIER | MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) $M_d$, lb/lb-mole |
|---|---|---|---|---|---|---|---|---|---|
| | ACTUAL READING | NET | ACTUAL READING | NET | ACTUAL READING | NET | | | |
| $O_2$ | 4.8 | 4.8 | | | | | | 44/100 | |
| (NET IS ACTUAL $O_2$ ADING MINUS ACTUAL , READING) | 17.6 | 12.8 | | | | | | 32/100 | |
| (NET IS ACTUAL CO ADING MINUS ACTUAL READING) | | | | | | | | 28/100 | |
| (NET IS 100 MINUS UAL CO READING) | | | | | | | | 28/100 | |
| | | | | | | | | TOTAL | |

(DJ) 230
4/12

# FIELD DATA

Plant TDPS
Date 4-28-86
Sampling Location Baghouse Outlet
Sample Type PS
Run Number PS-Blank
Operator MAG
Ambient Temperature
Barometric Pressure 29.40
Static Pressure ($P_s$) 0.06
Filter Number(s) I001- I007
Pretest Leak Rate = 0.006 cfm @ 15 in. Hg
Pretest Pitot Leak Check NA
Pretest Orsat Leak Check NA
Read and Record all Data Every 10 Minutes

Schematic of Traverse Point Layout

Probe Length and Type 5' Anderson
Pitot Tube I.D. No. NA
Nozzle I.D. Blank Run NA
Assumed Moisture, % NA
Temp. Readout S/N ES-8
Meter Box Number ES-8
Meter $H_@$ 1.548
C Factor NA
Meter Gamma 1.003
Heater Box Setting NA
Reference $\Delta P$ NA
Post Test Leak Rate = ___ cfm @ ___ in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check

| Traverse Point Number | Sampling Time, (min) | Clock Time (24-hour clock) | Gas Meter Reading ($V_m$) $ft^3$ | Velocity Head ($P_s$) in. $H_2O$ | Orifice Pres. Differential (H) in. $H_2O$ Desired | Orifice Pres. Differential (H) in. $H_2O$ Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Impinger Temp. °F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C-2 | 0 | 0903 | 142.660 | 0.29 | 0.75 | 0.75 | 220 | 57 | 57 | 0 | 186 | |
| | 3 | 0906 | 144.962 | Stop - power out | | | | | | | | |
| | 3 | 0926 | 144.962 | 0.29 | 0.75 | 0.75 | 220 | 59 | 58 | 0 | 161 | |
| | 4 | 0927 | 145.926 | POWER OUT | | | | | | | | |
| | 4 | 0929 | | | | | | | | | | |
| | 10 | 0935 | 150.1 | 0.29 | 0.75 | 0.75 | | 61 | 57 | 2 | 164 | |
| | 20 | 0947 | 155.2 | | 0.75 | 0.75 | | 62 | 60 | 2 | 164 | |
| | 30 | 0957 | 160.605 | | | | | | | | | |
| | | | | | | | | $\bar{T}$ = 59 | 125 | | | |

## FIELD DATA

Plant: TDPS
Date: 4.28.84
Sampling Location: Baghouse Outlet
Sample Type: PS
Run Number: PS-1
Operator: MDG
Ambient Temperature:
Barometric Pressure: 29.8
Static Pressure ($P_s$): 0.06
Filter Number(s): T008
Pretest Leak Rate = 0.005 cfm @ 12 in. Hg
Pretest Pitot Leak Check: NA
Pretest Orsat Leak Check: NA
Read and Record all Data Every 10 Minutes

Schematic of Traverse Point Layout

Probe Length and Type: 5' Anderson
Pitot Tube I.D. No.: NA
Nozzle I.D.: 0.250
Assumed Moisture, %: NA
Temp. Readout S/N: ES-8
Meter Box Number: ES-8
Meter $H_@$: 1.548
C Factor: ~~1.03~~ NA
Meter Gamma: 1.003
Heater Box Setting: NA
Reference Δp: NA
Post Test Leak Rate = ____ cfm @ ____ in. Hg
Post Test Pitot Leak Check:
Post Test Orsat Leak Check:

| Traverse Point Number | Sampling Time, (min) / Clock Time (24-hour clock) | Gas Meter Reading ($V_m$) $ft^3$ | Velocity Head ($P_s$) in. $H_2O$ | Orifice Pres. Differential (H) in. $H_2O$ Desired | Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Impinger Temp. °F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 / 1427 | 160.922 | 0.30 | 0.47 | 0.47 | 269 | 72 | 71 | 0 | | |
| | 10 / 1437 | 165.0 | 0.30 | 0.47 | 0.47 | 261 | 72 | 72 | 0 | | |
| | 20 / 1447 | 169.4 | | 0.47 | 0.47 | 258 | 74 | 73 | 0 | | |
| | 30 / 1457 | 173.644 | | Stop - too windy | | | | | | | |
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| | / | | | 6477 | | | 262.67 | 72.67 | 72 | | | |

# FIELD DATA

Plant TDPS
Date ~~4.29.88~~ 5.2.88
Sampling Location Baghouse Outlet
Sample Type P-Size
Run Number Page Run 2
Operator
Ambient Temperature
Barometric Pressure
Static Pressure ($P_s$)
Filter Number(s)
Pretest Leak Rate = 0.018 cfm @ 6 in. Hg
Pretest Pitot Leak Check
Pretest Orsat Leak Check
R and Record all Data Every ___ Minutes

Schematic of Traverse Point Layout

Probe Length and Type
Pitot Tube I.D. No.
Nozzle I.D.
Assumed Moisture, %
Temp. Readout S/N
Meter Box Number
Meter $\Delta H_@$ 1.548
C Factor
Meter Gamma 1.003
Heater Box Setting
Reference $\Delta p$
Post Test Leak Rate = ___ cfm @ 5 in. Hg OK
Post Test Pitot Leak Check
Post Test Orsat Leak Check

| Traverse Point Number | Sampling Time, (min) | Clock Time (24-hour clock) | Gas Meter Reading ($V_m$) $ft^3$ | Velocity Head ($\Delta P_s$) in. $H_2O$ | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Desired | Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Impinger Temp. °F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ~~174.469~~ | | | | | | | | | |
| | 0 | 0945 | 174.545 | 0.70 | 1.26 | 1.26 | 268 | 66 | 65 | 1 | | |
| | 10 | 0955 | 181.0 | 0.76 | 1.37 | 1.37 | 253 | 68 | 66 | 2 | | |
| | 20 | 0905 | 188.0 | 0.58 | 1.04 | 1.04 | 250 | 71 | 68 | 2 | | |
| | 23 | 0908 | 190.0 | Leak | Server | | | | | | | |
| | 23 | 0911 | 191.0 | 0.72 | 1.30 | 1.30 | | | | | | |
| | 30 | 0918 | 194.0 | 0.72 | 1.30 | 1.30 | 255 | 72 | 69 | 2 | | |
| | 40 | 0928 | 200.9 | 0.76 | 1.37 | 1.37 | 261 | 74 | 71 | 2 | | |
| | 50 | 0938 | 207.6 | 0.80 | 1.44 | 1.44 | 257 | 75 | 72 | 2 | | |
| | 60 | 0948 | 214.268 | Stop - end test | | | | | | | | |

## FIELD DATA

Plant TDPS
Date 5.2.88
Sampling Location Baghouse Outlet
Sample Type P-Sale
Run Number P-Sale Run 3
Operator [illegible]
Ambient Temperature
Barometric Pressure
Static Pressure ($P_s$)
Filter Number(s)
Pretest Leak Rate = ____ cfm @ ____ in. Hg
Pretest Pitot Leak Check
Pretest Orsat Leak Check
R : and Record all Data Every ____ Minutes

Schematic of Traverse Point Layout

Probe Length and Type
Pitot Tube I.D. No.
Nozzle I.D.
Assumed Moisture, %
Temp. Readout S/N
Meter Box Number
Meter $\Delta H_@$ 1.548
C Factor
Meter Gamma 1.003
Heater Box Setting
Reference $\Delta p$
Post Test Leak Rate = ____ cfm @ ____ in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check

| Traverse Point Number | Sampling Time, (min) / Clock Time (24-hour clock) | Gas Meter Reading ($V_m$) $ft^3$ | Velocity Head ($\Delta P_s$) in. $H_2O$ | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Desired | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Im-pinger Temp. °F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 / 1330 | 214.268 | 0.42 | 0.72 | 0.72 | 218 | ~~65~~ 71 | ~~65~~ 71 | 2~~4~~ | 246 | 61 |
| | 10 / 1340 | 218.5 | ~~0.40~~ | 0.72 | 0.72 | 237 | 72 | 71 | | | |
| | 20 / 1350 | 221.9 | | 0.72 | 0.72 | 241 | 74 | 72 | | | |
| | 30 / 1400 | 226.8 | | 0.72 | 0.72 | 245 | 76 | 73 | | | |
| | 40 / 1410 | 231.7 | | 0.72 | 0.72 | 243 | 78 | 75 | | | |
| | 50 / 1420 | 233.6 | | 0.72 | 0.72 | 245 | 78 | 76 | | | |
| | 58 / 14 | 234.444 | Stop end Run | | | | | | | | |
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ANT TOPS

TE 4-28-88

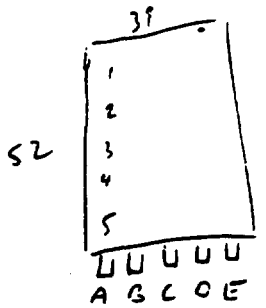
ATION Baghouse Outlet

ACK I.D. 52" x 39"

OMETRIC PRESSURE, in. Hg

ACK GAUGE PRESSURE, in. $H_2O$

ERATORS MOG/EJM




SCHEMATIC OF TRAVERSE POINT LAYOUT

| TRAVERSE POINT NUMBER | VELOCITY HEAD ($\Delta p_s$), in. $H_2O$ | STACK TEMPERATURE ($T_s$), °F |
|---|---|---|
| A - 1 | 0.07 | 194 |
| 2 | 0.06 | 208 |
| 3 | 0.08 | 215 |
| 4 | 0.13 | 224 |
| 5 | 0.15 | 228 |
| B - 1 | 0.24 | 219 |
| 2 | 0.19 | 220 |
| 3 | 0.14 | 220 |
| 4 | 0.18 | 232 |
| 5 | 0.23 | 235 |
| C - 1 | 0.30 | 229 |
| 2 | 0.26 | 228 |
| 3 | 0.25 | 233 |
| 4 | 0.31 | 236 |
| 5 | 0.34 | 235 |
| D - 1 | 0.53 | 236 |
| 2 | 0.54 | 239 |
| 3 | 0.57 | 239 |
| 4 | 0.64 | 240 |
| 5 | 0.46 | 239 |
| | | |
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| AVERAGE | | |

| TRAVERSE POINT NUMBER | VELOCITY HEAD ($\Delta p_s$), in. $H_2O$ | STACK TEMPERATURE ($T_s$), °F |
|---|---|---|
| E - 1 | 0.42 | 221 |
| 2 | 0.44 | 222 |
| 3 | 0.47 | 224 |
| 4 | 0.48 | 225 |
| 5 | 0.35 | 226 |
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| AVERAGE | | |

E A (Dur) 233
4/72

ENGINEERING-SCIENCE
LABORATORY TEST REPORT
ASPHALT FA170

## BACK HALF CHLOROFORM/ETHER EXTRACTIONS

| | RESIDUE(g) | H2O VOLUME(mls) | NET RESIDUE(g) |
|---|---|---|---|
| BLANK H2O | 0.0010 | 385.7 | 0.0000 |
| M5-1/H2O | 0.0220 | 489.7 | 0.0207 |
| M5-2/H2O | 0.0269 | 308.6 | 0.0261 |
| M5-3/H2O | 0.0322 | 425.9 | 0.0311 |
| M5-4/H2O | 0.0982 | 442.4 | 0.0970 |

## METHOD 5 ACETONE RESIDUES

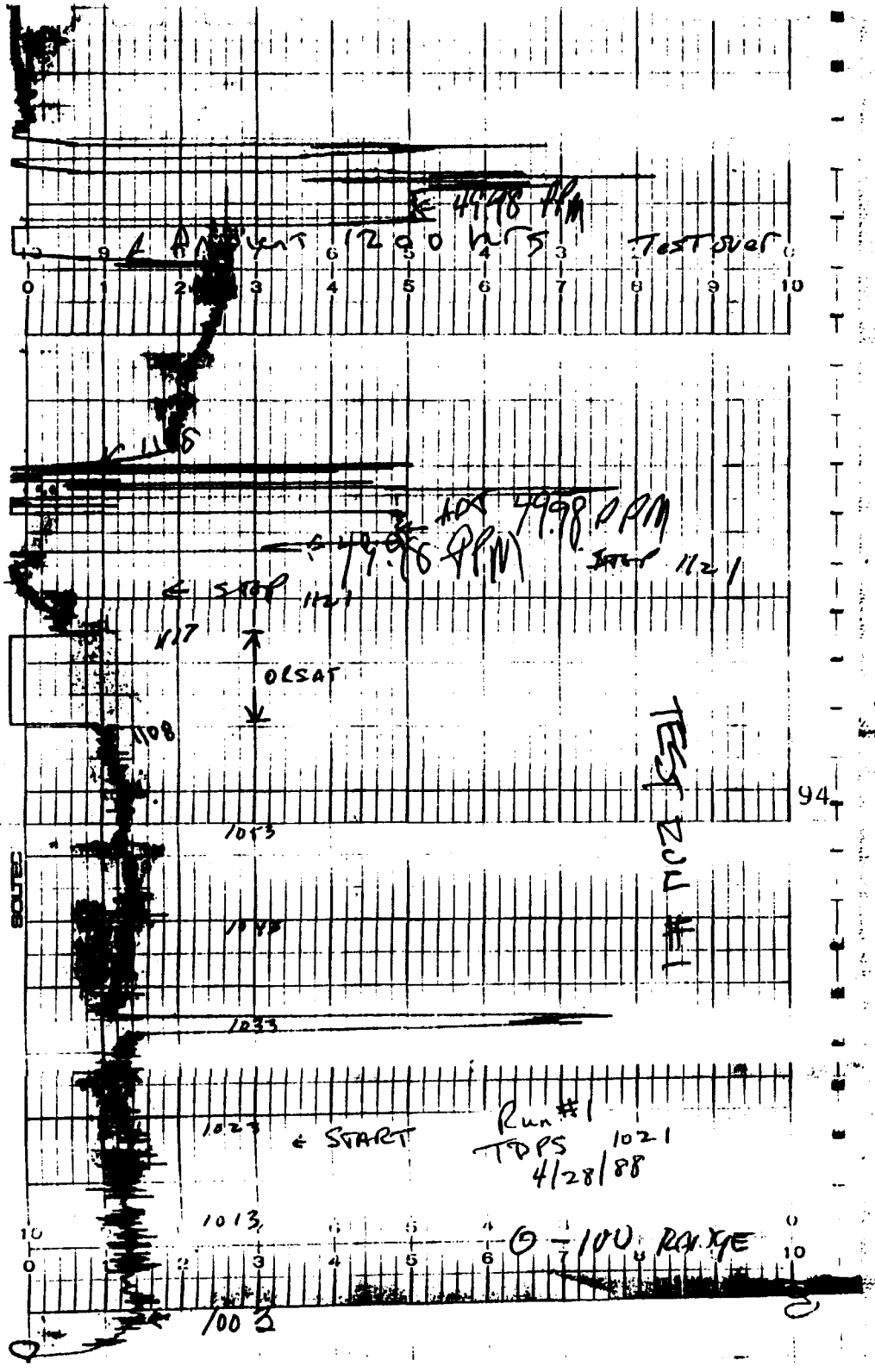
| | RESIDUE(g) | VOLUME(mls) | NET RESIDUE(g) |
|---|---|---|---|
| BLANK ACETONE | 0.0011 | 245.6 | 0.0000 |
| ACETONE/M5-1 | 0.0234 | 178.4 | 0.0226 |
| ACETONE/M5-2 | 0.0661 | 204.8 | 0.0652 |
| ACETONE/M5-3 | 0.0179 | 223.1 | 0.0169 |
| ACETONE/M5-4 | 0.0227 | 221.7 | 0.0217 |

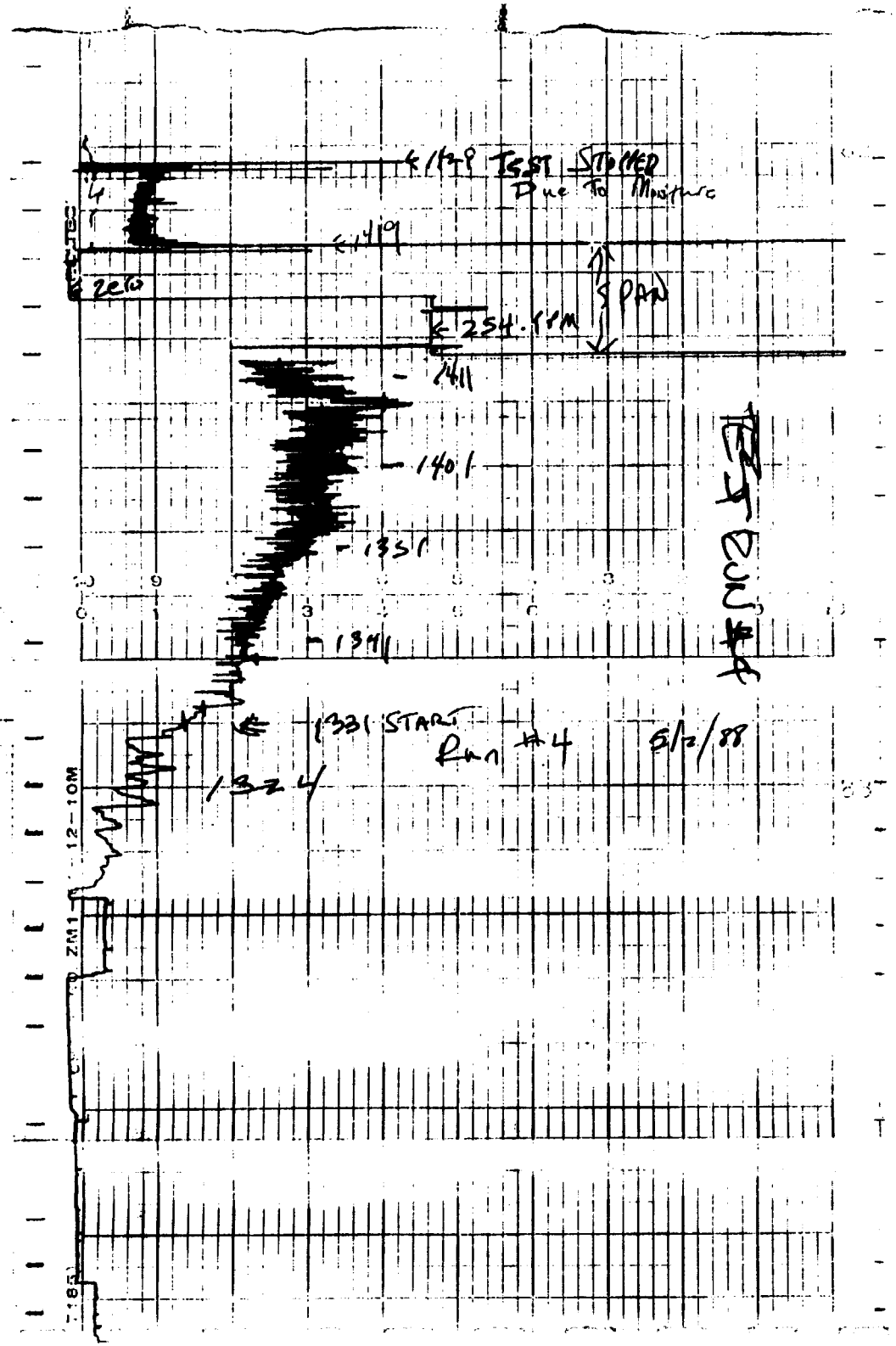
## METHOD 5 FILTER RESIDUES

| | RESIDUE(g) |
|---|---|
| F001/88 | 0.0352 |
| F002/88 | 0.0229 |
| F003/88 | 0.0084 |
| F004/88 | 0.0041 |

ANALYST: Janette Sua, John Punch

APPROVED: J Carlisle


49.98 RPM
1200 hrs
Test over
1116
49.98 RPM
49.98 RPM
Start 1121
Stop 1121
1117
OLSAT
1108
1053
1048
1033
1023
Start
Run #1
TOPS 1021
4/28/88
1013
0-100 RANGE
100 Ω
TEST RUN #1
SOLTEC


1419 TEST STOPPED
Due To Moisture
1419
zero
SPAN
254.11M
1411
1401
1351
1341
1331 START
Run #4 5/2/88
1324
TEST RUN #4
12-10M
ZM1

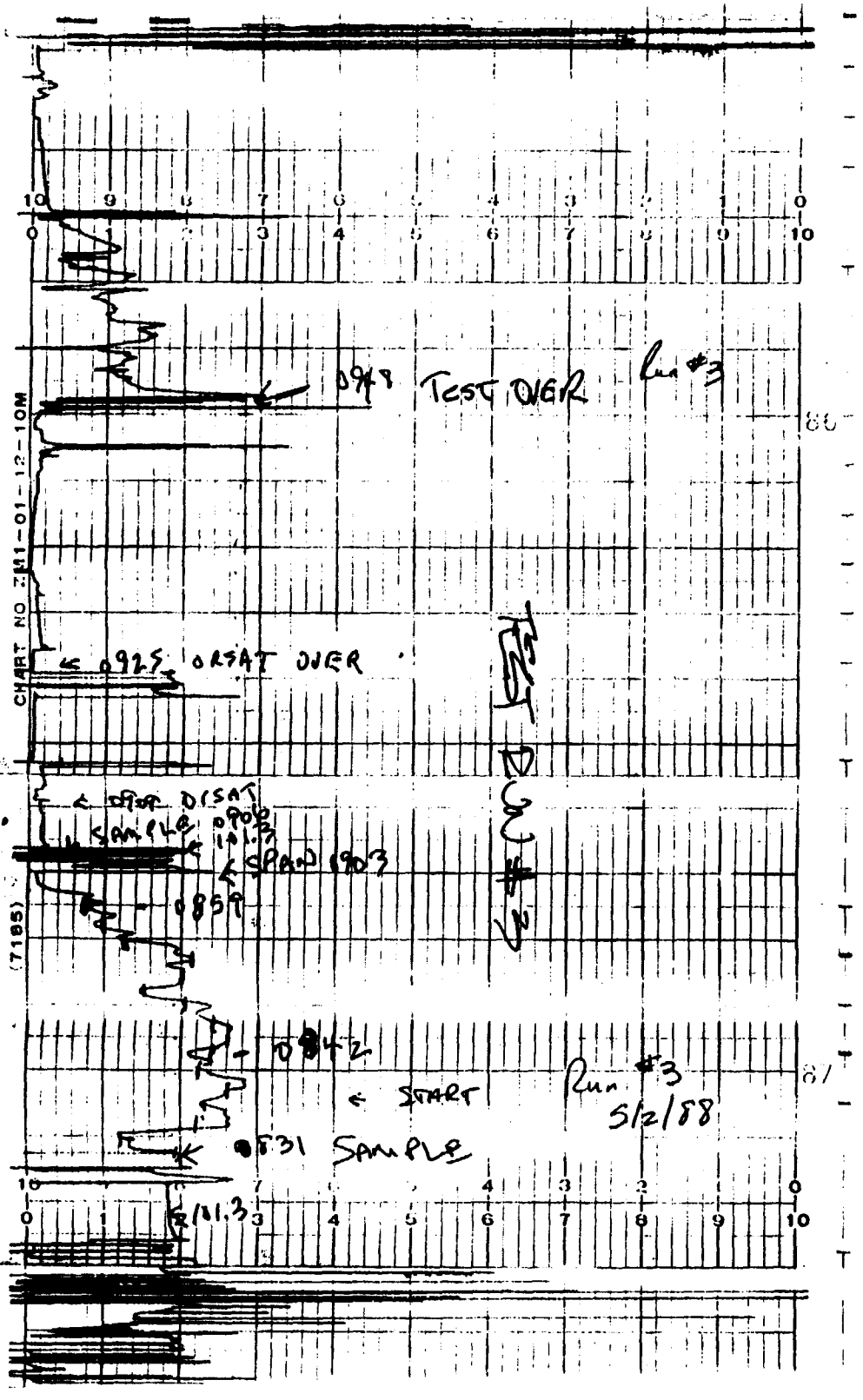


CHART NO ZM1-01-12-10M
(7185)
0948 TEST OVER
Run #3
88
0925 ORSAT OVER
START DISAT
SAMPLE 0900
121.3
SPAN 1903
0859
0842
START
Run #3
5/2/88
87
0831 SAMPLE
121.3

U.S. EPA
PARTICULATE CALCULATIONS
RUN NO. 1

PLANT : TDPS
DATE : 4-28-88
SAMP. LOCATION : STACK
OPERATING COND.: BACK HALF-CHLOROFORM/ETHER EXTRACTION DRY DOWN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SAMPLE TIME | = 60.0 | min. | NOZZLE DIA. | = | 0.249 | in. |
| BAR. PRESSURE | = 29.80 | in.Hg | NOZZLE AREA | = | 0.000338 | Sq.Ft. |
| STK. PRESSURE | = 29.80 | in.Hg | METER ORIFICE | = | 0.667 | in. H2O |
| EFF. STACK AREA | = 14.08 | Sq.Ft. | METER VOLUME | = | 29.708 | Cu.Ft. |
| Cp | = 0.84 | | METER TEMP. | = | 523 | DEG. R |
| GAS ANALYSIS | = 4.7 | % CO2 | STACK TEMP. | = | 716 | DEG. R |
| | 12.3 | % O2 | SQ.RT. dP | = | 0.543 | in. H2O |
| | 0.0 | % CO | COND.(Vic) | = | 308.7 | ml |
| | 83.0 | % N2 | METER Y | = | 1.001 | |
| LAB ANALYSIS | = 0.0207 | grams | HEAT INPUT | = | *** | MM Btu/hr |
| | | | F-FACTOR | = | 9780 | dscf/MM Bt |

**********

Vw(std) = 0.04707 x Vic = 14.531 scf

Vm(std) = 17.647 x Vm x Y x (Pb + (dH / 13.6)) / (Tm) = 29.920 scf

Bws = Vw(std) / (Vm(std) + Vw(std)) = 0.327

%EA =(%O2 - 0.5%CO) / (0.264%N2 x (%O2 - 0.5%CO)) = 0.046

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.24

Ms = (Md x (1-Bws)) + (18.0 x Bws) = 25.57

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts) / (Ms x Ps)] = 37.8 ft/sec

Qs = vs x As x 60 = 31944 acf/min

Qs(std)=Qs x (1-Bws)x(528/(Ts)) x (Ps/29.92)= 15795 dscf/min

I = (Ts) x [(0.00267 x Vic) + (Vm(std) / 17.647)] x 100 / (Time x Ps x An x vs x 60) = 131.5 %

**********

cs = 15.432 x grams / Vm(std) = 0.0107 grains/dsc

grains/acf = cs x 17.647xPs x (1-Bws) / (Ts) = 0.0053 grains/acf

C = cs / 7000 = 1.53E-06 lbs/dscf

EM = C x Qs(std) x 60 = 1.445 lbs/hr

U.S. EPA
PARTICULATE CALCULATIONS
RUN NO. 1

PLANT : TDPS
DATE : 4-28-88
SAMP. LOCATION : STACK
OPERATING COND.: FRONT HALF-FILTER AND RINSE, DRY DOWN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SAMPLE TIME | = | 60.0 | min. | NOZZLE DIA. | = | 0.249 | in. |
| BAR. PRESSURE | = | 29.80 | in.Hg | NOZZLE AREA | = | 0.000338 | Sq.Ft. |
| STK. PRESSURE | = | 29.80 | in.Hg | METER ORIFICE | = | 0.667 | in. H2O |
| EFF. STACK AREA | = | 14.08 | Sq.Ft. | METER VOLUME | = | 29.708 | Cu.Ft. |
| Cp | = | 0.84 | | METER TEMP. | = | 523 | DEG. R |
| GAS ANALYSIS | = | 4.7 | % CO2 | STACK TEMP. | = | 716 | DEG. R |
| | | 12.3 | % O2 | SQ.RT. dP | = | 0.543 | in. H2O |
| | | 0.0 | % CO | COND.(Vic) | = | 308.7 | ml |
| | | 83.0 | % N2 | METER Y | = | 1.001 | |
| LAB ANALYSIS | = | 0.0578 | grams | HEAT INPUT | = | *** | MM Btu/hr |
| | | | | F-FACTOR | = | 9780 | dscf/MM Bt |

**********

Vw(std) = 0.04707 x Vic = 14.531 scf

Vm(std) = 17.647 x Vm x Y x (Pb + (dH / 13.6)) / (Tm) = 29.920 scf

Bws = Vw(std) / (Vm(std) + Vw(std)) = 0.327

%EA =(%O2 - 0.5%CO) / (0.264%N2 x (%O2 - 0.5%CO)) = 0.046

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.24

Ms = (Md x (1-Bws)) + (18.0 x Bws) = 25.57

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts) / (Ms x Ps)] = 37.8 ft/sec

Qs = vs x As x 60 = 31944 acf/min

Qs(std)=Qs x (1-Bws)x(528/(Ts)) x (Ps/29.92)= 15795 dscf/min

I = (Ts) x [(0.00267 x Vic) + (Vm(std) / 17.647)] x 100 / (Time x Ps x An x vs x 60) = 131.5 %

**********

cs = 15.432 x grams / Vm(std) = 0.0298 grains/dsc

grains/acf = cs x 17.647xPs x (1-Bws) / (Ts) = 0.0147 grains/acf

C = cs / 7000 = 4.26E-06 lbs/dscf

EM = C x Qs(std) x 60 = 4.036 lbs/hr

U.S. EPA
PARTICULATE CALCULATIONS
RUN NO. 1

PLANT : TDPS
DATE : 4-28-88
SAMP. LOCATION : STACK
OPERATING COND.: TOTAL

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SAMPLE TIME | = | 60.0 | min. | NOZZLE DIA. | = | 0.249 | in. |
| BAR. PRESSURE | = | 29.80 | in.Hg | NOZZLE AREA | = | 0.000338 | Sq.Ft. |
| STK. PRESSURE | = | 29.80 | in.Hg | METER ORIFICE | = | 0.667 | in. H2O |
| EFF. STACK AREA | = | 14.08 | Sq.Ft. | METER VOLUME | = | 29.708 | Cu.Ft. |
| Cp | = | 0.84 | | METER TEMP. | = | 523 | DEG. R |
| GAS ANALYSIS | = | 4.7 | % CO2 | STACK TEMP. | = | 716 | DEG. R |
| | | 12.3 | % O2 | SQ.RT. dP | = | 0.543 | in. H2O |
| | | 0.0 | % CO | COND.(Vic) | = | 308.7 | ml |
| | | 83.0 | % N2 | METER Y | = | 1.001 | |
| LAB ANALYSIS | = | 0.0785 | grams | HEAT INPUT | = | *** | MM Btu/hr |
| | | | | F-FACTOR | = | 9780 | dscf/MM Bt |

**********

Vw(std) = 0.04707 x Vic = 14.531 scf

Vm(std) = 17.647 x Vm x Y x (Pb + (dH / 13.6)) / (Tm) = 29.920 scf

Bws = Vw(std) / (Vm(std) + Vw(std)) = 0.327

%EA =(%O2 - 0.5%CO) / (0.264%N2 x (%O2 - 0.5%CO)) = 0.046

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.24

Ms = (Md x (1-Bws)) + (18.0 x Bws) = 25.57

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts) / (Ms x Ps)] = 37.8 ft/sec

Qs = vs x As x 60 = 31944 acf/min

Qs(std)=Qs x (1-Bws)x(528/(Ts)) x (Ps/29.92)= 15795 dscf/min

I = (Ts) x [(0.00267 x Vic) + (Vm(std) / 17.647)] x 100 / (Time x Ps x An x vs x 60) = 131.5 %

**********

cs = 15.432 x grams / Vm(std) = 0.0405 grains/dsc

grains/acf = cs x 17.647xPs x (1-Bws) / (Ts) = 0.0200 grains/acf

C = cs / 7000 = 5.78E-06 lbs/dscf

EM = C x Qs(std) x 60 = 5.482 lbs/hr

U.S. EPA
PARTICULATE CALCULATIONS
RUN NO. 3

PLANT : TDPS
DATE : 5-2-88
SAMP. LOCATION : STACK
OPERATING COND.: BACK HALF-CHLOROFORM/ETHER EXTRACTION DRY DOWN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SAMPLE TIME | = 55.0 | min. | NOZZLE DIA. | = | 0.249 | in. |
| BAR. PRESSURE | = 29.80 | in.Hg | NOZZLE AREA | = | 0.000338 | Sq.Ft. |
| STK. PRESSURE | = 29.80 | in.Hg | METER ORIFICE | = | 1.258 | in. H2O |
| EFF. STACK AREA | = 14.08 | Sq.Ft. | METER VOLUME | = | 35.638 | Cu.Ft. |
| Cp | = 0.84 | | METER TEMP. | = | 520 | DEG. R |
| GAS ANALYSIS | = 3.4 | % CO2 | STACK TEMP. | = | 718 | DEG. R |
| | 13.6 | % O2 | SQ.RT. dP | = | 0.834 | in. H2O |
| | 0.0 | % CO | COND.(Vic) | = | 244.4 | ml |
| | 83.0 | % N2 | METER Y | = | 1.001 | |
| LAB ANALYSIS | = 0.0311 | grams | HEAT INPUT | = | *** | MM Btu/hr |
| | | | F-FACTOR | = | 9780 | dscf/MM Bt |

**********

Vw(std) = 0.04707 x Vic = 11.504 scf

Vm(std) = 17.647 x Vm x Y x (Pb + (dH / 13.6)) / (Tm) = 36.163 scf

Bws = Vw(std) / (Vm(std) + Vw(std)) = 0.241

%EA =(%O2 - 0.5%CO) / (0.264%N2 x (%O2 - 0.5%CO)) = 0.046

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.09

Ms = (Md x (1-Bws)) + (18.0 x Bws) = 26.41

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts) / (Ms x Ps)] = 57.2 ft/sec

Qs = vs x As x 60 = 48345 acf/min

Qs(std)=Qs x (1-Bws)x(528/(Ts)) x (Ps/29.92)= 26855 dscf/min

I = (Ts) x [(0.00267 x Vic) + (Vm(std) / 17.647)] x 100 / (Time x Ps x An x vs x 60) = 102.0 %

**********

cs = 15.432 x grams / Vm(std) = 0.0133 grains/dsc

grains/acf = cs x 17.647xPs x (1-Bws) / (Ts) = 0.0074 grains/acf

C = cs / 7000 = 1.90E-06 lbs/dscf

EM = C x Qs(std) x 60 = 3.055 lbs/hr

U.S. EPA
PARTICULATE CALCULATIONS
RUN NO. 3

PLANT : TDPS
DATE : 5-2-88
SAMP. LOCATION : STACK
OPERATING COND.: FRONT HALF-FILTER AND RINSE, DRY DOWN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SAMPLE TIME | = | 55.0 | min. | NOZZLE DIA. | = | 0.249 | in. |
| BAR. PRESSURE | = | 29.80 | in.Hg | NOZZLE AREA | = | 0.000338 | Sq.Ft. |
| STK. PRESSURE | = | 29.80 | in.Hg | METER ORIFICE | = | 1.258 | in. H2O |
| EFF. STACK AREA | = | 14.08 | Sq.Ft. | METER VOLUME | = | 35.638 | Cu.Ft. |
| Cp | = | 0.84 | | METER TEMP. | = | 520 | DEG. R |
| GAS ANALYSIS | = | 3.4 | % CO2 | STACK TEMP. | = | 718 | DEG. R |
| | | 13.6 | % O2 | SQ.RT. dP | = | 0.834 | in. H2O |
| | | 0.0 | % CO | COND. (Vic) | = | 244.4 | ml |
| | | 83.0 | % N2 | METER Y | = | 1.001 | |
| LAB ANALYSIS | = | 0.0253 | grams | HEAT INPUT | = | *** | MM Btu/hr |
| | | | | F-FACTOR | = | 9780 | dscf/MM Bt |

**********

Vw(std) = 0.04707 x Vic = 11.504 scf

Vm(std) = 17.647 x Vm x Y x (Pb + (dH / 13.6)) / (Tm) = 36.163 scf

Bws = Vw(std) / (Vm(std) + Vw(std)) = 0.241

%EA =(%O2 - 0.5%CO) / (0.264%N2 x (%O2 - 0.5%CO)) = 0.046

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.09

Ms = (Md x (1-Bws)) + (18.0 x Bws) = 26.41

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts) / (Ms x Ps)] = 57.2 ft/sec

Qs = vs x As x 60 = 48345 acf/min

Qs(std)=Qs x (1-Bws)x(528/(Ts)) x (Ps/29.92)= 26855 dscf/min

I = (Ts) x [(0.00267 x Vic) + (Vm(std) / 17.647)] x 100 / (Time x Ps x An x vs x 60) = 102.0 %

**********

cs = 15.432 x grams / Vm(std) = 0.0108 grains/dsc

grains/acf = cs x 17.647xPs x (1-Bws) / (Ts) = 0.0060 grains/acf

C = cs / 7000 = 1.54E-06 lbs/dscf

EM = C x Qs(std) x 60 = 2.485 lbs/hr

U.S. EPA
PARTICULATE CALCULATIONS
RUN NO. 3

PLANT : TDPS
DATE : 5-2-88
SAMP. LOCATION : STACK
OPERATING COND.: TOTAL

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SAMPLE TIME | = 55.0 | min. | NOZZLE DIA. | = | 0.249 | in. |
| BAR. PRESSURE | = 29.80 | in.Hg | NOZZLE AREA | = | 0.000338 | Sq.Ft. |
| STK. PRESSURE | = 29.80 | in.Hg | METER ORIFICE | = | 1.258 | in. H2O |
| EFF. STACK AREA | = 14.08 | Sq.Ft. | METER VOLUME | = | 35.638 | Cu.Ft. |
| Cp | = 0.84 | | METER TEMP. | = | 520 | DEG. R |
| GAS ANALYSIS | = 3.4 | % CO2 | STACK TEMP. | = | 718 | DEG. R |
| | 13.6 | % O2 | SQ.RT. dP | = | 0.834 | in. H2O |
| | 0.0 | % CO | COND.(Vic) | = | 244.4 | ml |
| | 83.0 | % N2 | METER Y | = | 1.001 | |
| LAB ANALYSIS | = 0.0564 | grams | HEAT INPUT | = | *** | MM Btu/hr |
| | | | F-FACTOR | = | 9780 | dscf/MM Bt |

**********

Vw(std) = 0.04707 x Vic = 11.504 scf

Vm(std) = 17.647 x Vm x Y x (Pb + (dH / 13.6)) / (Tm) = 36.163 scf

Bws = Vw(std) / (Vm(std) + Vw(std)) = 0.241

%EA =(%O2 - 0.5%CO) / (0.264%N2 x (%O2 - 0.5%CO)) = 0.046

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.09

Ms = (Md x (1-Bws)) + (18.0 x Bws) = 26.41

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts) / (Ms x Ps)] = 57.2 ft/sec

Qs = vs x As x 60 = 48345 acf/min

Qs(std)=Qs x (1-Bws)x(528/(Ts)) x (Ps/29.92)= 26855 dscf/min

I = (Ts) x [(0.00267 x Vic) + (Vm(std) / 17.647)] x 100 / (Time x Ps x An x vs x 60) = 102.0 %

**********

cs = 15.432 x grams / Vm(std) = 0.0241 grains/dsc

grains/acf = cs x 17.647xPs x (1-Bws) / (Ts) = 0.0134 grains/acf

C = cs / 7000 = 3.44E-06 lbs/dscf

EM = C x Qs(std) x 60 = 5.540 lbs/hr

U.S. EPA
PARTICULATE CALCULATIONS
RUN NO. 4

PLANT : TDPS
DATE : 5-2-88
SAMP. LOCATION : STACK
OPERATING COND.: BACK HALF-CHLOROFORM/ETHER EXTRACTION DRY DOWN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SAMPLE TIME | = | 60.0 | min. | NOZZLE DIA. | = | 0.249 | in. |
| BAR. PRESSURE | = | 29.80 | in.Hg | NOZZLE AREA | = | 0.000338 | Sq.Ft. |
| STK. PRESSURE | = | 29.80 | in.Hg | METER ORIFICE | = | 0.983 | in. H2O |
| EFF. STACK AREA | = | 14.08 | Sq.Ft. | METER VOLUME | = | 34.642 | Cu.Ft. |
| Cp | = | 0.84 | | METER TEMP. | = | 529 | DEG. R |
| GAS ANALYSIS | = | 4.8 | % CO2 | STACK TEMP. | = | 697 | DEG. R |
| | | 12.8 | % O2 | SQ.RT. dP | = | 0.755 | in. H2O |
| | | 0.0 | % CO | COND.(Vic) | = | 279.5 | ml |
| | | 82.4 | % N2 | METER Y | = | 1.001 | |
| LAB ANALYSIS | = | 0.0967 | grams | HEAT INPUT | = | *** | MM Btu/hr |
| | | | | F-FACTOR | = | 9780 | dscf/MM Bt |

**********

Vw(std) = 0.04707 x Vic = 13.156 scf

Vm(std) = 17.647 x Vm x Y x (Pb + (dH / 13.6)) / (Tm) = 34.569 scf

Bws = Vw(std) / (Vm(std) + Vw(std)) = 0.276

%EA =(%O2 - 0.5%CO) / (0.264%N2 x (%O2 - 0.5%CO)) = 0.046

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.28

Ms = (Md x (1-Bws)) + (18.0 x Bws) = 26.17

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts) / (Ms x Ps)] = 51.3 ft/sec

Qs = vs x As x 60 = 43325 acf/min

Qs(std)=Qs x (1-Bws)x(528/(Ts)) x (Ps/29.92)= 23670 dscf/min

I = (Ts) x [(0.00267 x Vic) + (Vm(std) / 17.647)] x 100 / (Time x Ps x An x vs x 60) = 101.4 %

**********

cs = 15.432 x grams / Vm(std) = 0.0432 grains/dsc

grains/acf = cs x 17.647xPs x (1-Bws) / (Ts) = 0.0236 grains/acf

C = cs / 7000 = 6.17E-06 lbs/dscf

EM = C x Qs(std) x 60 = 8.758 lbs/hr

U.S. EPA
PARTICULATE CALCULATIONS
RUN NO. 4

PLANT : TDPS
DATE : 5-2-88
SAMP. LOCATION : STACK
OPERATING COND.: FRONT HALF-FILTER AND RINSE, DRY DOWN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SAMPLE TIME | = | 60.0 | min. | NOZZLE DIA. | = | 0.249 | in. |
| BAR. PRESSURE | = | 29.80 | in.Hg | NOZZLE AREA | = | 0.000338 | Sq.Ft. |
| STK. PRESSURE | = | 29.80 | in.Hg | METER ORIFICE | = | 0.983 | in. H2O |
| EFF. STACK AREA | = | 14.08 | Sq.Ft. | METER VOLUME | = | 34.642 | Cu.Ft. |
| Cp | = | 0.84 | | METER TEMP. | = | 529 | DEG. R |
| GAS ANALYSIS | = | 4.8 | % CO2 | STACK TEMP. | = | 697 | DEG. R |
| | | 12.8 | % O2 | SQ.RT. dP | = | 0.755 | in. H2O |
| | | 0.0 | % CO | COND.(Vic) | = | 279.5 | ml |
| | | 82.4 | % N2 | METER Y | = | 1.001 | |
| LAB ANALYSIS | = | 0.0258 | grams | HEAT INPUT | = | *** | MM Btu/hr |
| | | | | F-FACTOR | = | 9780 | dscf/MM Bt |

**********

Vw(std) = 0.04707 x Vic = 13.156 scf

Vm(std) = 17.647 x Vm x Y x (Pb + (dH / 13.6)) / (Tm) = 34.569 scf

Bws = Vw(std) / (Vm(std) + Vw(std)) = 0.276

%EA =(%O2 - 0.5%CO) / (0.264%N2 x (%O2 - 0.5%CO)) = 0.046

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.28

Ms = (Md x (1-Bws)) + (18.0 x Bws) = 26.17

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts) / (Ms x Ps)] = 51.3 ft/sec

Qs = vs x As x 60 = 43325 acf/min

Qs(std)=Qs x (1-Bws)x(528/(Ts)) x (Ps/29.92)= 23670 dscf/min

I = (Ts) x [(0.00267 x Vic) + (Vm(std) / 17.647)] x 100 / (Time x Ps x An x vs x 60) = 101.4 %

**********

cs = 15.432 x grams / Vm(std) = 0.0115 grains/dsc

grains/acf = cs x 17.647xPs x (1-Bws) / (Ts) = 0.0063 grains/acf

C = cs / 7000 = 1.65E-06 lbs/dscf

EM = C x Qs(std) x 60 = 2.337 lbs/hr

U.S. EPA
PARTICULATE CALCULATIONS
RUN NO. 4

PLANT : TDPS
DATE : 5-2-88
SAMP. LOCATION : STACK
OPERATING COND.: TOTAL

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SAMPLE TIME | = | 60.0 | min. | NOZZLE DIA. | = | 0.249 | in. |
| BAR. PRESSURE | = | 29.80 | in.Hg | NOZZLE AREA | = | 0.000338 | Sq.Ft. |
| STK. PRESSURE | = | 29.80 | in.Hg | METER ORIFICE | = | 0.983 | in. H2O |
| EFF. STACK AREA | = | 14.08 | Sq.Ft. | METER VOLUME | = | 34.642 | Cu.Ft. |
| Cp | = | 0.84 | | METER TEMP. | = | 529 | DEG. R |
| GAS ANALYSIS | = | 4.8 | % CO2 | STACK TEMP. | = | 697 | DEG. R |
| | | 12.8 | % O2 | SQ.RT. dP | = | 0.755 | in. H2O |
| | | 0.0 | % CO | COND.(Vic) | = | 279.5 | ml |
| | | 82.4 | % N2 | METER Y | = | 1.001 | |
| LAB ANALYSIS | = | 0.1228 | grams | HEAT INPUT | = | *** | MM Btu/hr |
| | | | | F-FACTOR | = | 9780 | dscf/MM Bt |

**********

Vw(std) = 0.04707 x Vic = 13.156 scf

Vm(std) = 17.647 x Vm x Y x (Pb + (dH / 13.6)) / (Tm) = 34.569 scf

Bws = Vw(std) / (Vm(std) + Vw(std)) = 0.276

%EA =(%O2 - 0.5%CO) / (0.264%N2 x (%O2 - 0.5%CO)) = 0.046

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.28

Ms = (Md x (1-Bws)) + (18.0 x Bws) = 26.17

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts) / (Ms x Ps)] = 51.3 ft/sec

Qs = vs x As x 60 = 43325 acf/min

Qs(std)=Qs x (1-Bws)x(528/(Ts)) x (Ps/29.92)= 23670 dscf/min

I = (Ts) x [(0.00267 x Vic) + (Vm(std) / 17.647)] x 100 / (Time x Ps x An x vs x 60) = 101.4 %

**********

cs = 15.432 x grams / Vm(std) = 0.0548 grains/dsc

grains/acf = cs x 17.647xPs x (1-Bws) / (Ts) = 0.0299 grains/acf

C = cs / 7000 = 7.83E-06 lbs/dscf

EM = C x Qs(std) x 60 = 11.122 lbs/hr

FIELD DATA FORM

RUN # 1

| 1. {NumLock} to enter data. Turn off to move cursor.
| 2. {Ctrl}{Break} after data entry.
| 3. {Alt}M for next run.

## I. INPUT DATA

NET METER VOLUME (CU.FT.): 29.708
CONDENSATE VOLUME (ml): 308.7
LAB ANALYSIS (g): 0.0785

## II. FIELD DATA

| POINT NO. | delta P | delta H | STACK TEMP. (F) | Tm Inlet (F) | Tm Outlet (F) | SQ.RT. dP |
|---|---|---|---|---|---|---|
| 1 | 0.30 | 0.68 | 250 | 58 | 57 | 0.548 |
| 2 | 0.29 | 0.65 | 258 | 60 | 59 | 0.539 |
| 3 | 0.30 | 0.68 | 256 | 63 | 60 | 0.548 |
| 4 | 0.28 | 0.63 | 257 | 66 | 63 | 0.529 |
| 5 | 0.30 | 0.68 | 256 | 69 | 65 | 0.548 |
| 6 | 0.30 | 0.68 | 259 | 72 | 68 | 0.548 |
| 7 | | | | | | 0.000 |
| 8 | | | | | | 0.000 |
| 9 | | | | | | 0.000 |
| 10 | | | | | | 0.000 |
| 11 | | | | | | 0.000 |
| 12 | | | | | | 0.000 |
| 13 | | | | | | 0.000 |
| 14 | | | | | | 0.000 |
| 15 | | | | | | 0.000 |
| 16 | | | | | | 0.000 |
| 17 | | | | | | 0.000 |
| 18 | | | | | | 0.000 |
| 19 | | | | | | 0.000 |
| 20 | | | | | | 0.000 |
| 21 | | | | | | 0.000 |
| 22 | | | | | | 0.000 |
| 23 | | | | | | 0.000 |
| 24 | | | | | | 0.000 |
| 25 | | | | | | 0.000 |
| 26 | | | | | | 0.000 |
| 27 | | | | | | 0.000 |
| 28 | | | | | | 0.000 |
| 29 | | | | | | 0.000 |
| 30 | | | | | | 0.000 |
| 31 | | | | | | 0.000 |
| 32 | | | | | | 0.000 |
| 33 | | | | | | 0.000 |
| 34 | | | | | | 0.000 |
| 35 | | | | | | 0.000 |
| 36 | | | | | | 0.000 |
| 37 | | | | | | 0.000 |
| 38 | | | | | | 0.000 |
| 39 | | | | | | 0.000 |
| 40 | | | | | | 0.000 |
| 41 | | | | | | 0.000 |
| 42 | | | | | | 0.000 |

| | | | | |
|---|---|---|---|---|
| 43 | | | | 0.000 |
| 44 | | | | 0.000 |
| 45 | | | | 0.000 |
| 46 | | | | 0.000 |
| 47 | | | | 0.000 |
| 48 | | | | 0.000 |
| 49 | | | | 0.000 |
| 50 | | | | 0.000 |
| 51 | | | | 0.000 |
| 52 | | | | 0.000 |
| 53 | | | | 0.000 |
| 54 | | | | 0.000 |
| 55 | | | | 0.000 |
| 56 | | | | 0.000 |
| 57 | | | | 0.000 |
| 58 | | | | 0.000 |
| 59 | | | | 0.000 |
| 60 | | | | 0.000 |
| | d H | Ts (F) | Tm (F) | sq.rt. dP |
| | 0.667 | 256.0 | 63.3 | 0.543 |

FIELD DATA FORM

RUN # 3

| 1.{NumLock} to enter data. Turn off to move cursor.
| 2.{Ctrl}{Break} after data entry.
| 3.{Alt}M for next run.

## I. INPUT DATA

NET METER VOLUME (CU.FT.): 35.638
CONDENSATE VOLUME (ml): 244.4
LAB ANALYSIS (g): 0.0564

## II. FIELD DATA

| POINT NO. | delta P | delta H | STACK TEMP. (F) | Tm Inlet (F) | Tm Outlet (F) | SQ.RT. dP |
|---|---|---|---|---|---|---|
| 1 | 0.72 | 1.30 | 259 | 56 | 56 | 0.849 |
| 2 | 0.71 | 1.28 | 269 | 59 | 56 | 0.843 |
| 3 | 0.78 | 1.40 | 254 | 61 | 58 | 0.883 |
| 4 | 0.52 | 0.94 | 250 | 64 | 59 | 0.721 |
| 5 | 0.72 | 1.30 | 256 | 64 | 60 | 0.849 |
| 6 | 0.74 | 1.33 | 262 | 66 | 63 | 0.860 |
| 7 | | | | | | 0.000 |
| 8 | | | | | | 0.000 |
| 9 | | | | | | 0.000 |
| 10 | | | | | | 0.000 |
| 11 | | | | | | 0.000 |
| 12 | | | | | | 0.000 |
| 13 | | | | | | 0.000 |
| 14 | | | | | | 0.000 |
| 15 | | | | | | 0.000 |
| 16 | | | | | | 0.000 |
| 17 | | | | | | 0.000 |
| 18 | | | | | | 0.000 |
| 19 | | | | | | 0.000 |
| 20 | | | | | | 0.000 |
| 21 | | | | | | 0.000 |
| 22 | | | | | | 0.000 |
| 23 | | | | | | 0.000 |
| 24 | | | | | | 0.000 |
| 25 | | | | | | 0.000 |
| 26 | | | | | | 0.000 |
| 27 | | | | | | 0.000 |
| 28 | | | | | | 0.000 |
| 29 | | | | | | 0.000 |
| 30 | | | | | | 0.000 |
| 31 | | | | | | 0.000 |
| 32 | | | | | | 0.000 |
| 33 | | | | | | 0.000 |
| 34 | | | | | | 0.000 |
| 35 | | | | | | 0.000 |
| 36 | | | | | | 0.000 |
| 37 | | | | | | 0.000 |
| 38 | | | | | | 0.000 |
| 39 | | | | | | 0.000 |
| 40 | | | | | | 0.000 |
| 41 | | | | | | 0.000 |
| 42 | | | | | | 0.000 |

| | | | | |
|---|---|---|---|---|
| 43 | | | | 0.000 |
| 44 | | | | 0.000 |
| 45 | | | | 0.000 |
| 46 | | | | 0.000 |
| 47 | | | | 0.000 |
| 48 | | | | 0.000 |
| 49 | | | | 0.000 |
| 50 | | | | 0.000 |
| 51 | | | | 0.000 |
| 52 | | | | 0.000 |
| 53 | | | | 0.000 |
| 54 | | | | 0.000 |
| 55 | | | | 0.000 |
| 56 | | | | 0.000 |
| 57 | | | | 0.000 |
| 58 | | | | 0.000 |
| 59 | | | | 0.000 |
| 60 | | | | 0.000 |
| | d H | Ts (F) | Tm (F) | sq.rt. dP |
| | 1.258 | 258.3 | 60.2 | 0.834 |

FIELD DATA FORM

RUN # 4

1. {NumLock} to enter data. Turn off to move cursor.
2. {Ctrl}{Break} after data entry.
3. {Alt}M.

## I. INPUT DATA

NET METER VOLUME (CU.FT.): 34.642
CONDENSATE VOLUME (ml): 279.5
LAB ANALYSIS (g): 0.1228

## II. FIELD DATA

| POINT NO. | delta P | delta H | STACK TEMP. (F) | Tm Inlet (F) | Tm Outlet (F) | SQ.RT. dP |
|---|---|---|---|---|---|---|
| 1 | 0.42 | 0.72 | 211 | 65 | 65 | 0.648 |
| 2 | 0.46 | 0.79 | 237 | 66 | 65 | 0.678 |
| 3 | 0.57 | 0.97 | 241 | 68 | 66 | 0.755 |
| 4 | 0.66 | 1.13 | 245 | 71 | 68 | 0.812 |
| 5 | 0.66 | 1.13 | 245 | 73 | 70 | 0.812 |
| 6 | 0.68 | 1.16 | 245 | 75 | 71 | 0.825 |
| 7 | | | | | | 0.000 |
| 8 | | | | | | 0.000 |
| 9 | | | | | | 0.000 |
| 10 | | | | | | 0.000 |
| 11 | | | | | | 0.000 |
| 12 | | | | | | 0.000 |
| 13 | | | | | | 0.000 |
| 14 | | | | | | 0.000 |
| 15 | | | | | | 0.000 |
| 16 | | | | | | 0.000 |
| 17 | | | | | | 0.000 |
| 18 | | | | | | 0.000 |
| 19 | | | | | | 0.000 |
| 20 | | | | | | 0.000 |
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| 22 | | | | | | 0.000 |
| 23 | | | | | | 0.000 |
| 24 | | | | | | 0.000 |
| 25 | | | | | | 0.000 |
| 26 | | | | | | 0.000 |
| 27 | | | | | | 0.000 |
| 28 | | | | | | 0.000 |
| 29 | | | | | | 0.000 |
| 30 | | | | | | 0.000 |
| 31 | | | | | | 0.000 |
| 32 | | | | | | 0.000 |
| 33 | | | | | | 0.000 |
| 34 | | | | | | 0.000 |
| 35 | | | | | | 0.000 |
| 36 | | | | | | 0.000 |
| 37 | | | | | | 0.000 |
| 38 | | | | | | 0.000 |
| 39 | | | | | | 0.000 |
| 40 | | | | | | 0.000 |
| 41 | | | | | | 0.000 |
| 42 | | | | | | 0.000 |

| | | | | |
|---|---|---|---|---|
| | | | | 0.000 |
| 43 | | | | 0.000 |
| 44 | | | | 0.000 |
| 45 | | | | 0.000 |
| 46 | | | | 0.000 |
| 47 | | | | 0.000 |
| 48 | | | | 0.000 |
| 49 | | | | 0.000 |
| 50 | | | | 0.000 |
| 51 | | | | 0.000 |
| 52 | | | | 0.000 |
| 53 | | | | 0.000 |
| 54 | | | | 0.000 |
| 55 | | | | 0.000 |
| 56 | | | | 0.000 |
| 57 | | | | 0.000 |
| 58 | | | | 0.000 |
| 59 | | | | 0.000 |
| 60 | | | | |
| | d H | Ts (F) | Tm (F) | sq.rt. dP |
| | 0.983 | 237.3 | 68.6 | 0.755 |

METHOD FOR IMPINGER SAMPLE GRAVIMETRIC ANALYSIS

**Purpose:** Provide a method for extraction of hydrocarbon from a water sample.

**Apparatus:** Separatory funnel (11) with glass stopper
Tape weighed beakers (250 mls)
Filter funnel
Filter paper (whatman 541)

**Reagants:** Chloroform (analytical grade)
Diethyl ether (analytical grade)

**Method:** Decant sample into separatory funnel and wash container with 25 mls of chloroform, which are then added to the funnel. The funnel is shaken for one minute and the layers allowed to separate. The bottom layer (chloroform) is decanted through a 541 filter paper into the weighed beaker. The operation is repeated with 2 more 25 ml portions of chloroform. Finally, the filter paper is washed with 10 mls of the solvent.

The sample container is washed with 25 mls of ether which is added to the sep. funnel. Another 25 mls of ether are added directly to the sep. funnel and then is shaken for 1 minute. The layers are allowed to settle after which 50 mls of ether are added again to the sep. funnel and shaken for 1 minute. When the layers have separated, the bottom layer is discarded, and the top layer is passed through the filter into the beaker. The filter is washed with 10 mls of either and the beaker is allowed to dry at room temperature. Following desication for 24 hours, the beaker is weighted to constant weight, i.e., ±0.0005g, between consecutive readings not less than 6 hours apart. Subtraction of the tape weight from the final weight yield solvent extractable hydrocarbons.

# APPENDIX C

# BAG ANALYSIS RESULTS

ETS, INC.

A subsidiary of ETS International, Inc.

May 5, 1988

Mr. Vincent Angelo
TDPS Materials
800 West Olney Ave.
Philadelphia, PA 19120

SUBJECT: Laboratory Bag Analysis Report for TDPS Materials
ETS Contract No: 88-831-L

Dear Mr. Angelo:

Enclosed are two copies of the subject report.

Please feel free to contact yours truly or, in my absence, James Wright if you have any questions.

Sincerely,

ETS, INC.

John D. McKenna
President

JDM:dlg

enclosure

cc: Joseph Van Gieson
Engineering Science, Inc.
10521 Rosehaum St.
Fairfax, VA 22030-2899

RECEIVED
MAY 11 1988
ENGINEERING SCIENCE

ETS, INC. — SUITE C-103, 3140 CHAPARRAL DR. SW — ROANOKE, VA 24018-4394 TELEPHONE 703/774-8993

"Pollution Engineering National 5-STAR Environmental Award Winner."

# LABORATORY BAG ANALYSIS

# FOR

# TDPS MATERIALS

MAY, 1988


**ETS, INC.**

*A subsidiary of ETS International, Inc.*

3140 CHAPARRAL DR., SW

SUITE C-103

ROANOKE, VA 24018


*Pollution Control Consultants*
*Specializing In*
*Toxic Emission Measurement and Control*


ETS CONTRACT NO: 88-831-L

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CLIENT: TDPS Materials

SITE: Philadelphia, PA

CLIENT P.O. NO: N/A

APPLICATION: Mixer Collector

CLIENT CONTACT: Vincent Angelo

BAG TYPE: 14 oz. Nomex Felt

ETS CONTRACT NO: 88-831-L

BAGHOUSE TYPE: Pulse Jet

DATE: May 5, 1988

DUST: N/A

---

## INTRODUCTION

**BACKGROUND:** ETS, Inc. received one used Nomex felt bag from TDPS Materials on April 19, 1988.

**OBJECTIVE:** The objective of testing was to characterize the overall condition of the bag.

**TESTS PERFORMED:** The following tests were performed:

- Permeability
- Tensile Strength
- Mullen Burst
- Microscopics

## SUMMARY OF RESULTS

### PERMEABILITY

The as received permeability of the bag averaged 3.8 cfm/ft$^2$ (FPM). After vacuuming the fabric at 10" and 30" W.C., the average permeability increased to 7.5 FPM and 16.2 FPM, respectively. In all cases, the permeability of the middle section of the bag was considerably lower (up to 50% lower) than that of the remainder of bag (see Table I).

## STRENGTH

The average bursting strength of the fabric was 408 psi. The tensile strength averaged 53 lbs/inch in the warp direction and 133 lbs/inch in the fill direction.

## MICROSCOPICS

The collection side fabric was covered with a relatively light residual dust cake, with at least 30% of the fabric surface still visible. The dust cake consisted of agglomerations of fine black and clear particulate, with particle sizes ranging from 5 to 50 microns in diameter.

The non-collection side fabric had a moderate amount of fine, clear particles of 5-15 microns size clinging to individual fibers.

The cross-section of the fabric appeared to be clean, with no apparent signs of dust penetration from the collection side to the non-collection side.

## CONCLUSIONS

Based on typical 14-oz. Nomex values, the strength properties of the bag appear to be at satisfactory levels. Comparison of the results to actual new fabric specifications should be made to determine actual strength retentions.

The overall permeability recovery also appears satisfactory. Once again, direct comparison to the actual new bag permeability should be made.

The wide variation in permeability between the middle third of the bag and the remainder of the bag may suggest uneven cleaning, a stratified dust loading, or previous upset conditions.

Microscopic observations of fine particulate on the inside fabric of the bag suggests a possible dust leakage problem. Since no significant dust was observed in the fabric cross-section, it is not likely that the dust on the clean side of the bag came directly through the fabric from the collection side. Possible sources of this dust would include failed bags in the baghouse, pinholes in the bags, or tubesheet leakage. It is recommended that a leakage test with a fluorescent powder be conducted to determine the actual source.

WRITTEN BY: James Wright
James Wright

APPROVED BY: John D. McKenna
John D. McKenna

TABLE I

SUMMARY OF FABRIC FILTER TEST DATA

P.O. No.: N/A

Bag Material: 14 Oz. Nomex

Contract No.: 88-831-L

Bag Condition: Used

ETS Specimen No.: 3494DB

Fabric wt., oz/yd²: 19.5 After 30"vac.

Customer No.: None

Type of Weave: Felt

Customer: TDPS

Date: 4/26/88

| | TOP | MIDDLE | BOTTOM | AVG. | NEW* BAG VALUE | % RET. STRGTH |
|---|---|---|---|---|---|---|
| PERMEABILITY, FPM | | | | | | |
| 1. As Received | 4.8 | 1.8 | 4.9 | 3.8 | | |
| 2. After 10 in. Vac. | 9.6 | 4.0 | 8.8 | 7.5 | | |
| 3. After 30 in. Vac. | 20.1 | 10.2 | 18.2 | 16.2 | 25-35 | |
| | | | | | | |
| Mullen Burst, PSI | 394 | 411 | 420 | 408 | 400-450 | |
| | | | | | | |
| 1. Tensile Warp lb/in | 49 | 56 | 54 | 53 | 50-75 | |
| 2. Tensile Fill lb/in | 141 | 132 | 126 | 133 | 120-150 | |
| 3. MIT Flexes, Warp | | | | | | |
| 4. MIT Flexes, Fill | | | | | | |

*Typical values for 14-oz. Nomex felt. Actual values may vary.

# APPENDIX D

# PENDER REGULATIONS

(1) *Table* (Continued)

| Process | Process Factor, F (in Pounds Per Ton) |
|---|---|
| Primary lead production: | |
| Roasting | 0.004 (ore feed) |
| Sintering — windbox | 0.2 (sinter) |
| Lead reduction | 0.5 (product) |
| Primary zinc production: | |
| Roasting | 3 (ore feed) |
| Sintering — windbox | 2 (product) |
| Zinc reduction | 10 (product) |
| Secondary aluminum production: | |
| Sweating | 50 (aluminum product) |
| Melting and refining | 10 (aluminum feed) |
| Brass and bronze production (melting and refining) | 20 (product) |
| Iron foundry: | |
| Melting: | |
| Five tons per hour and less | 150 (iron) |
| More than five tons per hour | 50 (iron) |
| Sand handling | 20 (sand) |
| Shake-out | 20 (sand) |
| Secondary lead smelting | 0.5 (product) |
| Secondary magnesium smelting | 0.2 (product) |
| Secondary zinc smelting: | |
| Sweating | 0.01 (product) |
| Refining | 0.3 (product) |
| Asphaltic concrete production | 6 (aggregate feed) |
| Asphalt roofing manufacturing: (felt saturation) | 0.6 (asphalt used) |
| Portland cement manufacturing: | |
| Clinker production | 150 (dry solids feed) |
| Clinker cooling | 50 (product) |
| Coal dry-cleaning | 2 (product) |
| Lime calcining | 200 (product) |
| Petroleum refining (catalytic cracking) | 40 (liquid feed) |
| Pressed, blown, and spun glass; glass production melting furnaces | 50 (Fill) 50 (Fill) |

(2) *Formula*

$A = 0.76E^{0.42}$ where:

A = Allowable emissions in lbs./hr

E = Emission index = F x W lbs./hr.

F = Process factor in lbs./unit, and

W = Production or charging rate in units/hr.

The factor F shall be obtained from the table in paragraph (1) of this subsection. The units for F and W shall be compatible.

(3) *Allowable emissions.* Allowable emissions under this subsection are graphically indicated in Appendix B to this chapter.

(c) For processes not listed in subsection (b)(1) of this section including but not limited to coke oven battery waste heat stacks and autogeneous zinc coker waste heat stacks, the following shall apply:

(1) *Prohibited emissions.* No person shall cause, suffer, or permit the emission into the outdoor atmosphere of particulate matter from any process not listed in subsection (b)(1) of this section in such a manner that the concentration of particulate matter in the effluent gas, at any time, exceeds any of the following:

(i) 0.04 grains per dry standard cubic foot, when the effluent gas volume is less than 150,000 dry standard cubic feet per minute.

(ii) The rate determined by the formula:

$A = 6000E^{-1}$, where:

A = Allowable emissions in grains per dry standard cubic foot, and

E = Effluent gas volume in dry standard cubic feet per minute,

when E is equal to or greater than 150,000 but less than 300,000.

(iii) 0.02 grains per dry standard cubic foot, when the effluent gas volume is greater than 300,000 dry standard cubic feet per minute.

(2) *Allowable emissions.* Allowable emissions under this subsection are graphically indicated in Appendix C to this chapter.

## SULFUR COMPOUND EMISSIONS

**§123.21. General.**

(a) This section shall apply to all sources except those subject to other provisions of this Article, with respect to the control of sulfur compound emissions.

(b) No person shall cause, suffer, or permit the emission into the outdoor atmosphere of sulfur oxides, from any source, in such a manner that the concentration, at any time, of the sulfur oxides, expressed as $SO_2$, in the effluent gas exceeds 500 parts per million, by volume (dry basis).

**§123.22. Combustion units.**

(a) *Non-air basin areas.*

(1) *General provision.* No person shall cause, suffer, or permit the emission into the outdoor atmosphere of sulfur oxides, expressed as $SO_2$, from any combustion unit, at any time, in excess of the rate of four pounds per million B.t.u. of heat input over any one-hour period except as provided for in paragraph (4) of this subsection.

(2) *Commercial fuel oil.* No person shall, at any time, offer for sale, deliver for use, exchange in trade, cause the use of, suffer the use of, or permit the use of commercial fuel oil in non-air basin areas which contains sulfur in

(c) Any person responsible for any source specified in items (1) through (7) or (9) of subsection (a) of this section shall take all reasonable actions to prevent particulate matter from becoming airborne. Such actions shall include, but not be limited to, the following:

(1) Use, where possible, of water or chemicals for control of dust in the demolition of buildings or structures, construction operations, the grading of roads, or the clearing of land.

(2) Application of asphalt, oil, water or suitable chemicals on dirt roads, material stockpiles, and other surfaces which may give rise to airborne dusts.

(3) Paving and maintenance of roadways.

(4) Prompt removal of earth or other material from paved streets onto which earth or other material has been transported by trucking or earth moving equipment, erosion by water, or other means.

(d) The requirements contained in subsection (a) of this section and § 123.2 of this Title (relating to fugitive particulate matter) shall not apply to fugitive emissions arising from the production of agricultural commodities in their unmanufactured state on the premises of the farm operation.

**§123.2. Fugitive particulate matter.**

No person shall cause, suffer, or permit fugitive particulate matter to be emitted into the outdoor atmosphere from any source or sources specified in items §123.1(a)(1)-(9) (relating to prohibition of certain emissions) if such emissions are visible, at any time, at the point such emissions pass outside the person's property.

## PARTICULATE MATTER EMISSIONS

**§123.11. Combustion units.**

(a) No person shall cause, suffer, or permit the emission into the outdoor atmosphere of particulate matter, at any time, from any combustion unit in excess of the following:

(1) The rate of 0.4 lbs. per million B.t.u. of heat input, when the heat input to the combustion unit in millions of B.t.u's per hour is greater than 2.5 but less than 50.

(2) The rate determined by the following formula:

$A = 3.6E^{-0.56}$

where:

A = Allowable emissions in pounds per million B.t.u. of heat input, and

E = Heat input to the combustion unit in millions of B.t.u.'s per hour,

when E is equal to or greater than 50 but less than 600.

(3) The rate of 0.1 pounds per million B.t.u. of heat input when the heat input to the combustion unit in millions of B.t.u.'s per hour is equal to or greater than 600.

(b) Allowable emissions under subsection (a) of this section are graphically indicated in Appendix A to this Chapter.

**§123.12. Incinerators.**

No person shall cause, suffer, or permit the emission to the outdoor atmosphere of particulate matter from any incinerator, at any time, in such a manner that the particulate matter concentration in the effluent gas exceeds 0.1 grain per dry standard cubic foot, corrected to 12% carbon dioxide.

**§123.13. Processes.**

(a) The provisions of subsections (b) and (c) shall apply to all processes except combustion units and incinerators.

(b) No person shall cause, suffer, or permit the emission into the outdoor atmosphere of particulate matter from any process listed in the following table, at any time, either in excess of the rate calculated by the formula set forth in paragraph (2) or in such a manner that the concentration of particulate matter in the effluent gas exceeds 0.02 grains per dry standard cubic foot, whichever is greater:

(1) *Table*

| *Process* | *Process Factor, F (in pounds per ton)* |
|---|---|
| Byproduct coke production: | |
| pushing operation | 1 (coke pushed) |
| Sole heated nonrecovery coke oven | 20 (coal charged/oven) |
| Carbon black manufacturing | 500 (product) |
| Charcoal manufacturing | 400 (product) |
| Paint manufacturing | 0.05 (pigment handled) |
| Phosphoric acid manufacturing | 6.0 ($P_2O_5$ produced) |
| Detergent drying | 30 (product) |
| Alfalfa dehydration | 30 (product) |
| Grain elevators (loading or unloading) | 90 (grain) |
| Grain screening and cleaning | 300 (grain) |
| Grain drying | 200 (product) |
| Meat smoking | 0.01 (meat) |
| Ammonium nitrate manufacturing (granulator) | 0.1 (product) |
| Ferroalloy production furnace | 0.3 (product) |
| Primary iron and/or steel making: | |
| Iron production | 100 (product) |
| Sintering — windbox | 20 (dry solids feed) |
| Steel production | 40 (product) |
| Scarfing | 20 (product) |

equipment. Where ovens must be pushed and charged to generate enough gas for underfiring, use of the ovens in best repair with respect to the emission of air contaminants.

(4) *Sinter plants.* Sinter plants shall cease production.

(5) *Steel making furnaces.* Steel making furnaces shall cease production to the extent possible without causing damage to equipment.

(6) *Mines and quarries.* Mines and quarries shall undergo a maximum reduction of operation without causing damage to equipment.

**§ 137.14. Emergency level actions.**

(a) *General requirements.* General requirements for emergency level actions shall include all of the following:

(1) The continuance of all control actions taken for warning level.

(2) At all places of employment, the immediate cessation of operations to the extent possible without causing injury to persons or damage to equipment except that the following establishments may remain in operation:

(i) Commercial establishments engaged in selling or distributing food or medical and surgical supplies.

(ii) Those governmental and semi-governmental offices determined by the head of the respective governments or of the respective semi-governmental agencies to be vital for public safety or welfare or for the enforcement of the provisions of this Article.

(iii) Those engaged in rendering medical or surgical services.

(3) The cessation of operations of motor vehicles, except in emergencies, when approved by police officials.

(b) *Requirements for specific sources.* In addition to taking the actions listed in subsection (a) of this section, thermal eletric generating facilities shall undergo a maximum reduction of power supplies to users outside the emergency area.

## CHAPTER 139 — SAMPLING AND TESTING

**(Adopted January 27, 1972; Amended July 17, 1975; July 26, 1977; July 25, 1978; April 9, 1979; Effective August 1, 1979; June 12, 1979; June 19, 1981; August 12, 1983)**

### SUBCHAPTER A. SAMPLING AND TESTING METHODS AND PROCEDURES

**§139.1. Sampling facilities.**

Upon the request of the Department, the person responsible for a source shall provide adequate sampling ports, safe sampling platforms and adequate utilities for the performance by the Department of tests on such source. The Department shall set forth, in the request, the time period in which the facilities shall be provided as well as the specifications for the said facilities.

**§139.2. Sampling by others.**

Sampling and testing done by persons other than the Department may be accepted by the Department provided that:

(1) The Department has been given reasonable notice of the sampling and testing and has been given reasonable opportunity to observe and participate in the sampling and testing.

(2) The sampling and testing is conducted under the direct supervision of persons qualified, by training and experience, to conduct such sampling and testing.

(3) Procedures for the sampling and testing are in accord with the provisions of this Chapter.

(4) The reports of the sampling and testing are accurate and comprehensive.

**§139.3. General requirements.**

(a) The Department shall use the methods set forth in this Chapter to assess emissions from stationary sources or ambient levels of air contaminants.

(b) The Department has published a supplement to this chapter entitled "Source Testing Manual." This supplement contains detailed information on source test methods, procedures, and guidance for the reporting of emissions to the Department. This supplement is available from the Department by request.

(c) The performance standards for stationary sources set forth in this Chapter permit freedom in the selection of equipment and consistency in obtaining accurate results which are representative of the conditions under which a source is evaluated.

(d) The sampling and analytical procedures employed to measure ambient levels of air contaminants shall be consistent with obtaining accurate results which are representative of the conditions being evaluated.

**§139.4 References.**

The references referred to in this Chapter are as follows:

(1) "Standards of Performance for New Stationary Sources," Federal Register, Part II, Volume 36, No. 247, pp. 24876-24895, December 23, 1971, Washington, D.C.

(2) Devorkin, H., et al., "Air Pollution Source Testing Manual," Los Angeles Air Pollution Control District, Second Printing, November 1965.

(3) "Standard Method for Sampling Stacks for Particulate Matter," American Society for Testing

Materials, D 2928-71, 1916 Race Street, Philadelphia, Pennsylvania.

(4) "Method 11 — Determination of Hydrogen Sulfide Content of Fuel Gas Streams in Petroleum Refineries," 40 C.F.R. §1, Part 60, Appendix A (1982) Superintendent of Documents, Washington, D.C.

(5) "Recommended Standard Method for Continuing Dust Fall Survey (APM-1, Revision 1)," TR-2 Air Pollution Measurements Committee, *J. Air Poll. Control Assoc., 16:372 (1966).*

(6) "Air Pollution Measurements of the National Air Sampling Network: Analyses of Suspended Particulates 1957-1961," Public Health Service Pub. No. 978, Washington, D.C. 1962.

(7) Interbranch Chemical Advisory Committee, "Selected Methods for the Measurement of Air Pollutants," PHS Pub. No. 999-AP-11, Cincinnati Ohio, 1965, p. I-1.

(8) "Standard Method of Test for Inorganic Fluoride in the Atmosphere," ASTM Standards on Methods of Atmospheric Sampling and Analyses, Philadelphia, Pennsylvania, 1962, p. 67.

(9) Hilovsky, Robert J., *et al.*, Determination of Sulfur Oxide (utilizing Isopropyl Alcohol and Sodium Hydroxide), "Air Pollution Source Testing Manual," Method 5.4, South Coast Air Quality Management District, El Monte, CA, Second Printing, August 1978.

(10) "Standard Method of Sampling Petroleum and Petroleum Products," American Society for Testing Materials, D 270-65, 1916 Race Street, Philadelphia, Pennsylvania.

(11) "Standard Method of Test for Kinematic Viscosity of Transparent and Opaque Liquids (and the calculation of Dynamic Viscosity)," American Society for Testing Materials, D-445-74, 1916 Race Street, Philadelphia, Pennsylvania.

(12) "Standard Method of Test for Sulfur in Petroleum Products (Lamp Method)," American Society for Testing Materials, D 1266-70, 1916 Race Street, Philadelphia, Pennsylvania.

(13) "Standard Method of Test for Sulfur in Petroleum Products by the Bomb Method," American Society for Testing Materials, D 129-64, 1916 Race Street, Philadelphia, Pennsylvania.

(14) Standard Method of Test for Sulfur in Petroleum Products (High Temperature Method)," American Society for Testing Materials, D 1552-64, 1916 Race Street, Philadelphia, Pennsylvania.

(15) "Standard Method of Test for Sulfur in Petroleum Products (X-Ray Spectrographic Method)," American Society for Testing Materials, D 2622-67, 1916 Race Street, Philadelphia, Pennsylvania.

(16) Method 24—Determination of volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings, "Standards of Performance of New Stationary Sources: Addition to Reference Methods 24 and 25 to Appendix A," Federal Register, Part VII, Volume 45, No. 194, pages 65956-65973, October 3, 1980, Washington, D.C.

(17) Standard Methods for the Examination of Water and Wastewater, 14th Ed., "Organic Carbon (total), Combustion-Infrared Method," American Public Health Association, Washington, D.C.

(18) Method 25—Determination of Total Gaseous Nonmethane Organic Emissions as Carbon, "Standards of Performance for New Stationary Sources; Addition of Reference Methods 24 and 25 to Appendix A," Federal Register, Part VII, Volume 45, No. 194, pages 65956-65973, October 3, 1980, Washington, D.C.

(19) Emission Test Procedure for Tank Truck Gasoline Loading Terminals (Appendix A), "Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals," EPA-450/2-77-026, U.S. Environmental Protection Agency, October 1977.

(20) Detection of VOC Leaks from Petroleum Refinery Equipment (Appendix B), "Control of Volatile Organic Compound Leaks from Petroleum Refinery Equipment" EPA-450/2-78-036, U.S. Environmental Protection Agency, June 1978.

(21) Pressure Vacuum Test Procedures for Leak Tightness of Truck Tanks (Appendix A), "Controls of Volatile Organic Compound Leaks from Gasoline Tank Trucks and Vapor Collection Systems, "EPA-450/2-78-051, U.S. Environmental Protection Agency, December 1978.

(22) Gasoline Vapor Leak Detection Procedure by Combustible Gas Detector (Appendix B), "Control of Volatile Organic Compound Leaks from Gasoline Tank Trucks and Vapor Collection Systems," EPA-450/2-78-051, U.S. Environmental Protection Agency, December 1978.

(23) "Standard Test Method for Gasoline Diluent in Used Gasoline — Engine Oils by Distillation," American Society for Testing and Materials, ANSI/ASTM D322-80, 1916 Race Street, Philadelphia, Pennsylvania.

## STATIONARY SOURCES

**§139.11. General requirements.**

The following are applicable to source tests for determining emissions from stationary sources:

(1) All performance tests shall be conducted while the source is operating at maximum routine operating conditions or under such other conditions, within the capaci-

ty of the equipment, as may be requested by the Department.

(2) The Department shall consider for approval test results where sufficient information is provided to verify the source conditions existing at the time of the test and where adequate data is available to show the manner in which the test was conducted. Information submitted to the Department shall include, as a minimum:

(i) A thorough source description, including a description of any air cleaning devices and the flue.

(ii) Process conditions, e.g., charging rate of raw material or rate of production of final product, boiler pressure, oven temperature, and other conditions which may affect emissions from the process.

(iii) The location of the sampling ports.

(iv) Effluent characteristics, including velocity, temperature, moisture content, gas density (%CO, $CO_2$, $O_2$ and $N_2$), static and barometric pressures.

(v) Sample collection techniques employed, including procedures used, equipment descriptions and data to verify that isokinetic sampling for particulate matter collection occurred and that acceptable test conditions were met.

(vi) Laboratory procedures and results.

(vii) Calculated results.

**§139.12. Emissions of particulate matter.**

Tests for determining emissions of particulate matter from stationary source shall conform with the following:

(1) Test methods for particulate emissions shall include both dry filter(s) and wet impingers and provide for at least a 95% collection efficiency of particulate matter.

(2) Isokinetic sampling procedures shall be used in sampling for particulate matter emissions and the weights of all soluble and insoluble particulate determined gravimetrically after removal of uncombined water.

(3) Test methods and procedures shall be equivalent to or modified to produce results equivalent to those obtained by employing the procedures specified in §139.4(1) and (2) of this Title (relating to references). The equipment shall be inert where appropriate and similar to that specified in §139.4 (1)-(3) of this Title (relating to references).

(4) The minimum sampling time shall be one hour and the minimum sample volume shall be 50 cubic feet corrected to standard conditions (dry basis).

(5) Results shall be calculated based upon sample train component weights specified in §139.4(1) of this title (relating to references) and insoluble weights in the impinger solution and on sample-exposed surfaces subsequent to the final filtration media. Insoluble weights shall be determined by 0.22$\mu$ membrane filtration. Results shall be reported as pounds of particulate matter per hour and in accordance with the units specified in §§123.11-123.13 of this title (relating to particulate matter emissions) and §129.12 of this Title (relating to sulfuric acid plants).

**§139.13. Emissions of $SO_2$, $H_2S$ and $NO_2$.**

The following are applicable to tests for determining emissions of $SO_2$, $H_2S$ and $NO_2$ from stationary sources:

(1) Test methods for $SO_2$, $H_2S$ and $NO_2$ shall provide for at least 95% of the respective pollutant.

(2) Sample collection for $SO_2$ shall be at a constant rate and the weight of oxides of sulfur shall be determined gravimetrically.

(3) Test methods and procedures for sulfur oxides shall be equivalent to or modified to produce results equivalent to those which would be obtained by employing the procedures specified in §139.4 (2) of this title (relating to references). Test methods and procedures for $SO_2$ from combustion sources shall be equivalent to or modified to produce results equivalent to those which would be obtained by employing procedures specified in §139.4 (10) of this title (relating to references). Details for sampling equipment are contained in §139.4 (1) or (10) of this title.

(4) Sample collection for $H_2S$ shall be at a constant rate and the weight of hydrogen sulfide shall be determined colorimetrically.

(5) Test methods and procedures for $H_2S$ shall be equivalent to or modified to produce results equivalent to those obtained by employing the procedures specified in §139.4 (4) of this Title (relating to references). The equipment shall be inert where appropriate and similar to that specified in §139.4 (2) of this Title (relating to references).

(6) For determining emissions of $SO_2$ and $H_2S$, the minimum sampling time shall be one hour and the minimum sample volume shall be 30 cubic feet corrected to standard conditions (dry basis).

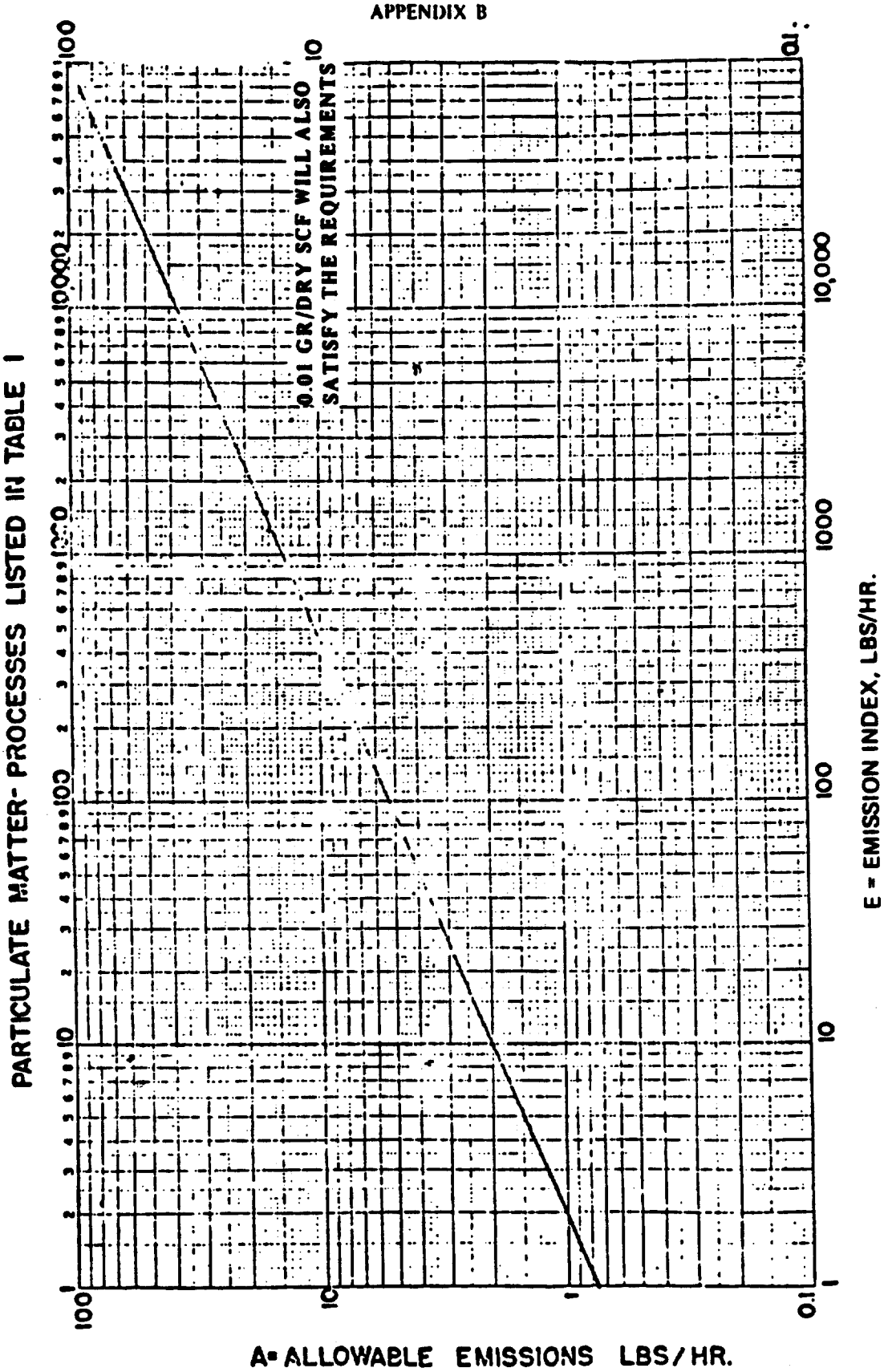
(7) Test methods and procedures and equipment for $NO_2$ shall be similar to those specified in §139.41(1) of this Title (relating to references). Minimum sampling requirements are four grab samples taken at 15-minute intervals in accordance with §139.4(1) of this title.

(8) Results shall be reported as pounds per hour and in accordance with units for the emission standard for that source as specified in Chapter 123 or 129 of this title (relating to standards for contaminants and sources) or as other terms specified by the Department.

**§139.14. Emissions of volatile organic compounds.**

(a) The following are applicable to tests for determining volatile organic content:

APPENDIX B


PARTICULATE MATTER- PROCESSES LISTED IN TABLE I
0.01 GR/DRY SCF WILL ALSO SATISFY THE REQUIREMENTS
E = EMISSION INDEX, LBS/HR.
A= ALLOWABLE EMISSIONS LBS/HR.
100
10
1
0.1
10,000
1000
100
10
1

# APPENDIX E

## ECS REPORTS DATED APRIL 19 AND MAY 9, 1988

ECS ENERGY CONTROL AND SERVICES, INC.

May 9, 1988

Engineering-Science, Incorporated
10521 Rosehaven Street
Fairfax, Virginia 22030
(703) 591-7575

ATTENTION: MR. JOE VAN GIESEN

SUBJECT: TDPS INCORPORATED
PHILADELPHIA, PA.

Dear Joe:

We enclose the report of findings covering the last visits. As you will see, the hydrocarbons which were present have been for the most part, been eliminated.

The stack conditions at the plant remain visually unchanged except that the cooler the outside air temperature, the whiter the plume, as would be expected.

We appreciated the opportunity to work with you and your company and we would be pleased to be of service to you again.

If all things seem in order, we would appreciate your accepting the enclosed invoice, for processing at your earliest convenience.

Best regards,

C. R. Safarik, P.E.

CRS:bb
Enclosure

14497 NO. DALE MABRY, STE. 209 • TAMPA, FL 33618 • (813) 962-0449 • ATLANTA (404) 971-4817
ENERGY SAVING EQUIPMENT AND SERVICE

# PLANT PROCESS PERFORMANCE

# TESTS RESULTS FOR

# TDPS INCORPORATED, PHILADELPHIA, PA.

MAY 9. 1988

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Appendix.....Pages 14-15

**ABSTRACT:**

A return trip was made to TDPS Incorporated, Philadelphia, Pennsylvania on April 28, 1988, April 29, 1988 and May 2, 1988. The same test plan and setup was used as covered in the report of April 19, 1988 covering the visits of April 6, 1988, April 11, 1988 and April 12, 1988. This set of tests were performed after the plant changed the combustion zone flights.

During the first day of tests April 28, 1988, a Hauck serviceman was present to effect proper burner adjustment.

## INTRODUCTION:

During the testing covered by this report, there was clear evidence that the combustion zone had been a major contributor to the measured hydrocarbons; Since the new flights were installed and burner adjustment was accomplished there was a dramatic decrease in hydrocarbons.

In addition, the invalidity of the information obtainable from Probe #2 as determined by the first visit was eliminated during this return trip, and data was recorded from Probe #2 and used in this report. Essentially, this data permitted the evaluation of the existing THC recorded in terms of burner contribution as separate from volatilization of liquid A.C.

It was further determined that R.A.P. is probably not contributing in any large way to THC readings, but that exhaust gas temperatures are significant to THC emmissions, as would be expected.

**OBSERVATIONS:**

1. Plant stack discharge still appears to be dust particularly since the previously measured hydrocarbons have been dramatically reduced, but stack opacity has not appreciably changed. (Figure IB)

2. Stack conditions appear to worsen as exhaust gas temperature increases.

3. The new flights which were installed in the combustion zone, have removed the flame and material interference.

4. Burner gas pressure when changed from 1.8 psig to 1.0 psig caused the burner to control the process at a higher burner throttle position, which enhanced mixing, further reducing THC and CO.

5. At 260 tons per hour the burner control position is now in the range of 50%-55% instead of 35%.

6. Baghouse pressure drop still runs in the 1"-2" W.C. range.

7. Probe 1 and Probe 2 data revealed that the difference in THC was caused by volatilization of liquid asphalt cement.

8. Plant odor has diminshed but, is proportional to exit gas temperature.

9. Dust dropout occurs about 200 yards downwind.

10. R.A.P. rates up to 25% have little observable effect on stack conditions.

11. Combustion zone draft levels do not correlate well with operating conditions or excess air.

12. The sensing tube for combustion zone draft had been disconnected and remained that way until discovered during testing. Whether the exhaust damper was full open or not, stack conditions were the same.

**DISCUSSION:**

In general, the stack emmissions conditions as observed by eye, have not changed since the first report period. The flight modifications and burner adjustments were successful in removing significant levels of hydrocarbons from the stack. In fact, at this point, the hydrocarbon emmissions from the stack have been reduced to almost 1/20th of the original conditions.

In this set of testing, data from Probe #1 and #2 were obtained. A leak in the #2 Probe fitting had originally given poor readings. The difference in these readings is useful to determine the contribution of liquid A.C.

The following comments are provided, based on the data presented.

1. Draft in the combustion zone does not correlate in any discernable way to excess air (Figure IA) or with ACFM as calculated, (Figure IIA). This is perhaps due to the strong aerodynamic flow field produced in the combustion zone which now is undisturbed by material and furthermore prevails at higher burner firing rates.

2. The hydrocarbons do not seem dependent on burner position as before (Figure IIB).

3. Draft required at up to 275 tons per hour appears to be best set at 0.25" W.C.

This happens to correspond to the burner manufacturer's recommendations.

4. The average efficiency has been elevated (Figure IIB) from before and additional comparison is found by comparing the therms per ton of "Appendix A" of both reports. Where damper position and burner position had major influences on efficiency, this effect has been greatly reduced.

5. In comparing efficiencies, at 30% burner or less the improvement has been over 30% savings, and at higher burner positions about 6% savings are realized. Overall thermodynamic efficiency factors are presented in "Appendix A", to obtain the "percent" value, merely multiply by 100.

**DISCUSSION:**

**(CONTINUED)**

6. In Figure IIIA, a new presentation of data due to introducing exit gas temperature as a variable, shows that there is a marked increase of THC as exit gas temperature rises above 310°F.

7. Since data obtained from Probe #2 was useable this time, we were able to present the effect of liquid A.C. volatilization.

This figure clearly shows that exit gas temperature directly affects the volatilization of liquid A.C. and it is from this source that hydrocarbon levels build. Additional data is needed to prove this trend to be true overall, but experience with the history of other drum mixers allows the above opinion to be expressed.

8. Downstream carriage of visible emmissions is still present despite the dramatic reduction of measureable hydrocarbons.

**CONCLUSIONS:**

The overshadowing conclusion of this report is that hydrocarbon content as measured at this particular plant has not been the major contribution to stack opacity problems. At elevated exit gas temperatures, odor, and slight blue to tan color at times were evidence of the hydrocarbons present.

Secondly the hydrocarbons which were present prior to this visit were primarilly due to unburned fuel caused by poor combustion zone conditions and poor burner adjustment.

Thirdly exit gas temperatures should be kept below 310°F unless liquid A.C. with a smaller light end component can be used. This should be accomplished by running the exhaust damper open far enough rather than by reducing its position, and the possible consideration of exit gas temperature control.

In that particulate appears to be the only culprit left, the baghouse needs enlargement so the plant air flow can be kept at necessary levels, and at the same time, collection efficiencies can be increased.

With the evidence of condensible hydrocarbon potential from volatilized liquid A.C., baghouse preheat and plant shutdown procedures need a closer look; In addition to which close baghouse inspection should continue, to prevent any opportunity for carbonaceous deposits to occur on the bags.

For your interest, I enclose curves of maximum allowable CO and THC emmissions based on California Southcoast Air Quality Board Standards which are 150 #/Day for hydrocarbons and 500 #/Day for Carbon Monoxide. As long as TDPS maintains control of exit gas temperature, 300°F or less they are within these limits, the most stringent in the country.

The final conclusion calls for modifying the existing baghouse, different bags, physical extension, or its direct replacement with a larger unit, to improve collection efficiency. Hopefully your findings will agree with mine.

We thank you for the opportunity to be of service!

Very truly yours,

C. R. Safarik, P.E.

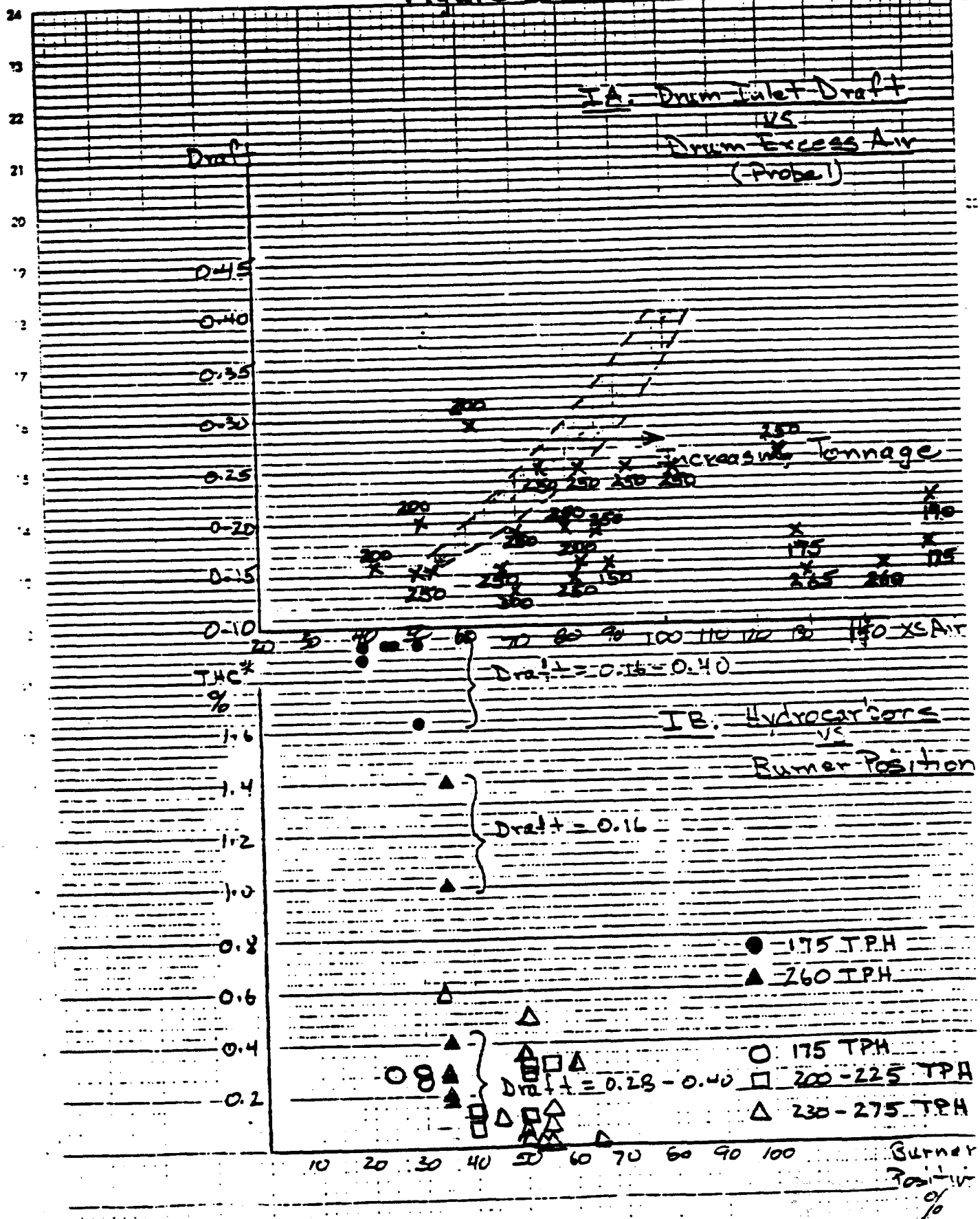
CRS:bb
Enclosures

| IN # | PROBE LOCATION | TPH | RAP % | EXHAUST DAMPER OPEN % | DRAFT | BURNER POSITION % OF HIGH FIRE | $O_2$ % | CO (PPM) | THC (%) | XS AIR % | EXHAUST GAS TEMP °F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 200 | 25 | 60 | 0.28 | 25 (Gas Pressure 1.8 psig) | 8.5 | 1860 | 0.61 | 61 | 300 |
| 2 | 1 | 250 | 30 | 60 | 0.25 | 30 (Gas Pressure 1.4 psig) | 12.2 | 687 | 0.10 | 124 | 300 |
| 3 | 1 | 250 | 25 | 82 | 0.26 | 45 (Gas Pressure 1.0 psig) | 11.1 | 321 | 0.0 | 101 | 300 |
| [illegible] | 1 | 260 | 25 | 85 | 0.25 | 55 (Gas Pressure 1.0 psig) | 10.6 | 220 | 0.0 | 91 | 300 |
| 5 | 1 | 260 | 25 | 85 | 0.25 | 50 | 10.0 | 179 | 0.0 | 82 | 300 |
| [illegible] | 1 | 261 | 25 | 85 | 0.25 | 52 | 9.5 | 164 | 0.0 | 75 | 300 |
| [illegible] | 1 | 225 | 25 | 100 | --- | 55 | 12.5 | 699 | 0.30 | 129 | 310 |
| 8 | 1 | 225 | 25 | 100 | --- | 50 | 12.6 | 699 | 0.25 | 130 | 310 |
| 9 | 1 | 225 | 25 | 80 | --- | 50 | 12.4 | 1110 | 0.32 | 131 | 310 |
| [illegible] | 1 | 225 | 25 | 60 | --- | 50 | 11.6 | 636 | 0.15 | 111 | 310 |
| [illegible] | 1 | 225 | 25 | 60 | --- | 50 | 11.6 | 580 | 0.15 | 111 | 310 |
| [illegible] | 1 | 245 | 25 | 50 | --- | 55 | 9.3 | 194 | 0.03 | 72 | 310 |
| [illegible] | 1 | 250 | 25 | 100 | --- | 50 | 5.8 | 167 | 0.13 | 35 | 300 |
| [illegible] | 1 | 250 | 25 | 100 | --- | 50 | 5.9 | 169 | 0.14 | 35 | 300 |

| IN # | PROBE LOCATION | TPH | RAP % | EXHAUST DAMPER OPEN % | DRAFT | BURNER POSITION % OF HIGH FIRE | $O_2$ % | CO (PPM) | THC (%) | XS AIR % | EXHAUST GAS TEMP °F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 275 | 25 | 100 | --- | 60 | 11.8 | 763 | 0.34 | 115 | 300 |
| | 1 | 275 | 25 | 80 | --- | 55 | 12.5 | 995 | 0.17 | 133 | 300 |
| | 1 | 275 | 25 | 80 | --- | 55 | 11.4 | 545 | 0.17 | 110 | 300 |
| | 1 | 230 | 25 | 80 | --- | 50 | 10.7 | 389 | 0.09 | 94 | 310 |
| | 1 | 230 | 25 | 80 | --- | 50 | 12.5 | 995 | 0.53 | 133 | 340 |
| | 1 | 230 | 25 | 80 | --- | 50 | 12.4 | 995 | 0.37 | 129 | 335 |
| | 1 | 150 | 25 | 60 | --- | 30 | 13.4 | 814 | 0.25 | 155 | 300 |
| | 1 | 175 | 25 | 50 | 0.18 | 30 | 13.4 | 631 | 0.25 | 155 | 300 |
| | 1 | 175 | 25 | 50 | 0.18 | 30 | 12.2 | 653 | 0.25 | 127 | 300 |
| | 1 | 150 | 25 | 40 | 0.16 | 25 | 10.4 | 345 | 0.29 | 88 | 300 |
| | 1 | 200 | 25 | 40 | 0.14 | 40 | 10.3 | 311 | 0.16 | 87 | 250 |
| | 1 | 200 | 25 | 50 | 0.20 | 40 | 7.6 | 108 | 0.07 | 51 | 300 |
| | 1 | 250 | 25 | 50 | 0.15 | 50 | 7.5 | 91 | 0.11 | 50 | 280 |
| | 1 | 260 | 25 | 55 | 0.16 | 55 | 8.0 | 81 | 0.10 | 55 | 290 |
| | 1 | 250 | 0 | 55 | 0.15 | 45 | 9.1 | 135 | 0.16 | 68 | 290 |
| | 2 | 260 | 0 | 55 | 0.15 | 50 | 13.3 | 71 | 0.03 | 160 | 285 |
| | 2 | 265 | 0 | 55 | 0.15 | 52 | 12.2 | 78 | 0.03 | 130 | 285 |

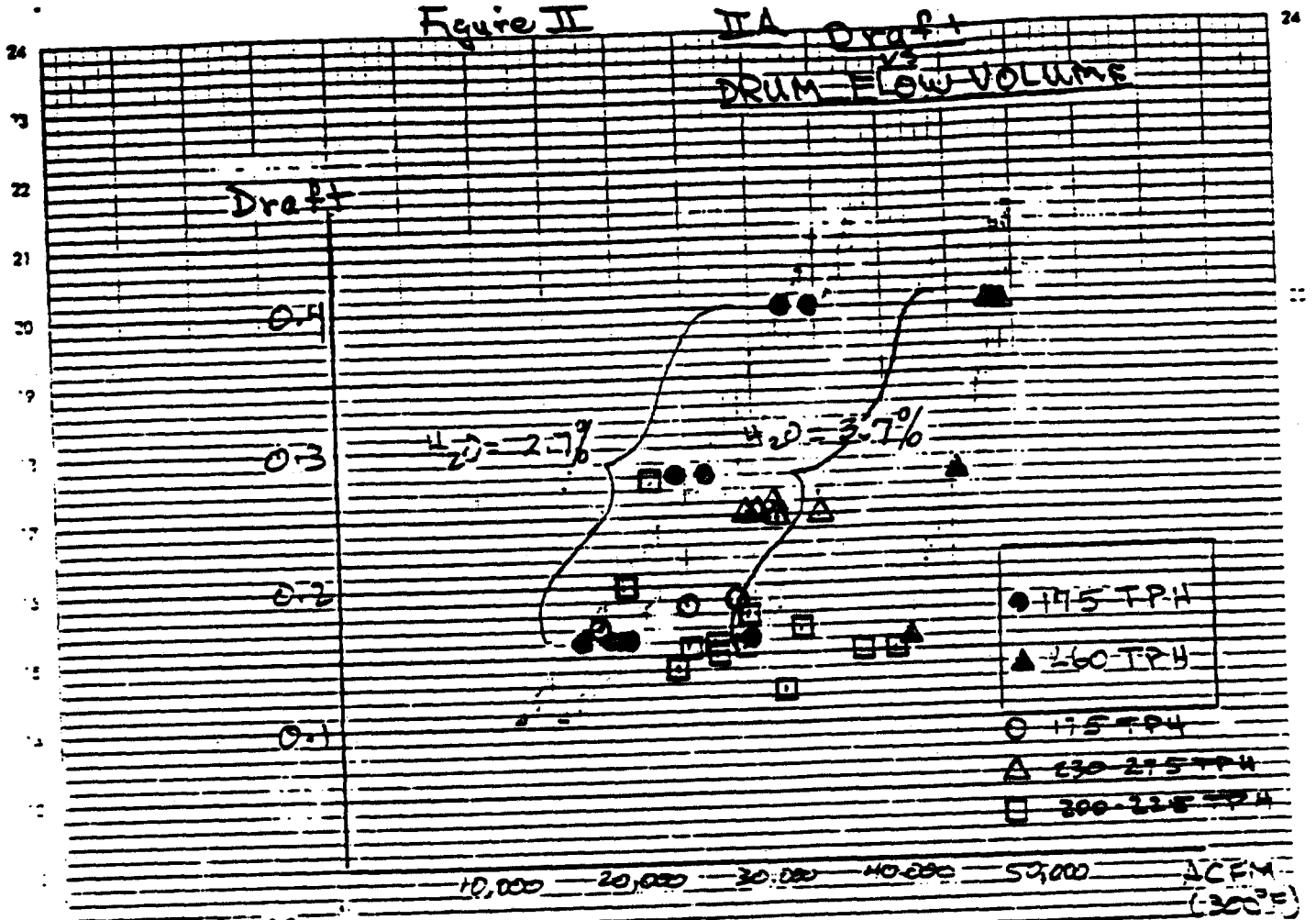
| RUN # | PROBE LOCATION | TPH | RAP % | EXHAUST DAMPER OPEN % | DRAFT | BURNER POSITION % OF HIGH FIRE | $O_2$ % | CO (PPM) | THC (%) | XS AIR % | EXHAUST GAS TEMP °F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2 | 300 | 25 | 55 | 0.13 | 60 | 9.0 | 93 | 0.0 | 68 | 280 |
| 3 | 2 | 270 | 25 | 60 | 0.16 | 65 | 6.7 | 118 | 0.04 | 42 | 300 |
| 4 | 2 | 270 | 25 | 60 | 0.16 | 65 | 9.2 | 108 | 0.07 | 70 | 300 |
| 5 | 2 | 250 | 25 | 60 | 0.16 | 60 | 10.2 | 150 | 0.09 | 84 | 300 |
| 6 | 1 | 250 | 0 | 60 | 0.17 | 55 | 10.3 | 499 | 0.88 | 87 | 310 |
| 7 | 1 | 250 | 0 | 60 | 0.18 | 55 | 9.3 | 203 | 0.23 | 71 | 310 |
| 8 | 1 | 260 | 0 | 60 | 0.18 | 55 | 9.1 | 91 | 0.08 | 68 | 300 |

Figure I




[illegible] 50% XS Air.

Figure II


IIA Draft vs DRUM FLOW VOLUME
Draft
0.4
0.3
0.2
0.1
$H_2O$ = 2.7%
$H_2O$ = 3.7%
175 TPH
260 TPH
175 TPH
230-275 TPH
300-325 TPH
10,000
20,000
30,000
40,000
50,000
ACFM (300°F)

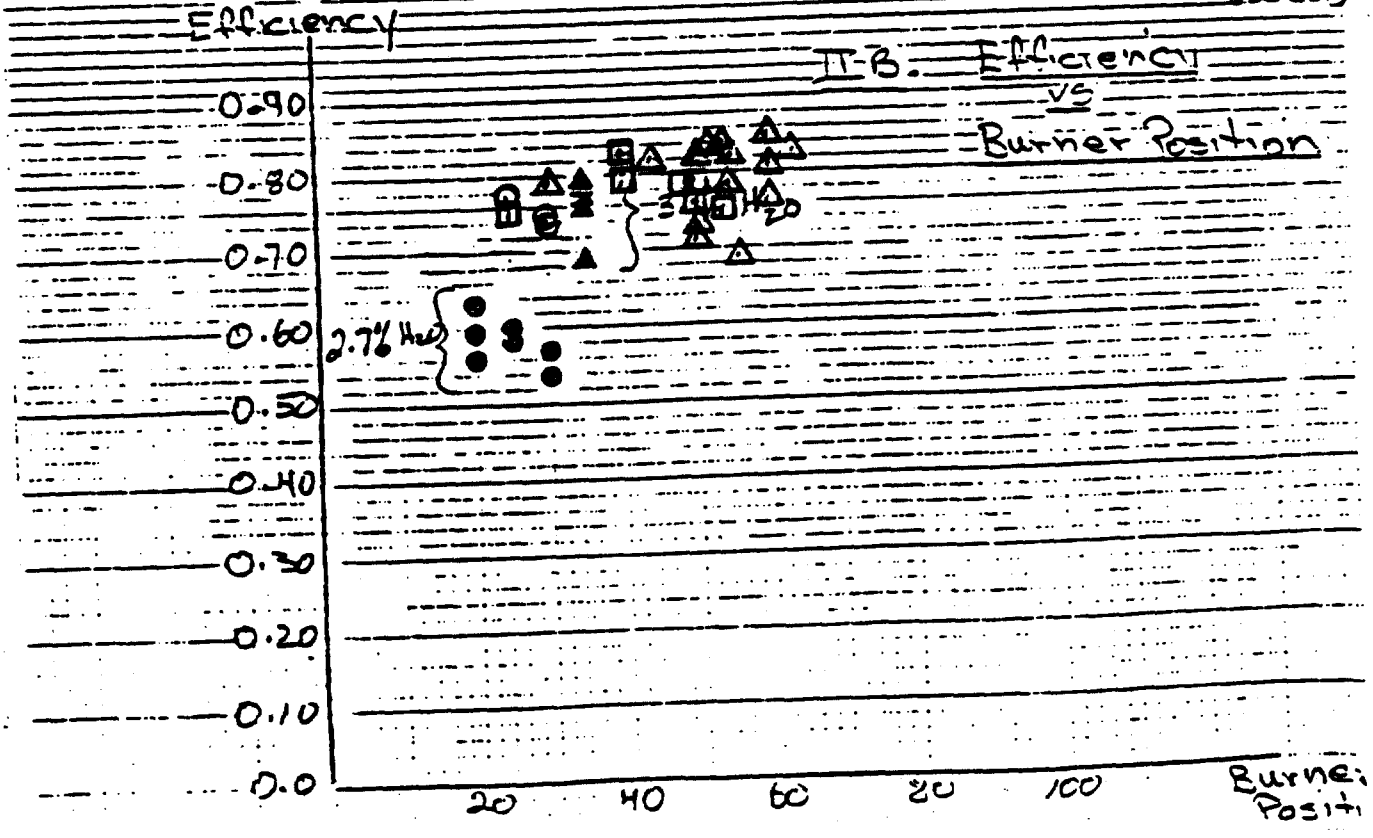

Efficiency
II-B. Efficiency vs Burner Position
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.0
2.7% $H_2O$
$H_2O$
20
40
60
80
100
Burner Position

Figure III

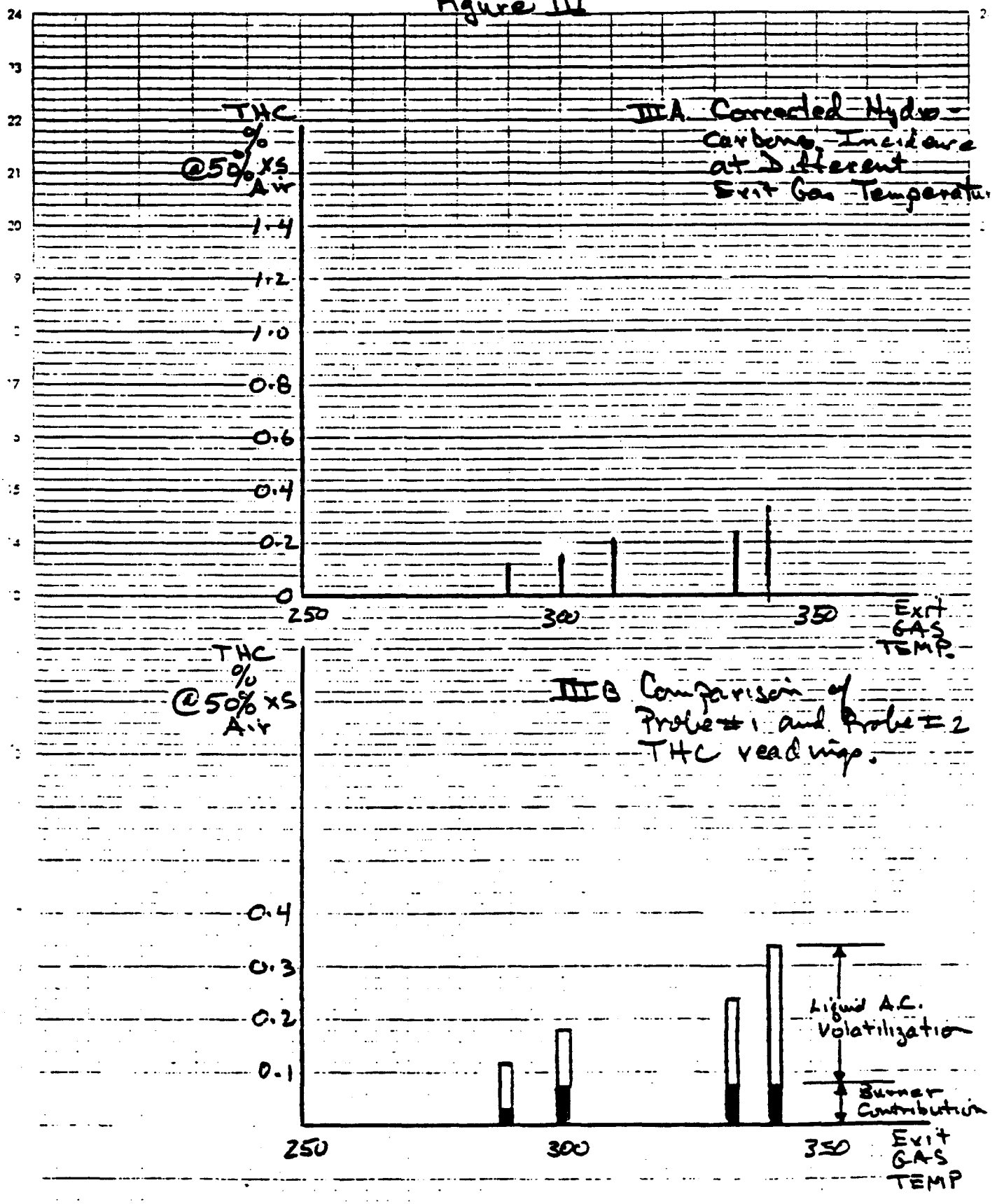
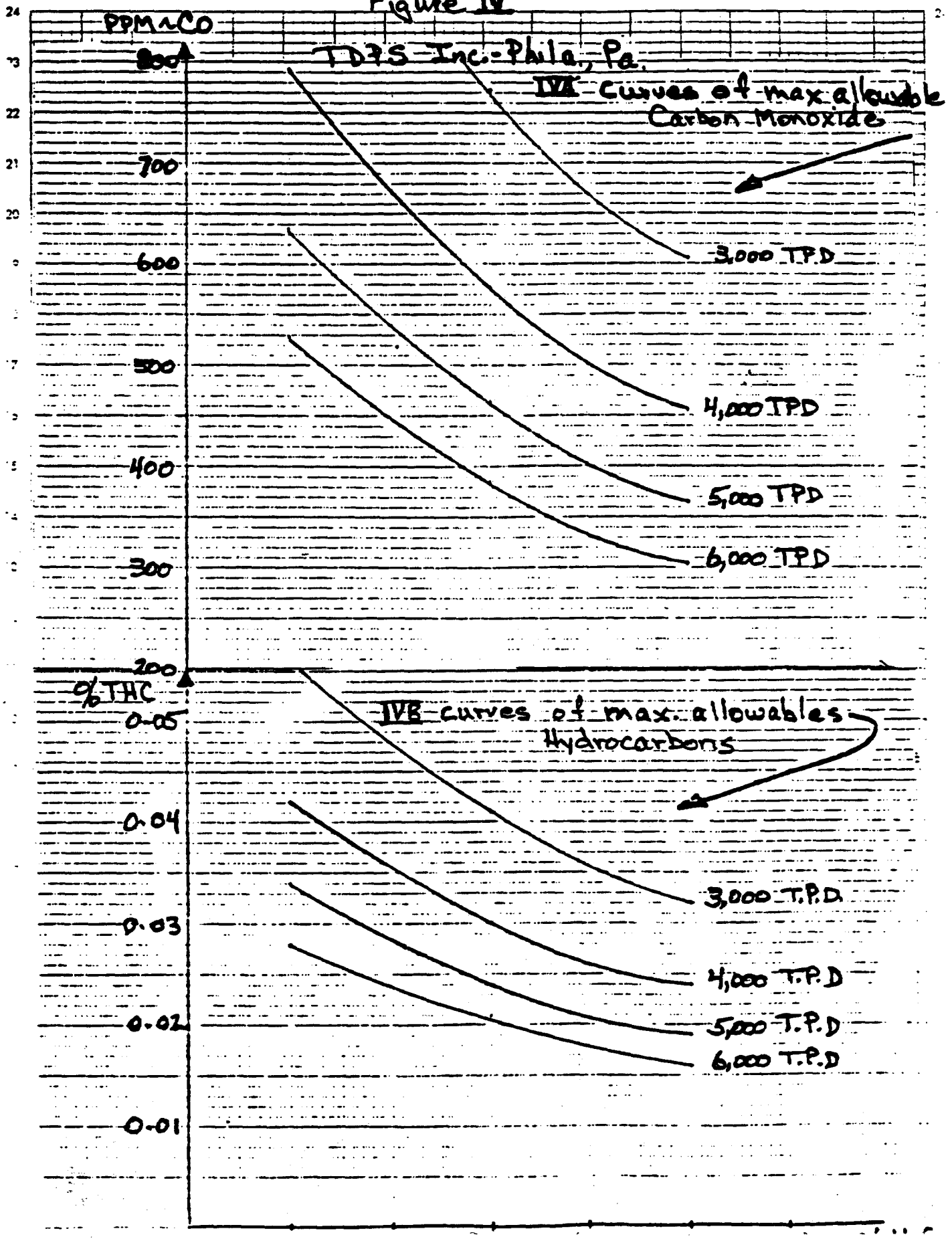

THC
%
@50% xs
Air
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
250
300
350
Exit
GAS
TEMP.
IIIA Corrected Hydro-
carbons Incidence
at Different
Exit Gas Temperatu
THC
%
@50% xs
Air
0.4
0.3
0.2
0.1
250
300
350
Exit
GAS
TEMP
IIIB Comparison of
Probe #1 and Probe #2
THC readings.
Liquid A.C.
Volatilization
Burner
Contribution

Figure IV


PPM ~ CO
800
700
600
500
400
300
200
TDTS Inc. - Phila., Pa.
IVA Curves of max allowable Carbon Monoxide
3,000 T.P.D
4,000 TPD
5,000 TPD
6,000 TPD
% THC
0.05
0.04
0.03
0.02
0.01
IVB curves of max. allowables Hydrocarbons
3,000 T.P.D
4,000 T.P.D
5,000 T.P.D
6,000 T.P.D

**APPENDIX A:**

| RUN | $Q_{INPUT}$ | ACFM | THREMS/TON | f |
|---|---|---|---|---|
| 1 | $41.09 \times 10^6$ | 22,825 | 2.05 | .75 |
| 2 | $48.8 \times 10^6$ | 34,805 | 1.95 | .79 |
| 3 | $47.6 \times 10^6$ | 31,531 | 1.90 | .81 |
| 4 | $48.9 \times 10^6$ | 31,325 | 1.87 | .82 |
| 5 | $48.7 \times 10^6$ | 30,186 | 1.87 | .822 |
| 6 | $48.7 \times 10^6$ | 29,405 | 1.86 | .826 |
| 7 | $46.4 \times 10^6$ | 33,258 | 2.06 | .748 |
| 8 | $45.9 \times 10^6$ | 33,083 | 2.04 | .756 |
| 9 | $46.4 \times 10^6$ | 33,479 | 2.06 | .747 |
| 10 | $44.2 \times 10^6$ | 30,113 | 1.96 | .785 |
| 11 | $44.1 \times 10^6$ | 30,060 | 1.96 | .785 |
| 12 | $45.9 \times 10^6$ | 27,357 | 1.87 | .822 |
| 13 | $46.6 \times 10^6$ | 23,709 | 1.86 | .827 |
| 14 | $46.6 \times 10^6$ | 23,709 | 1.86 | .827 |
| 15 | $56.6 \times 10^6$ | 38,699 | 2.06 | .749 |
| 16 | $55.0 \times 10^6$ | 40,199 | 2.00 | .77 |
| 17 | $55.0 \times 10^6$ | 37,319 | 2.00 | .77 |
| 18 | $44.3 \times 10^6$ | 28,526 | 1.93 | .80 |
| 19 | $50.3 \times 10^6$ | 36,108 | 2.19 | .705 |

**APPENDIX A:**

| RUN | $Q_{INPUT}$ | ACFM | THERMS/TON | f |
|---|---|---|---|---|
| 20 | $48.3 \times 10^6$ | 34,391 | 2.09 | .734 |
| 21 | $31.2 \times 10^6$ | 24,254 | 2.08 | .74 |
| 22 | $36.4 \times 10^6$ | 28,297 | 2.08 | .74 |
| 23 | $35.7 \times 10^6$ | 25,476 | 2.04 | .755 |
| 24 | $29.7 \times 10^6$ | 18,572 | 1.98 | .777 |
| 25 | $38.7 \times 10^6$ | 24,247 | 1.93 | .797 |
| 26 | $37.3 \times 10^6$ | 20,394 | 1.86 | .827 |
| 27 | $46.8 \times 10^6$ | 25,560 | 1.87 | .822 |
| 28 | $48.8 \times 10^6$ | 27,096 | 1.88 | .82 |
| 29 | $47.6 \times 10^6$ | 27,792 | 1.90 | .81 |
| 30 | $51.4 \times 10^6$ | 40,962 | 1.97 | .78 |
| 31 | $51.6 \times 10^6$ | 37,559 | 1.94 | .792 |
| 32 | $54.7 \times 10^6$ | 32,326 | 1.82 | .845 |
| 33 | $49.8 \times 10^6$ | 26,253 | 1.85 | .834 |
| 34 | $50.2 \times 10^6$ | 29,744 | 1.86 | .829 |
| 35 | $47.6 \times 10^6$ | 29,605 | 1.90 | .81 |
| 36 | $55.8 \times 10^6$ | 33,790 | 2.23 | .69 |
| 37 | $48.8 \times 10^6$ | 28,650 | 1.95 | .789 |
| 38 | $49.4 \times 10^6$ | 28,860 | 1.90 | .81 |

ECS ENERGY CONTROL AND SERVICES, INC.

April 19, 1988

RECEIVED
APR 22 1988
ENGINEERING SCIENCE

Engineering-Science, Incorporated
10521 Rosehaven Street
Fairfax, Virginia 22030
(703) 591-7575

ATTENTION: MR. JOE VAN GIESEN

SUBJECT: TDPS INCORPORATED
PHILADELPHIA, PA.

Dear Joe:

I enclose the final copy of the report of findings from our visit to the subject client on April 6, 1988 and April 11, 1988 and April 12, 1988. I hope the "draft" I "faxed" to you arrived in readable form.

In the event, it is necessary to return to the plant, please let me know. I have "penciled in" April 28, 1988 - April 29, 1988 as a window for that purpose.

Very truly yours,

C. R. Safarik, P.E.

CRS:bb
Enclosure

14497 NO. DALE MABRY, STE. 209 • TAMPA, FL 33618 • (813) 962-0449 • ATLANTA (404) 971-4817
ENERGY SAVING EQUIPMENT AND SERVICE

ECS ENERGY CONTROL AND SERVICES, INC.

# PLANT PROCESS PERFORMANCE

# TEST RESULTS FOR

# TDPS INCORPORATED, PHILADELPHIA, PA.

APRIL 19, 1988

14497 NO. DALE MABRY, STE. 209 • TAMPA, FL 33618 • (813) 962-0449 • ATLANTA (404) 971-4817
ENERGY SAVING EQUIPMENT AND SERVICE

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**ABSTRACT:**

A CMI Drum Mixer owned by TDPS, Incorporated, Philadelphia, Pennsylvania, having an exhaust gas problem, was equipped with a state of the air Combustion Analyzer System, to monitor the total hydrocarbons, carbon monoxide and oxygen leaving the drum.

Plant feed rates, moistures and exhaust damper position were varied in the testing in order to gather significance of these parameters on exit gas conditions.

## INTRODUCTION:

The plant stack conditions have been causing complaint by the surrounding population, particularly a seven story school located downwind at times, and about 250 yards away.

In order to determine if the visible emmissions and odors are due to the presence of hydrocarbons and carbon monoxide, Energy Control and Services, Incorporated, was called in to take measurements, and diagnose cause.

The report which follows presents the data which was acquired, and results of supportive calculation, which correlates burner performance, and the previously mentioned variables, to exit gas conditions.

Two probes positioned inside of the drum, as shown in Sketch #1, were used. The plant was firing a Hauck StarJet Burner, SJG-4520, on natural gas, controlled by material discharge temperature.

The baghouse, supplied originally with the plant, physically appears too small for this drum mixer. From the data acquired, we have calculated the drum exhaust flow at 300°F, for the different damper positions and production rates, to assist in evaluating the baghouse.

**OBSERVATIONS:**

1. Plant stack discharge appeared to be dust, or hydrocarbons and steam, upon initial visual inspection.

2. Stack conditions did not appear to appreciably change between burner firing rates of 10% to 35% or even at high fire.

3. Stack conditions seemed to worsen when the exhaust damper was opened to 100%, but those observations being subjective, are not conclusive.

4. The burner flame was marginally stable, and having a lazy characteristic, not typical of the combustion characteristics of an aerodynamically stablized flame.

5. The natural gas flame, had significant yellow regions in it after the "kicker flight" zone, due to considerable veiling of material through the flame in the combustion zone.

6. The combustion zone flights, as shown in Figure 2 were not capable of keeping the combustion zone clear enough of material to permit complete combustion of the fuel.

7. The burner linkage was reported by plant personnel to have slipped, so the settings are not to factory adjustments.

   The gas valve was at position 2, and the air valve at its lowest position, at low fire. The gas pressure was 1.8 psig to the gas valve.

8. Burner secondary air was set at a swirl of 40°.

**OBSERVATIONS:**

**(CONTINUED)**

9. At 260 tons per hour, nearly the limit of the feed ability of the plant, the burner firing position was only 35%.

10. Baghouse pressure drop typically ran at 1" to 2" W.C., seemingly low, considering typical levels of 4"-5" on most plants.

11. Exit gas temperatures and material temperatures typically ran at 300°F, and for the most part, were within 10°F of each other.

12. Excess Air was more than amply available at all production rates, up to 260 tph at 3.7% moisture. ...for example at 260 tph and 3.7% moisture, at 100% excess air (fully open exhaust damper), <u>from an air standpoint</u>, the plant could handle 440 tph at 3.7% moisture and 360 tph at 5% moisture at the same prevailing efficiency of say 78%. Any incomplete combustion was not due to a shortage of air.

**DISCUSSION:**

Upon arriving at the plant, and meeting with local and federal representatives of air quality and health departments, we learned that the City of Philadelphia Air Quality people feed that the visible stack emmissions were condensed visible organic compounds and that the associated odor, confirmed their suspicions.

The E.P.A. representatives, when inspecting the plant, found nothing unacceptable, but admitted that the E.P.A. had no specification limit for hydrocarbons for this area.

The city people questioned the plant personnel, to determine what production rates gave the highest operating efficiency, or the best stack conditions. The plant people could not say.

They also asked how one determines if the baghouse has torn or damaged bags. They indicated that the baghouse is inspected every Saturday.

It is not within the scope of their report to cover the additional theories, inspections and discussions with outside personnel, but we will now go on to the measured exit gas data.

The Enerac 2000 which is the analytical instrument used by the EMS 2000 Efficiency Monitoring System, manufactured by Energy Control and Services, Incorporated, was connected to each of two probes (Sketch #1) to obtain the data presented herein.

Due to production rate constraints, typical in asphalt plants, and production schedules, the data taken was somewhat sparse, but sufficient to form reasonable conclusions.

Some plots are presented in Figures I, II and III but the data's variability makes meaningful correlation difficult. The high concentration of unburned fuel, disguises relationships which can normally be expected, such as the variance of efficiency with exhaust damper position.

All data presented is obtained as % by <u>volume</u> or ppm, and <u>all</u> plots present the data from Probe #1 only. This was done for two reasons: One, not much data was found to be needed from Probe #2 due to an inordinate presence of unburned fuel at either probe. Secondly the excess air level at Probe #2 was not characteristic of the overall drum excess air level and was probably in a main entrained air strata from the RAP collar. Nevertheless, hydrocarbon levels at either probe, corrected to a constant excess air level, were consistent.

**DISCUSSION:**

**(CONTINUED)**

The following comments are provided, based on the data:

1. Hydrocarbon levels upstream of (Probe #2) and downstream of (Probe #1) the liquid asphalt injector, connedted to the same excess air levels, were the same.

2. RAP introduction rates, had little effect on hydrocarbons efficiency etc.

3. Overwhelming presence of hydrocarbons, were present at 20% burner position and dramatically reduced at 35% burner position. (Figure IB)

4. Excess air increased as draft increased (Figure IA) but at the same draft, excess air levels measured were higher at higher tonnages. (The opposite of intuitive expection).

5. ACFM values for each data point were calculated, based on the calculated efficiencies, moisture level and tons per hour. The relationship to draft is presented in Figure IIA.

6. Figure IIB weakly suggests higher efficiencies were obtained at higher burner positions.

7. Correlation of therms per ton versus firing rate (tons per hour) is thrown off by the change in moisture, in Figure IIIA.

8. Figure IIIB shows opposite relationships between the change in therms per ton as damper position changes, when comparing 2.7% moisture to 3.7% moisture.

When fines were inspected, there was no sign of carbon deposit, and when RAP was varied there was no change in hydrocarbons (runs 1-10), in the exhaust gases.

**CONCLUSIONS:**

1. The predominant contribution to hydrocarbons and carbon monoxide emmissions is due to poor burner adjustment and improper combustion zone conditions.

2. Burner adjustment and flight changes are mandatory to "clean up" the unburned fuel.

3. The H-C and CO present in the exit gases is not coming from RAP, or liquid A-C.

4. The H-C and CO present in the exit gases cannot be found (visually) in the baghouse fines.

5. The visible emmissions from the stack must be fines carrying out of the baghouse.

6. The baghouse appears too small, but the pressure drop is very low. This means the baghouse is operating at the lowest possible collection efficiency.

7. Either the baghouse is suffering from improper bag material, or little if any coke is forming on the bag surface.

8. The odors detected from the plant are a result of the emmissions of blue smoke from uncovered sections of the slat conveyor and clouds of blue smoke leaving the tops of the silos.

9. The V.O.C. from the sources cited in"8" can be observed to dissipate and become invisible in a very short distance from the source; say about 50-75 feet.

10. The emmissions from the stack of the plant carry great distances downwind, say 200-300 yards and more, lending credence to the emmissions being fines.

When changes in flights and burner adjustment are completed, it will be interesting to confirm the disappearance of hydrocarbons and see if there is a continuance of visible emmissions!

PLANT OPERATING DATA

TDPS, INCORPORATED

PHILADELPHIA, PENNSYLVANIA

| PROBE LOCATION | TPH (TOTAL) | RAP % | EXHAUST DAMPER % OPEN | DRAFT " W.C. | BURNER POSITION % OF HIGH FIRE | $O_2$ (%) | CO (PPM) | THC (%) | XS AIR (%) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 175 | 25 | 38 | 0.16 | 20 | 7.3 | 2000 | 1.93 | 48 |
| 1 | 175 | 25 | 38 | 0.16 | 20 | 6.4 | 2000 | 1.92 | 39 |
| 1 | 175 | 25 | 60 | 0.28 | 20 | 9.0 | 2000 | 1.93 | 68 |
| 2 | 175 | 25 | 38 | 0.16 | 20 | 12.5 | 2000 | 1.93 | 130 |
| 1 | 175 | 10 | 40 | 0.16 | 25 | 7.3 | 2000 | 1.93 | 48 |
| 2 | 175 | 10 | 40 | 0.16 | 25 | 11.6 | 2000 | 1.93 | 48 |
| 1 | 175 | 10 | 55 | 0.28 | 30 | 10.0 | 2000 | 1.93 | 81 |
| 2 | 175 | 10 | 55 | 0.28 | 30 | 17.5 | 500 | 0.65 | 450 |
| 1 | 175 | 0 | 45 | 0.16 | 25 | 8.2 | 2000 | 1.93 | 54 |
| 2 | 175 | 0 | 45 | 0.16 | 25 | 13.6 | 2000 | 1.93 | 143 |
| 1 | 260 | 25 | 60 | 0.16 | 35 | 7.0 | 2000 | 1.0-1.4 | 45 |
| 1 | 260 | 25 | 80 | 0.28 | 35 | 9.7-10.5 | 300-350 | 0.15-0.23 | 81-92 |
| 2 | 260 | 25 | 80 | 0.28 | 35 | 16.0 | 800-1000 | 0.35-0.40 | 295 |
| 2 | 260 | 25 | 100 | 0.40 | 35 | 16.0 | 1200 | 0.30 | 295 |
| 1 | 260 | 25 | 100 | 0.40 | 35 | 11.0 | 800 | 0.30 | 99 |
| 1 | 260 | 25 | 100 | 0.40 | 35 | 11.1 | 765 | 0.22 | 101 |
| 1 | 260 | 25 | 100 | 0.40 | 35 | 11.3 | 600 | 0.15 | 102 |
| 2 | 260 | 25 | 100 | 0.40 | 35 | 16.0 | 1400 | 0.17 | 295 |

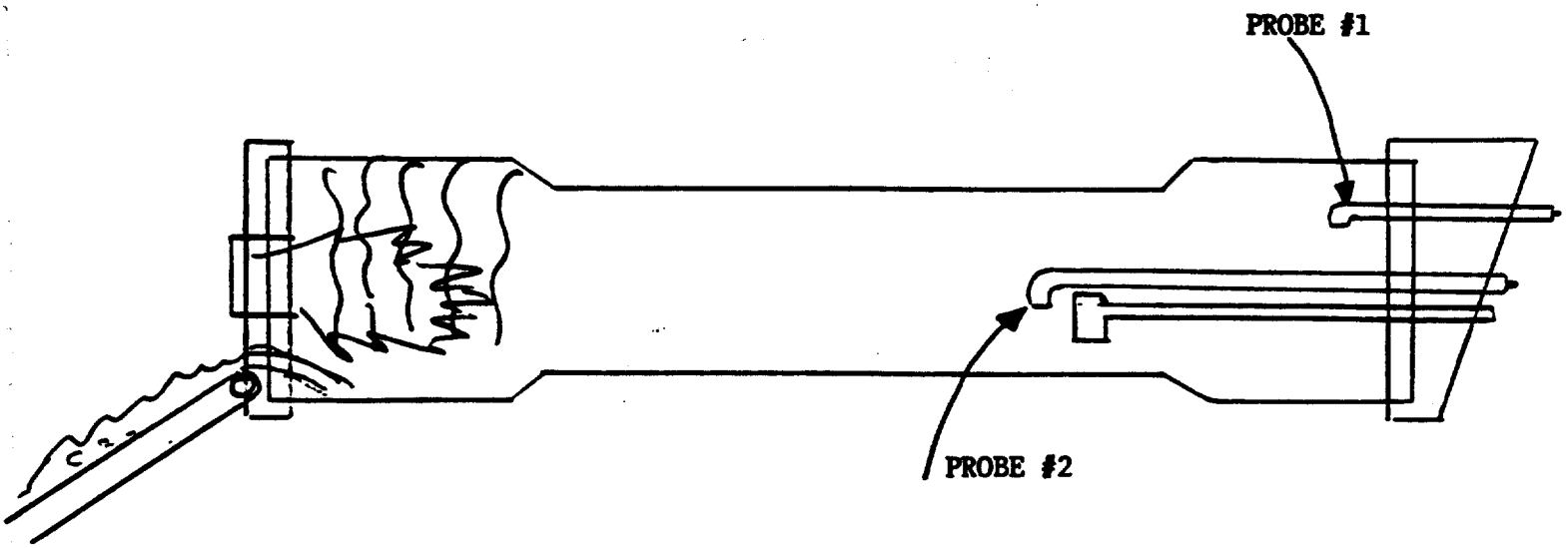
| PROBE LOCATION | TPH (TOTAL) | RAP % | EXHAUST DAMPER % OPEN | DRAFT " W.C. | BURNER POSITION % OF HIGH FIRE | $O_2$ (%) | CO (PPM) | THC (%) | XS AIR (%) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 175 | 25 | 38 | 0.16 | 20 | 6.4 | 2000 | 1.93 | 39 |
| 1 | 175 | 25 | 100 | 0.40 | 30 | 8.2 | 1982 | 2.07 | 56 |
| 1 | 175 | 25 | 100 | 0.40 | 25 | 7.3 | 1800 | 1.98 | 48 |

ALL DATA WAS TAKEN AT:

1. MATERIAL TEMPERATURE OF 300°F
2. TOP MIX ID-2
3. GAS PRESSURE = APPROXIMATELY 1.8 PSIG
4. BURNER SPIN AT 40°
5. 1-10 AT 2.7% $H_2O$ 11-21 AT 3.7% $H_2O$

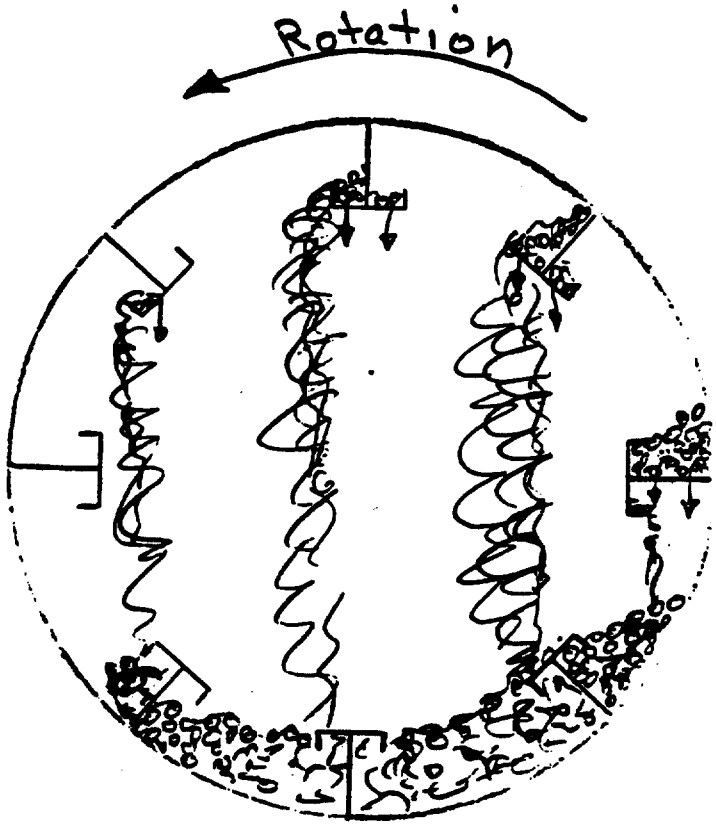
SKETCH #1

EXIT GAS SAMPLE PROBE ARRANGEMENT



SKETCH #2

COMBUSTION ZONE FLIGHTS



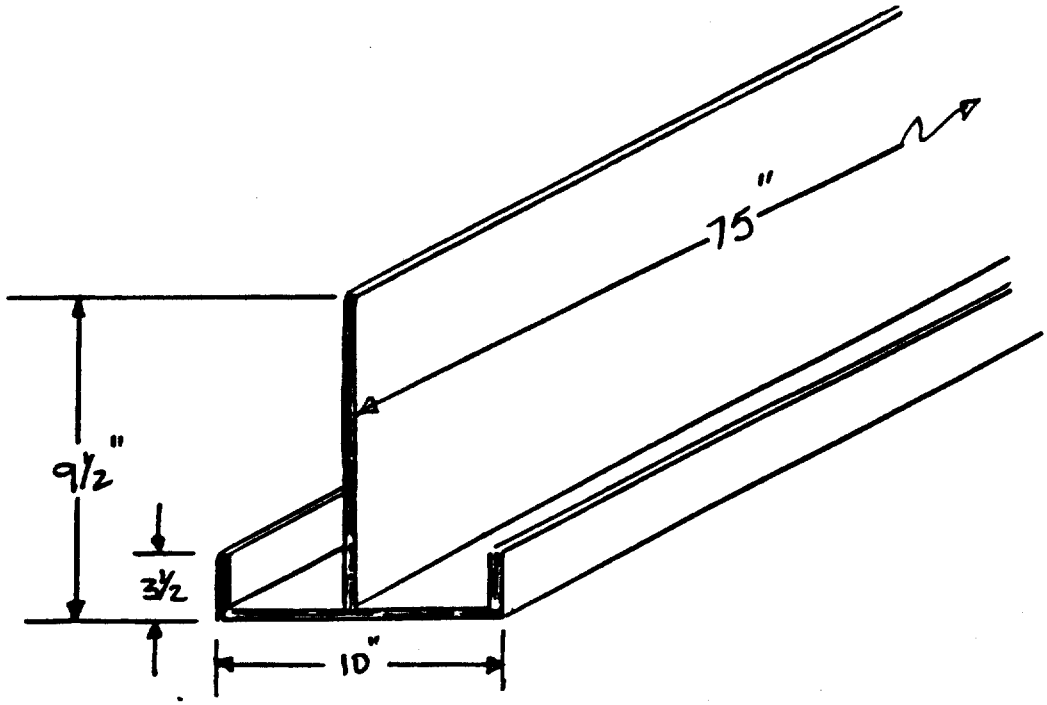
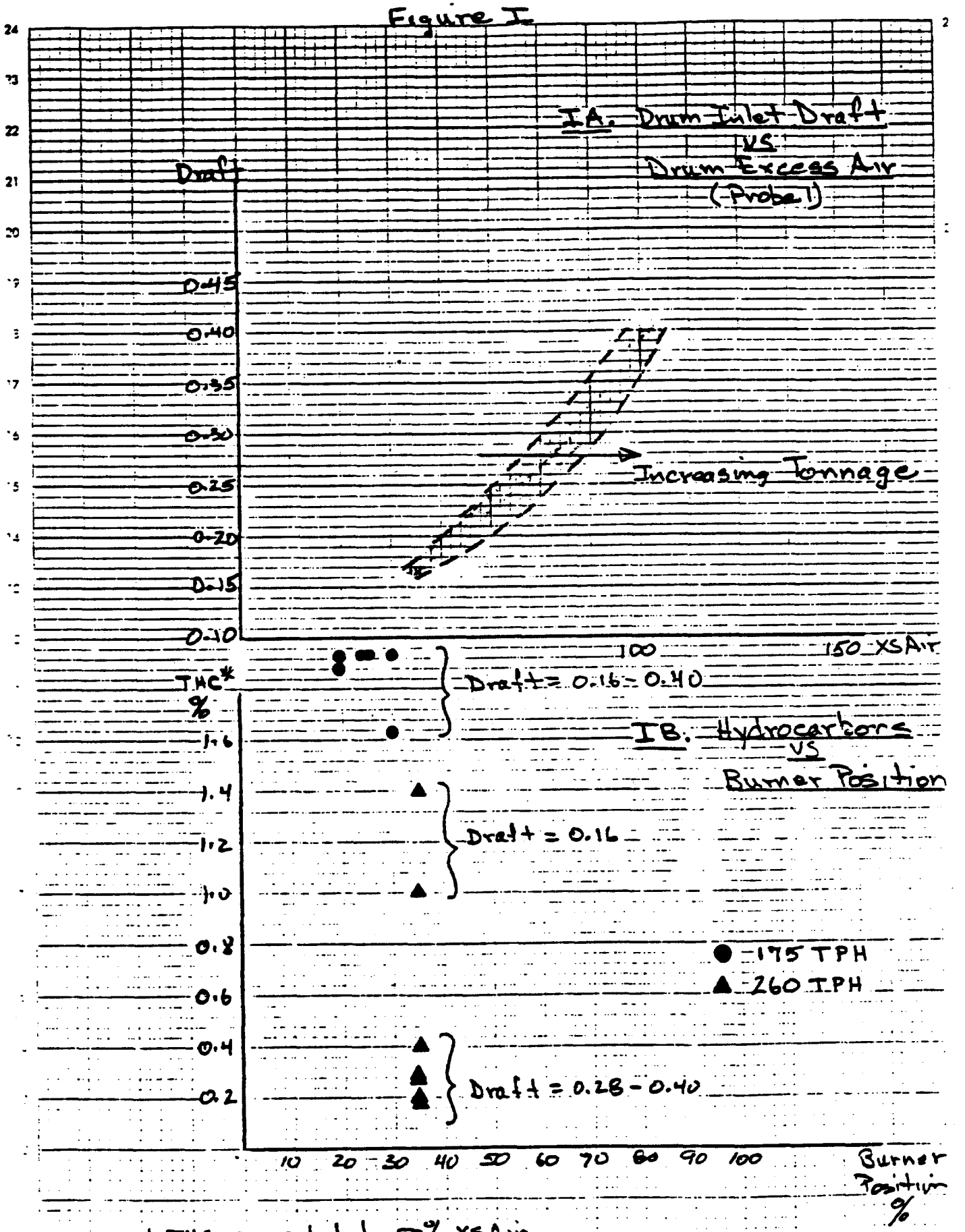
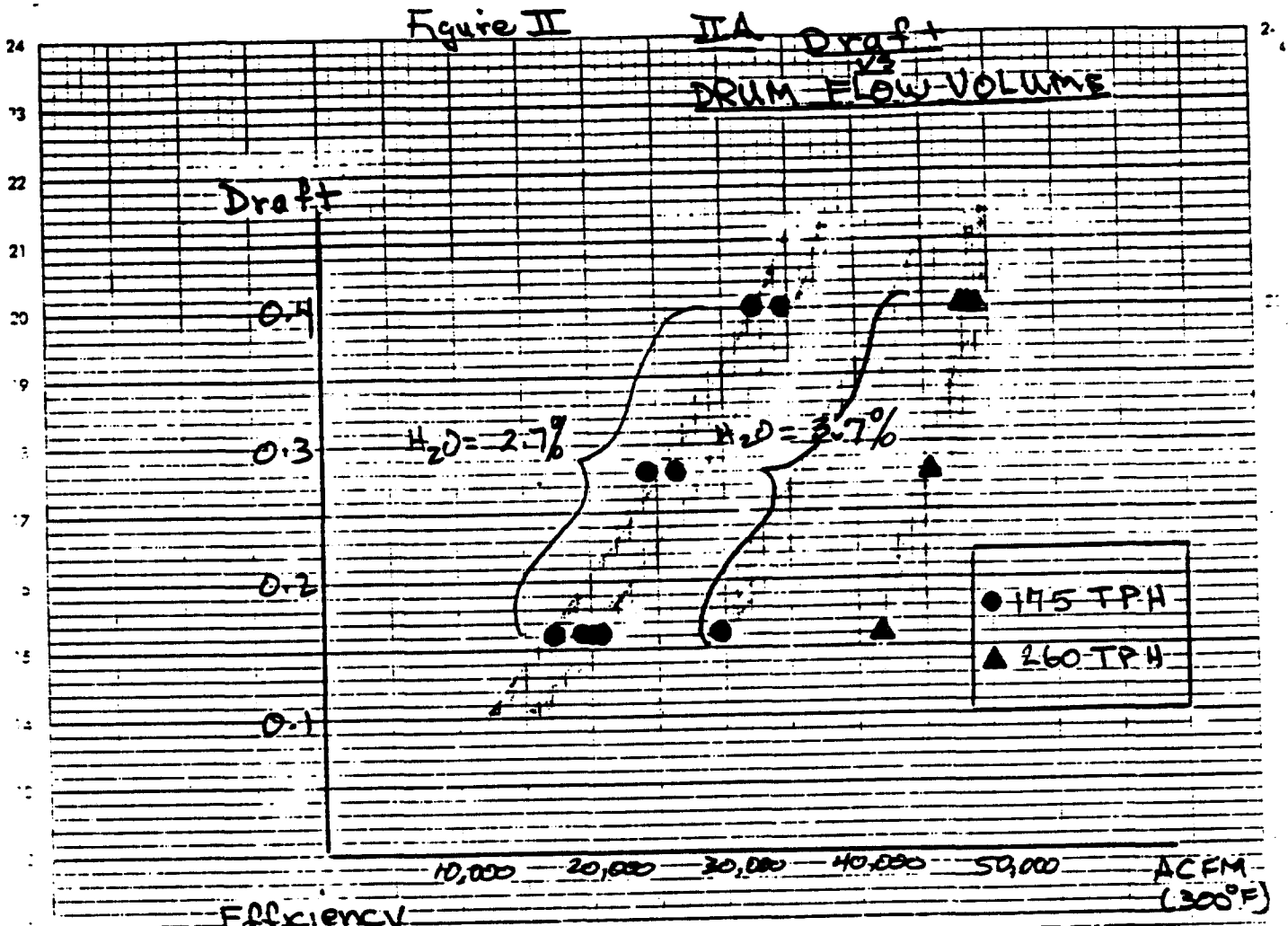



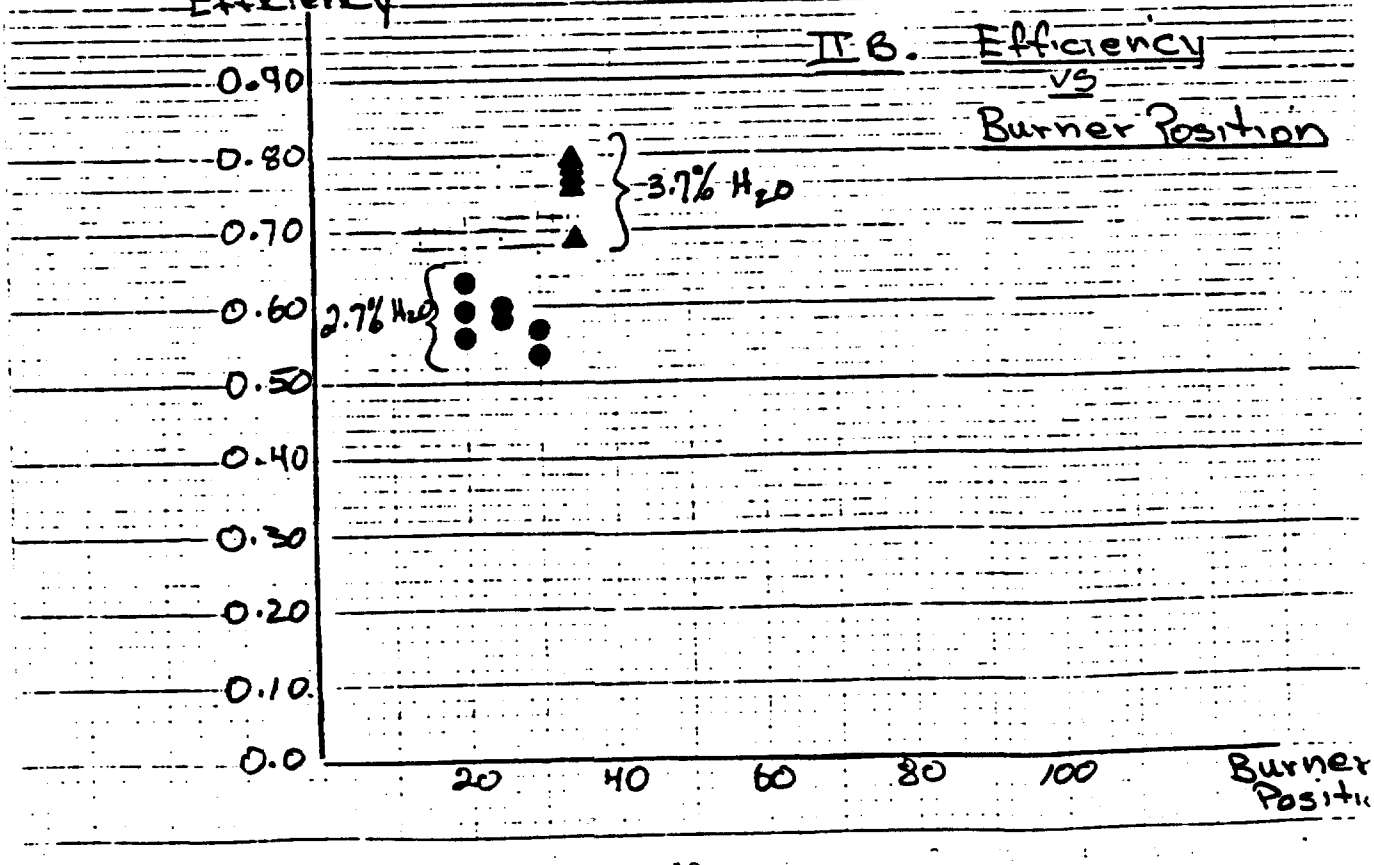
Figure I




* THC corrected to 50% XSAir.

Figure II


IIA Draft vs DRUM FLOW VOLUME
Draft
0.4
0.3
0.2
0.1
$H_2O$ = 2.7%
$H_2O$ = 3.7%
145 TPH
260 TPH
10,000
20,000
30,000
40,000
50,000
ACFM (300°F)


IIB. Efficiency vs Burner Position
Efficiency
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.0
3.7% $H_2O$
2.7% $H_2O$
20
40
60
80
100
Burner Position

**APPENDIX A:**

**(CONTINUED)**

| RUN | $Q_{INPUT}$ | ACFM | THERMS/TON |
|---|---|---|---|
| 1 | $44.4 \times 10^6$ | 21,573 | 2.43 |
| 2 | $43.1 \times 10^6$ | 20,155 | 2.36 |
| 3 | $47.3 \times 10^6$ | 24,929 | 2.58 |
| 5 | $44.4 \times 10^6$ | 21,573 | 2.43 |
| 7 | $49.5 \times 10^6$ | 27,403 | 2.70 |
| 9 | $45.3 \times 10^6$ | 21,480 | 2.48 |
| 11 | $90.5 \times 10^6$ | 43,312 | 3.33 |
| 12 | $79.6 \times 10^6$ | 47,074 | 2.93 |
| 15 | $82.3 \times 10^6$ | 50,895 | 3.03 |
| 16 | $80.9 \times 10^6$ | 50,583 | 2.98 |
| 17 | $79.9 \times 10^6$ | 50,269 | 2.94 |
| 19 | $67.5 \times 10^6$ | 30,624 | 3.69 |
| 20 | $73.5 \times 10^6$ | 35,747 | 4.02 |
| 21 | $70.4 \times 10^6$ | 33,171 | 3.85 |