AP42 Section:	11.7
Background Chapter:	4
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Title:	*Emission Test Report, Walking Vane Bakeout Oven, 3M Corporation, Chattanooga, TN*, Pedco Environmental, Inc., Cincinnati, OH, May 1981.

AP-42 Section Reference 11.7
Report Sect. Reference 4 14

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COPY

EMISSION TEST REPORT

WALKING VANE BAKEOUT OVEN EXHAUST

3M CORPORATION
PEERLESS STREET PLANT
CHATTANOOGA, TENNESSEE

May 1981

Prepared by: Dale Hershey

Reviewed by: Richard W. Gerstle, P.E.

PN: 5179

Environmental Engineering and Pollution Control/3M

PO Box 33331
St. Paul, Minnesota 55133
612/778 4791

July 2, 1981

3M

Subject: 3M Chattanooga
Electric Bakeout Oven
Permit 0090-30500899-68T

Mr. C. E. Rollins
Chattanooga - Hamilton County
Air Pollution Control Bureau
3511 Rossville Boulevard
Chattanooga, TN 37407

Dear Mr. Rollins:

On May 20-21, 1981, PEDCo Environmental, tested the air emissions from the electric bakeout oven at our Chattanooga plant. I have enclosed one copy of the emission test report for your review.

As noted in the report, the average organic emission rate was 0.24 lbs/hr. with or without the catalytic converter. On the basis of this test, it appears that the prime benefit of the converter was the reduction of a visible emission plume.

If you have any questions or need additional information to finalize our permit for this process, please contact me at (612) 778-5200.

Yours truly,

Robert Paschke

Robert A. Paschke, P.E.
Environmental Specialist

RAP/dmt

Enc.

REPORT CERTIFICATION

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

Date: June 15 1995 Signature: Daft C Hanley

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

Date: June 15, 1995 Signature: Richard W. Gerstle

Richard W. Gerstle, P.E.

CONTENTS

1.0 INTRODUCTION

On May 20 and 21, 1981, personnel from PEDCo Environmental, Inc., conducted emission tests on the walking vane bakeout oven at the 3M Corporation Peerless Street Plant in Chattanooga, Tennessee. The bakeout oven is used to dry small molded plastic pieces for electrical circuit boards. Tests for hydrocarbon emissions were conducted using the procedures of EPA Reference Method 25*. Exhaust stream temperature and flow rate were measured by EPA Methods 1 and 2**.

Mr. Gary Hipple and Mr. Larry Wingo of the 3M Corporation coordinated the process operation and testing activities. The following personnel from the Chattanooga-Hamilton County Air Pollution Control Bureau were on hand to observe the sampling program: Gary Ewing, C.E. Rollins, and Harvey Rice.

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*Federal Register, Vol. 45, No. 194, October 3, 1980.

**Federal Register, Vol. 42, No. 160, August 18, 1977.

2.0 SUMMARY OF RESULTS

Emissions from the walking vane bakeout oven are controlled by a catalytic oxidizer. Testing was conducted with the oxidizer on to determine the controlled emission rate and with the oxidizer off to determine the uncontrolled emission rate. The measured exhaust stream flow rates for both operating conditions are listed in Table 2-1. With the oxidizer on, the exhaust flow rate averaged 14690 scfh. The gas stream temperature was 150°F as measured with a mercury in glass thermometer. A wet bulb-dry bulb measurement showed 1.7 percent moisture in the gas stream. The percent oxygen and carbon dioxide in the gas stream was measured with Fyrite^{R} analyzers. The carbon dioxide content was below the detectable level for the Fyrite^{R} analyzer. With the oxidizer off, the exhaust gas temperature was 102°F and the average flow rate was 17040 scfh. Gas stream moisture content was measured at 1.6 percent.

Emissions data from the Method 25* sampling are summarized in Table 2-2. Three sets of duplicate samples were collected during each operating condition. With the oxidizer on, the non-methane organic (NMO) concentration in the exhaust stack ranged from 328 to 704 parts per million (ppm) with an average concentration of 536 ppm measured as methane. The average emission rate of organic carbon was 0.24 lb/h.

*Federal Register, Vol. 45, No. 194, October 3, 1980.

TABLE 2-1. EXHAUST STREAM FLOW RATE AND COMPOSITION

Process operating conditions	Run No.	Gas stream flow rate		Temperature, °F	Moisture[b], %	Carbon dioxide[c], %	Oxygen[c], %
		actual acfh	standard[a] scfh				
Controlled - oxidizer on	V-1	17470	14880	148	1.7	0	21
	V-2	17150	14500	152	1.7	0	21
Average		17310	14690	150	1.7	0	21
Uncontrolled - oxidizer off	V-3	19450	18060	102	1.6	0	21
	V-4	17610	16380	101	1.6	0	21
	V-5	18000	16690	104	1.6	0	21
Average		18350	17040	102	1.6	0	21

[a]Standard conditions: 68°F, 29.92 in. Hg.

[b]Moisture measured by wet bulb/dry bulb technique.

[c]Measured with Fyrite[R] analyzers.

TABLE 2-2. EMISSIONS DATA SUMMARY

Process operating conditions	Sample I.D.	NMO concentration, ppm as CH_4[a]	Organic carbon emission rate, lb/h as C_1[b]
Controlled - oxidizer on	CBO-1A	328	0.15
	CBO-1B	c	c
	CBO-2A	473	0.22
	CBO-2B	574	0.26
	CBO-3A	704	0.32
	CBO-3B	601	0.27
Average		536	0.24
Uncontrolled - oxidizer off	UCBO-1A	350	0.19
	UCBO-1B	275	0.15
	UCBO-2A	408	0.22
	UCBO-2B	472	0.25
	UCBO-3A	620	0.33
	UCBO-3B	607	0.32
Average		455	0.24

[a]NMO = Nonmethane organics measured as methane.

[b]Based on the molecular weight of carbon - 12 lb/lb mole, and the average standard exhaust air flow rate from Table 2-1.

[c]Sample was lost in shipment due to a fracture in the condensate trap. Sample CBO-1B was not analyzed.

With the oxidizer off, the average uncontrolled emission rate of organic carbon was also 0.24 lb/h. The uncontrolled nonmethane organic concentrations ranged from 275 to 620 ppm with an average value of 455 ppm as methane. During the sampling, it was observed that the oxidizer considerably reduced the visible emissions from the exhaust stack. However, from the data it appears that the oxidizer does not reduce the quantity of organic emissions.

One sample from the controlled emissions tests was lost in shipment due to a fracture in the condensate trap. This sample was not analyzed.

Appendix B of the report contains all field data sheets for this test. Laboratory results for the Method 25 tests are in Appendix C.

3.0 PROCESS DESCRIPTION

Figure 3-1 is a process diagram showing the walking vane bakeout oven and exhaust system. The bakeout oven is used to dry small plastic parts for electrical circuits. The plastic parts are stacked on trays and drawn through the oven by means of a conveyor belt which operates at the rate of 3/4 inch per minute. Approximately 2500 g of plastic parts are loaded on each tray and trays are fed to the oven at the rate of 1 tray per 23 minutes. During the emission testing the plastic material feed rate was about 15 lb/h. All testing was conducted after the oven had been filled with material.

The oven has four heating zones which operate at 250°C. Air from the heating zones is aspirated into a catalytic oxidizer for emission control. The outlet of the oxidizer consists of a 2-1/2 inch diameter pipe. Air from the oxidizer exhaust is drawn along with dilution air through a 6 in. I.D. exhaust stack and vented above the roof level. Emission samples were collected from the 6 in. exhaust duct through sample ports installed about 5 feet above the roof level.

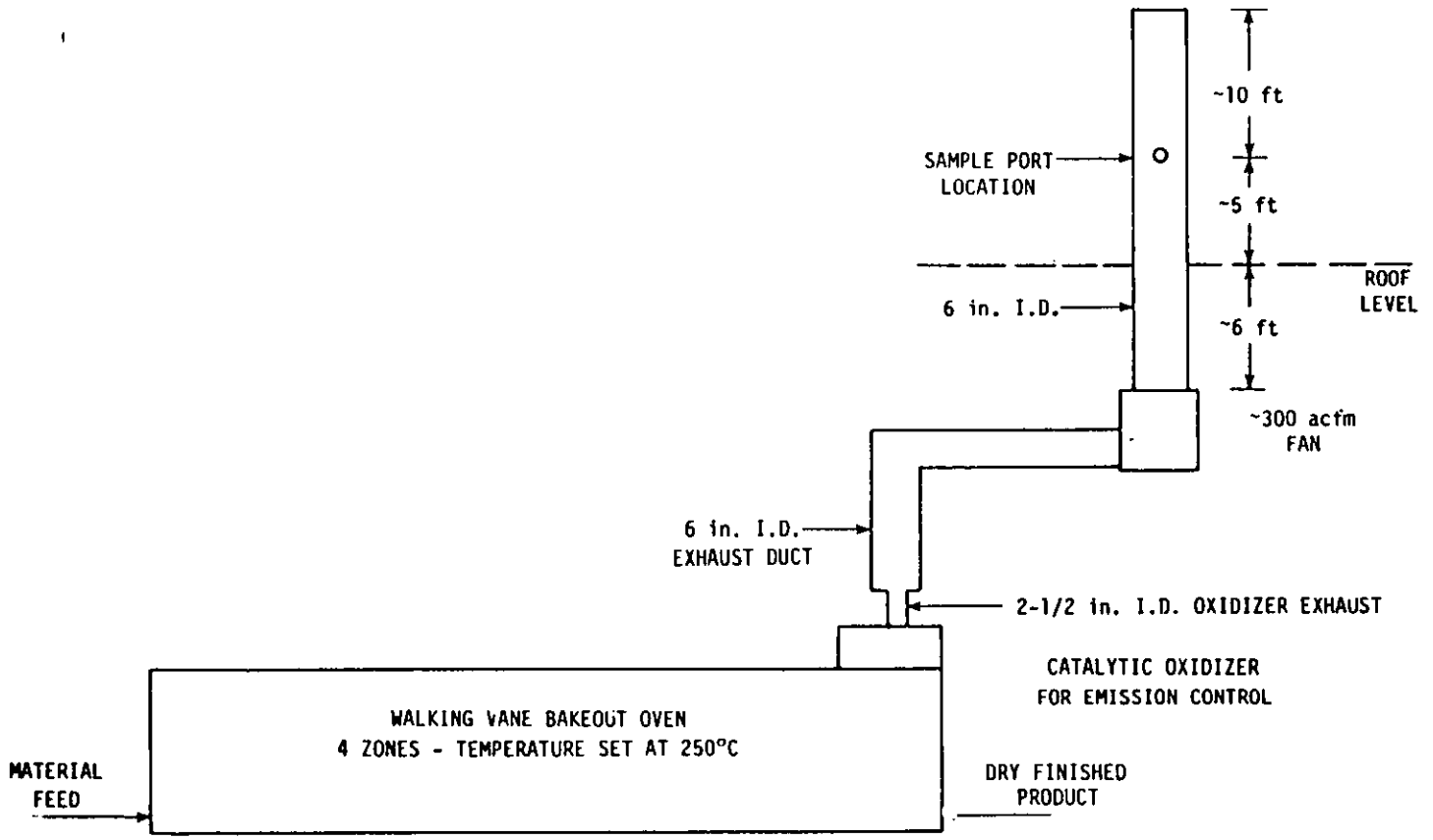

Figure 3-1. Process diagram for walking vane bakeout oven. 3M Corp., Chattanooga, Tennessee

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 GAS STREAM FLOW RATE AND COMPOSITION

Exhaust gas flow rate and temperature were measured by EPA Methods 1 and 2*. A total of 12 sampling points were used for each velocity traverse on the six inch diameter duct. Gas velocity was measured using a standard type pitot tube and an inclined manometer with divisions of 0.005 in. H_2O on a 0 to 0.25 in. H_2O scale.

The standard type pitot tube was used to minimize flow disturbance in the small diameter duct. Gas stream temperature was measured with an ASTM grade mercury-in-glass thermometer. Moisture content of the exhaust air was determined by wet bulb/dry bulb measurements using a mercury-in-glass thermometer.

Fyrite^R analyzers were used to check the carbon dioxide and oxygen content of the gas stream.

4.2 HYDROCARBON EMISSIONS

Sampling and analysis for hydrocarbon emissions was conducted using EPA Method 25** for the determination of total gaseous nonmethane organics. Samples were collected by drawing

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*Federal Register, Vol. 42, No. 160, August 18, 1977.

**Federal Register, Vol. 45, No. 194, October 3, 1980.

gas from the stack through a dry-ice condensate trap by means of an evacuated sample tank. Sampling was conducted at a single point in the stack and a constant sampling rate between 80 and 90 ml/min was maintained. Both the sample tank and the condensate trap were analyzed to determine the nonmethane organic content of the exhaust gas.

Analysis of the tank fraction was accomplished by injecting the sample into an analyzer which separates the nonmethane organics from CO, CO_2, and CH_4, oxidizes the components to CO_2 and reduces the CO_2 to methane for measurement with a flame ionization detector (FID).

Condensate was recovered by heating the trap and probe line to 650°C, converting the contents to carbon dioxide with a catalytic oxidizer, and collecting the CO_2 in an intermediate collection tank. The intermediate tank was analyzed by injecting the contents into the analyzer where the CO_2 was reduced to methane and measured with the FID. The total gaseous nomethane organic content was determined by summing the results of the trap and tank analyses. A complete description of the sampling and analytical procedures is in Appendix D of this report. Laboratory results and calibration procedures are in Appendices C and E, respectively.

5.0 QUALITY ASSURANCE

The quality assurance procedures specified in Method 25 include oxidation and reduction catalyst checks, complete calibration of the NMO analyzer, use of proper materials of construction for sampling tanks and traps (316 stainless steel), and checks to determine the blank values for the analyzer and trap conditioning apparatus carrier gases. In addition, PEDCo has found it necessary to use the following procedures to check and prepare sampling equipment before testing. Prior to each test, all condensate traps are checked for cleanliness using the trap conditioning apparatus. Traps are heated to 650°C with carrier gas passing through the trap, and oxidizer, and into an intermediate collection tank. The intermediate collection tank is then analyzed to determine the level of contaminant remaining in the trap. This process is repeated until an acceptable blank value is obtained. Typical blank values for traps range from 5 to 10 ppm.

Gas sampling tanks are cleaned by evacuating the tanks and filling with nitrogen. This procedure is repeated until an analysis of the tank on the Method 25 analyzer demonstrates that the tank contains no contaminants from previous sampling jobs. All tanks to be used in a testing program are checked in this manner before shipment to the sampling site.

Chromatograms showing the blank checks for the traps and tanks used in this test are in Appendix C with the laboratory results.

APPENDIX A

METHOD 25 AND EMISSION STREAM FLOW RATE CALCULATIONS

```
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
```

```
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
```

```
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
```



```
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
```

```
:JOB RPT,P5179.PEI,PUB
PRIORITY = ES; INPRI = 8; TIME = UNLIMITED SECONDS
JOB NUMBER = #J107
WED, JUN  3, 1981,  4:10 PM
HP3000 / MPE III B.01.16
:RUN STKVELPG.STACK
```

STACK VELOCITY DATA

PLANT	3M CHATTANOOGA
DATE	05/20/81
SAMPLING LOCATION	BAKE OVEN EXHAUST
RUN NUMBER	V-1
CLOCK TIME	1400
OPERATOR	HERSHEY
AMBIENT TEMP. (DEG.F)	65.
BAR.PRESS.(IN HG)	29.33
STATIC PRESS.(IN H2O)	.03
MOLECULAR WEIGHT	28.81
STACK INSIDE DIM(IN)	6.000
PITOT TUBE COEFF.	1.00
MOISTURE CONTENT(%)	1.70

TRAVERSE POINT NO.	POSITION INCHES	VELOCITY HEAD (IN H2O)	STACK TEMP (DEG.F)
01	.0	.085	148.
02	.0	.120	148.
03	.0	.127	148.
04	.0	.130	148.
05	.0	.123	148.
06	.0	.110	148.
01	.0	.110	148.
02	.0	.118	148.
03	.0	.135	148.
04	.0	.126	148.
05	.0	.115	148.
06	.0	.100	148.
AVERAGE		.117	148.

PLANT	3M CHATTANOOGA
DATE	05/20/81
SAMPLING LOCATION	BAKE OVEN EXHAUST
RUN NUMBER	V-1

STACK AREA, SQ. FT.	.196
STACK ABS. PRES., IN HG.	29.33
STACK GAS TEMPERATURE, DEG.F	148.
SQRT(VEL HD X STACK TEMP ABS)	8.4
STACK GAS VELOCITY, ACT. FPS	24.7
STACK GAS VOLUME (WET), ACT. CFM.	291.2
STACK GAS VOLUME (DRY), ACT. CFM.	286.2
STACK GAS VOLUME @ 29.92 IN. HG AND 68 DG. F :	
(DRY)	243.7
(WET)	247.9

SAMPLE CALCULATIONS

SYMBOLS:

AREA	CROSS-SECTIONAL STACK AREA, SQ FT	PTC	PITOT TUBE COEFFICENT
BPRES	BAROMETRIC PRESSURE, IN HG	SPRES	STATIC PRESSURE, IN H2O
DELP	DELTA P	STEMP	STACK TEMPERATURE, DEG F
DIA	DIAMETER OF CIRCULAR STACK, IN	STPRES	STACK PRESSURE, IN HG
DIM1	LENGTH OF RECTANGULAR STACK, IN	STVEL	STACK VELOCITY, AFPM
DIM2	WIDTH OF RECTANGULAR STACK, IN	TEMP	TEMPERATURE, DEG F
MOIST	MOISTURE CONTENT	VH	VELOCITY HEAD, IN H2O
MW	MOLECULAR WEIGHT	SVOLFLW	STANDARD VOLUMETRIC FLOW (WET), ACFM
NP	NUMBER OF TRAVERSE POINTS	VOLFLW	VOLUMETRIC FLOW (WET), ACFM
BW	MOLE FRACTION WATER VAPOR	SVOLFLD	STANDARD VOLUMETRIC FLOW (DRY), DSCFM

FORMULAS AND SAMPLE CALCULATIONS:

$$DELP = \frac{SUM[SQRT[VH * TEMP]]}{NP} = \frac{100.9}{12} = 8.4$$

$$STPRES = BPRES + (SPRES/13.6) = 29.33 + (.03/13.6) = 29.3 \text{ IN HG}$$

$$STEMP = \frac{SUM[STEMP]}{NP} = \frac{1776.}{12} = 148. \text{ DEG F}$$

$$AREA(CIRCULAR\ STACK) = \frac{3.1416 * (DIA/2)**2}{144} = \frac{3.1416 * (6.000/2)**2}{144} = .196 \text{ SQ FT}$$

$$STVEL = \frac{85.49 * PTC * DELP}{SQRT[MW * STPRES]} = \frac{85.49 * 1.00 * 8.4}{SQRT[28.81 * 29.3]} = 24.7 \text{ AFPM}$$

$$VOLFLW = 60. * STVEL * AREA = 60. * 24.7 * .196 = 291.2 \text{ ACFM}$$

$$SVOLFLW = \frac{VOLFLW * STPRES * (460. + 68.)}{29.92 * (STEMP + 460.)} = \frac{291.2 * 29.3 * (460. + 68.)}{29.92 * (148.0 + 460.)} = 247.9 \text{ ACFM}$$

$$SVOLFLD = SVOLFLW * (1 - BW) = 247.9 * (1 - .02) = 243.7 \text{ DSCFM}$$

STACK VELOCITY DATA

PLANT	3M CHATTANOOGA
DATE	05/20/81
SAMPLING LOCATION	BAKE OVEN EXHAUST
RUN NUMBER	V-2
CLOCK TIME	1510
OPERATOR	HERSHEY
AMBIENT TEMP. (DEG.F)	67.
BAR.PRESS.(IN HG)	29.33
STATIC PRESS.(IN H2O)	-.03
MOLECULAR WEIGHT	28.81
STACK INSIDE DIM(IN)	6.000
PITOT TUBE COEFF.	1.00
MOISTURE CONTENT(%)	1.70

TRAVERSE POINT NO.	POSITION INCHES	VELOCITY HEAD (IN H2O)	STACK TEMP (DEG.F)
01	.0	.110	152.
02	.0	.116	152.
03	.0	.127	152.
04	.0	.127	152.
05	.0	.112	152.
06	.0	.092	152.
01	.0	.095	152.
02	.0	.115	152.
03	.0	.125	152.
04	.0	.122	152.
05	.0	.102	152.
06	.0	.095	152.
AVERAGE		.112	152.

PLANT	3M CHATTANOOGA
DATE	05/20/81
SAMPLING LOCATION	BAKE OVEN EXHAUST
RUN NUMBER	V-2
STACK AREA, SQ. FT.	.196
STACK ABS. PRES., IN HG.	29.33
STACK GAS TEMPERATURE, DEG.F	152.
SQRT(VEL HD X STACK TEMP ABS)	8.2
STACK GAS VELOCITY, ACT. FPS	24.3
STACK GAS VOLUME (WET), ACT. CFM.	285.8
STACK GAS VOLUME (DRY), ACT. CFM.	280.9
STACK GAS VOLUME @ 29.92 IN. HG AND 68 DG. F	
(DRY)	237.6
(WET)	241.7

SAMPLE CALCULATIONS

SYMBOLS:

AREA	CROSS-SECTIONAL STACK AREA, SQ FT	PTC	PITOT TUBE COEFFICENT
BPRES	BAROMETRIC PRESSURE, IN HG	SPRES	STATIC PRESSURE, IN H2O
DELP	DELTA P	STEMP	STACK TEMPERATURE, DEG F
DIA	DIAMETER OF CIRCULAR STACK, IN	STPRES	STACK PRESSURE, IN HG
DIM1	LENGTH OF RECTANGULAR STACK, IN	STVEL	STACK VELOCITY, AFPM
DIM2	WIDTH OF RECTANGULAR STACK, IN	TEMP	TEMPERATURE, DEG F
MOIST	MOISTURE CONTENT	VH	VELOCITY HEAD, IN H2O
MW	MOLECULAR WEIGHT	SVOLFLW	STANDARD VOLUMETRIC FLOW (WET), ACFM
NP	NUMBER OF TRAVERSE POINTS	VOLFLW	VOLUMETRIC FLOW (WET), ACFM
BW	MOLE FRACTION WATER VAPOR	SVOLFLD	STANDARD VOLUMETRIC FLOW (DRY), DSCFM

FORMULAS AND SAMPLE CALCULATIONS:

$$DELP = \frac{SUM(SQRT(VH * TEMP))}{NP} = \frac{99.0}{12} = 8.2$$

STPRES = BPRES + (SPRES/13.6) = 29.33 + (.03/13.6) = 29.3 IN HG

$$STEMP = \frac{SUM(STEMP)}{NP} = \frac{1824.}{12} = 152. \text{ DEG F}$$

$$AREA(CIRCULAR\ STACK) = \frac{3.1416 * (DIA/2)^{**}2}{144} = \frac{3.1416 * (6.000/2)^{**}2}{144} = .196 \text{ SQ FT}$$

$$STVEL = \frac{85.49 * PTC * DELP}{SQRT(MW * STPRES)} = \frac{85.49 * 1.00 * 8.2}{SQRT(28.81 * 29.3)} = 24.3 \text{ AFPM}$$

VOLFLW = 60. * STVEL * AREA = 60. * 24.3 * .196 = 285.8 ACFM

$$SVOLFLW = \frac{VOLFLW * STPRES * (460. + 68.)}{29.92 * (STEMP + 460.)} = \frac{285.8 * 29.3 * (460. + 68.)}{29.92 * (152.0 + 460.)} = 241.7 \text{ ACFM}$$

SVOLFLD = SVOLFLW * (1 - BW) = 241.7 * (1 - .02) = 237.6 DSCFM

[redacted] STACK VELOCITY DATA

PLANT	3M CHATTANOOGO
DATE	05/21/81
SAMPLING LOCATION	BAKE OVEN EXHAUST
RUN NUMBER	V-3
CLOCK TIME	900
OPERATOR	HERSHEY
AMBIENT TEMP. (DEG.F)	68.
BAR. PRESS. (IN HG)	29.57
STATIC PRESS. (IN H2O)	.03
MOLECULAR WEIGHT	28.85
STACK INSIDE DIM(IN)	6.000
PITOT TUBE COEFF.	1.00
MOISTURE CONTENT(%)	1.40

TRAVERSE POINT NO.	POSITION INCHES	VELOCITY HEAD (IN H2O)	STACK TEMP (DEG.F)
01	.0	.135	102.
02	.0	.165	102.
03	.0	.170	102.
04	.0	.170	102.
05	.0	.160	102.
06	.0	.140	102.
01	.0	.150	102.
02	.0	.163	102.
03	.0	.175	102.
04	.0	.172	102.
05	.0	.157	102.
06	.0	.132	102.
AVERAGE		.157	102.

PLANT	3M CHATTANOOGO
DATE	05/21/81
SAMPLING LOCATION	BAKE OVEN EXHAUST
RUN NUMBER	V-3

STACK AREA, SQ. FT.	.196
STACK ABS. PRES., IN HG	29.57
STACK GAS TEMPERATURE, DEG.F	102.
SQRT(VEL HD X STACK TEMP ABS)	9.4
STACK GAS VELOCITY, ACT. FPS	27.5
STACK GAS VOLUME (WET), ACT. CFM.	324.1
STACK GAS VOLUME (DRY), ACT. CFM.	319.0
STACK GAS VOLUME @ 29.92 IN. HG AND 68 DG. F :	
(DRY)	296.2
(WET)	301.0

SYMBOLS:

AREA	CROSS-SECTIONAL STACK AREA, SQ FT	PTC	PITOT TUBE COEFFICENT
BPRES	BAROMETRIC PRESSURE, IN HG	SPRES	STATIC PRESSURE, IN H2O
DELP	DELTA P	STEMP	STACK TEMPERATURE, DEG F
DIA	DIAMETER OF CIRCULAR STACK, IN	STPRES	STACK PRESSURE, IN HG
DIM1	LENGTH OF RECTANGULAR STACK, IN	STVEL	STACK VELOCITY, AFPM
DIM2	WIDTH OF RECTANGULAR STACK, IN	TEMP	TEMPERATURE, DEG F
MOIST	MOISTURE CONTENT	VH	VELOCITY HEAD, IN H2O
MW	MOLECULAR WEIGHT	SVOLFLW	STANDARD VOLUMETRIC FLOW (WET), ACFM
NP	NUMBER OF TRAVERSE POINTS	VOLFLW	VOLUMETRIC FLOW (WET), ACFM
SW	MOLE FRACTION WATER VAPOR	SVOLFLD	STANDARD VOLUMETRIC FLOW (DRY), DSCFM

FORMULAS AND SAMPLE CALCULATIONS:

$$DELP = \frac{SUM(SQRT(VH * TEMP))}{NP} = \frac{112.7}{12} = 9.4$$

$$STPRES = BPRES + (SPRES/13.6) = 29.57 + (\ .03/13.6) = 29.6 \text{ IN HG}$$

$$STEMP = \frac{SUM(STEMP)}{NP} = \frac{1224.}{12} = 102. \text{ DEG F}$$

$$AREA(CIRCULAR\ STACK) = \frac{3.1416 * (DIA/2)^{**}2}{144} = \frac{3.1416 * (\ 6.000/2)^{**}2}{144} = .196 \text{ SQ FT}$$

$$STVEL = \frac{85.49 * PTC * DELP}{SQRT(MW * STPRES)} = \frac{85.49 * 1.00 * 9.4}{SQRT(\ 28.82 * 29.6\ )} = 27.5 \text{ AFPM}$$

$$VOLFLW = 60. * STVEL * AREA = 60. * 27.5 * .196 = 324.1 \text{ ACFM}$$

$$SVOLFLW = \frac{VOLFLW * STPRES * (\ 460. + 68.\ )}{29.92 * (\ STEMP + 460.\ )} = \frac{324.1 * 29.6 * (\ 460. + 68.\ )}{29.92 * (\ 102.0 + 460.\ )} = 301.0 \text{ ACFM}$$

$$SVOLFLD = SVOLFLW * (1 - SW) = 301.0 * (1 - .02) = 296.2 \text{ DSCFM}$$

STACK VELOCITY DATA

PLANT	3M CHATTANOOGA
DATE	05/21/81
SAMPLING LOCATION	BAKE OVEN EXHAUST
RUN NUMBER	V-4
CLOCK TIME	1020
OPERATOR	HERSHEY
AMBIENT TEMP. (DEG.F)	68.
BAR.PRESS.(IN HG)	29.57
STATIC PRESS.(IN H2O)	-.03
MOLECULAR WEIGHT	28.92
STACK INSIDE DIM(IN)	6.000
PITOT TUBE COEFF.	1.00
MOISTURE CONTENT(%)	1.60

TRAVERSE POINT NO.	POSITION INCHES	VELOCITY HEAD (IN H2O)	STACK TEMP (DEG.F)
01	.0	.100	101.
02	.0	.120	101.
03	.0	.141	101.
04	.0	.145	101.
05	.0	.135	101.
06	.0	.116	101.
01	.0	.115	101.
02	.0	.130	101.
03	.0	.145	101.
04	.0	.142	101.
05	.0	.104	101.
06	.0	.120	101.
AVERAGE		.129	101.

PLANT		3M CHATTANOOGA
DATE		05/21/81
SAMPLING LOCATION		BAKE OVEN EXHAUST
RUN NUMBER		V-4
STACK AREA, SQ. FT.		.196
STACK ABS. PRES., IN HG.		29.57
STACK GAS TEMPERATURE, DEG.F		101.
SQRT(VEL HD X STACK TEMP ABS)		8.5
STACK GAS VELOCITY, ACT. FPS		24.9
STACK GAS VOLUME (WET), ACT. CFM.		293.5
STACK GAS VOLUME (DRY), ACT. CFM.		288.8
STACK GAS VOLUME @ 29.92 IN. HG AND 68 DG. F :		
(DRY)		268.6
(WET)		273.0

SAMPLE CALCULATIONS

SYMBOLS:

AREA	CROSS-SECTIONAL STACK AREA, SQ FT	PTC	PITOT TUBE COEFFICENT
BPRES	BAROMETRIC PRESSURE, IN HG	SPRES	STATIC PRESSURE, IN H2O
DELP	DELTA P	STEMP	STACK TEMPERATURE, DEG F
DIA	DIAMETER OF CIRCULAR STACK, IN	STPRES	STACK PRESSURE, IN HG
DIM1	LENGTH OF RECTANGULAR STACK, IN	STVEL	STACK VELOCITY, AFPM
DIM2	WIDTH OF RECTANGULAR STACK, IN	TEMP	TEMPERATURE, DEG F
MOIST	MOISTURE CONTENT	VH	VELOCITY HEAD, IN H2O
MW	MOLECULAR WEIGHT	SVOLFLW	STANDARD VOLUMETRIC FLOW (WET), ACFM
NP	NUMBER OF TRAVERSE POINTS	VOLFLW	VOLUMETRIC FLOW (WET), ACFM
BW	MOLE FRACTION WATER VAPOR	SVOLFLD	STANDARD VOLUMETRIC FLOW (DRY), DSCFM

FORMULAS AND SAMPLE CALCULATIONS:

$$DELP = \frac{SUM(SQRT[VH * TEMP])}{NP} = \frac{102.1}{12} = 8.5$$

$$STPRES = BPRES + (SPRES/13.6) = 29.57 + (.03/13.6) = 29.6 \text{ IN HG}$$

$$STEMP = \frac{SUM(STEMP)}{NP} = \frac{1212.}{12} = 101. \text{ DEG F}$$

$$AREA(CIRCULAR\ STACK) = \frac{3.1416 * (DIA/2)^{**}2}{144} = \frac{3.1416 * (6.000/2)^{**}2}{144} = .196 \text{ SQ FT}$$

$$STVEL = \frac{85.49 * PTC * DELP}{SQRT[MW * STPRES]} = \frac{85.49 * 1.00 * 8.5}{SQRT[28.82 * 29.6]} = 24.9 \text{ AFPM}$$

$$VOLFLW = 60. * STVEL * AREA = 60. * 24.9 * .196 = 293.5 \text{ ACFM}$$

$$SVOLFLW = \frac{VOLFLW * STPRES * (460. + 68.)}{29.92 * (STEMP + 460.)} = \frac{293.5 * 29.6 * (460. + 68.)}{29.92 * (101.0 + 460.)} = 273.0 \text{ ACFM}$$

$$SVOLFLD = SVOLFLW * (1 - BW) = 273.0 * (1 - .02) = 268.6 \text{ DSCFM}$$

STACK VELOCITY DATA

PLANT	3M CHATTANOOGA
DATE	05/21/81
SAMPLING LOCATION	BAKE OVEN EXHAUST
RUN NUMBER	V-5
CLOCK TIME	1130
OPERATOR	HERSHEY
AMBIENT TEMP. (DEG.F)	70.
BAR.PRESS.(IN HG)	29.61
STATIC PRESS.(IN H2O)	.03
MOLECULAR WEIGHT	28.82
STACK INSIDE DIM(IN)	6.000
PITOT TUBE COEFF.	1.00
MOISTURE CONTENT(%)	1.60

TRAVERSE POINT NO.	POSITION INCHES	VELOCITY HEAD (IN H2O)	STACK TEMP (DEG.F)
01	.0	.100	104.
02	.0	.130	104.
03	.0	.146	104.
04	.0	.147	104.
05	.0	.135	104.
06	.0	.125	104.
01	.0	.120	104.
02	.0	.140	104.
03	.0	.150	104.
04	.0	.149	104.
05	.0	.142	104.
06	.0	.133	104.
AVERAGE		.135	104.

PLANT	3M CHATTANOOGA
DATE	05/21/81
SAMPLING LOCATION	BAKE OVEN EXHAUST
RUN NUMBER	V-5

STACK AREA, SQ. FT.	.196
STACK ABS. PRES., IN HG.	29.61
STACK GAS TEMPERATURE, DEG.F	104.
SQRT(VEL HD X STACK TEMP ABS)	8.7
STACK GAS VELOCITY, ACT. FPS	25.5
STACK GAS VOLUME (WET), ACT. CFM.	300.1
STACK GAS VOLUME (DRY), ACT. CFM.	295.3
STACK GAS VOLUME @ 29.92 IN. HG AND 68 DG. F :	
(DRY)	273.6
(WET)	278.1

SAMPLE CALCULATIONS

SYMBOLS:

AREA	CROSS-SECTIONAL STACK AREA, SQ FT	PTC	PITOT TUBE COEFFICENT
BPRES	BAROMETRIC PRESSURE, IN HG	SPRES	STATIC PRESSURE, IN H2O
DELP	DELTA P	STEMP	STACK TEMPERATURE, DEG F
DIA	DIAMETER OF CIRCULAR STACK, IN	STPRES	STACK PRESSURE, IN HG
DIM1	LENGTH OF RECTANGULAR STACK, IN	STVEL	STACK VELOCITY, AFPM
DIM2	WIDTH OF RECTANGULAR STACK, IN	TEMP	TEMPERATURE, DEG F
MOIST	MOISTURE CONTENT	VH	VELOCITY HEAD, IN H2O
MW	MOLECULAR WEIGHT	SVOLFLW	STANDARD VOLUMETRIC FLOW (WET), ACFM
NP	NUMBER OF TRAVERSE POINTS	VOLFLW	VOLUMETRIC FLOW (WET), ACFM
BW	MOLE FRACTION WATER VAPOR	SVOLFLD	STANDARD VOLUMETRIC FLOW (DRY), DSCFM

FORMULAS AND SAMPLE CALCULATIONS:

$$DELP = \frac{SUM[SQRT(VH * TEMP)]}{NP} = \frac{104.5}{12} = 8.7$$

$$STPRES = BPRES + (SPRES/13.6) = 29.61 + (.03/13.6) = 29.6 \text{ IN HG}$$

$$STEMP = \frac{SUM[STEMP]}{NP} = \frac{1248.}{12} = 104. \text{ DEG F}$$

$$AREA(\text{CIRCULAR STACK}) = \frac{3.1416 * (DIA/2)^{**}2}{144} = \frac{3.1416 * (6.000/2)^{**}2}{144} = .196 \text{ SQ FT}$$

$$STVEL = \frac{85.49 * PTC * DELP}{SQRT[MW * STPRES]} = \frac{85.49 * 1.00 * 8.7}{SQRT[28.82 * 29.6]} = 25.5 \text{ AFPM}$$

$$VOLFLW = 60. * STVEL * AREA = 60. * 25.5 * .196 = 300.1 \text{ ACFM}$$

$$SVOLFLW = \frac{VOLFLW * STPRES * (460. + 68.)}{29.92 * (STEMP + 460.)} = \frac{300.1 * 29.6 * (460. + 68.)}{29.92 * (104.0 + 460.)} = 278.1 \text{ ACFM}$$

$$SVOLFLD = SVOLFLW * (1 - BW) = 278.1 * (1 - .02) = 273.6 \text{ DSCFM}$$

```
END OF PROGRAM
!EOJ
CPU SEC. = 9.  ELAPSED MIN. = 1.  WED, JUN  3, 1981,  4:11 PM
```

```
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM

#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM

#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM

#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
#J107; #0785  *  RPT, P5179.PEI; $STDLIST  *  WED, JUN  3, 1981,  4:11 PM
```

METHOD 25 CALCULATIONS

Equations:

1.0 Gas volume samples, V_s

$$V_s = 0.386 \frac{°K}{mm\ Hg} V \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

where:

V - Gas collection tank volume, dscm

P_t - Gas sample tank pressure after sampling but prior to pressurizing, mm Hg, absolute

P_{ti} - Gas sample tank pressure prior to sampling, mm Hg, absolute

T_t - Sample tank temperature at completion of sampling, °K

T_{ti} - Sample tank temperature before sampling, °K

2.0 Source concentration of non-condensible organics, C_T

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \times C_{tm}$$

where:

C_{tm} - Measured concentration of gas sample tank, ppm methane

P_{tf} - Final tank pressure after pressurizing, mm Hg, absolute

T_{tf} - Sample tank temperature after pressurizing, °K

3.0 Source concentration of condensible organics from trap recovery, C_c

$$C_c = 0.386 \frac{V_v \times P_f}{V_s \times T_t} \times C_{cm}$$

where:

V_v - Intermediate collection tank volume, dscm

V_s - Gas sample volume, dscm

P_f - Final pressure of intermediate collection tank, mm Hg, absolute

T_f - Final temperature of intermediate collection tank, °K

C_{cm} - Measured concentration of intermediate collection tank, ppm as methane

4.0 Total gaseous non-methane organic (TGNMO) concentration at source, C, ppm methane

$$C = C_t + C_c$$

METHOD 25 CALCULATIONS

Field Data and Results:

Plant 3M Chattanooga Test date 5-20-81

Sampling location Walking Cane Kiln Run number CBO-1A
Bake Oven exhaust

Calculated by M.A. Khabiya

1.0 Sample volume

$$V_s = 0.386\ V\ \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

V - Volume of sample tank,	6.399×10^{-3}	dscm
P_{ti} - Sample tank pre-test pressure,	2.0	mm Hg
T_{ti} - Sample tank pre-test temperature,	293	°K
P_t - Sample tank post-test pressure,	548	mm Hg
T_t - Sample tank post-test temperature,	297	°K
V_s - Volume of gas sampled,	4.5406×10^{-3}	dscm

2.0 Source concentration non-condensible organics, tank fraction

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \times C_{tm}$$

P_{tf} - Final pressurized tank pressure,	948	mm Hg
T_{tf} - Final pressurized tank temperature,	296.5	°K
C_{tm} - Measured concentration of gas sample tank,	122.6	ppm CH_4
C_T - Source concentration of non-condensibles,	213.2	ppm CH_4

Run number CB0-14

3.0 Source concentration of condensible organics, trap fraction

$$C_c = 0.386 \left(\frac{V_v \times P_f}{V_s \times T_f}\right) C_{cm}$$

V_v - Volume of intermediate collection tank, 6.380×10^{-3} dscm

P_f - Final pressure intermediate collection tank, 920 mm Hg

T_f - Final temperature intermediate collection tank, 296.5 °K

C_{cm} - Measured concentration of intermediate tank, 68.1 ppm CH_4

C_c - Source concentration condensible organics, 114.6 ppm CH_4

4.0 Total gaseous non-methane organic (TGNMO) concentration at source

$$C = C_t + C_c$$

C - TGNMO source concentration, 327.8 ppm CH_4

Note: standard conditions - 293°K, 760 mm Hg.

METHOD 25 CALCULATIONS

Field Data and Results:

Plant 3M Test date 5/20/81

Sampling location Bakeout ovens exhaust Run number CBO-2A

Calculated by _____

1.0 Sample volume

$$V_s = 0.386\ V\ \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

V - Volume of sample tank,	6.4208×10^{-3}	dscm
P_{ti} - Sample tank pre-test pressure,	1.0	mm Hg
T_{ti} - Sample tank pre-test temperature,	293	°K
P_t - Sample tank post-test pressure,	559	mm Hg
T_t - Sample tank post-test temperature,	297	°K
V_s - Volume of gas sampled,	4.66×10^{-3}	dscm

2.0 Source concentration non-condensible organics, tank fraction

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \times C_{tm}$$

P_{tf} - Final pressurized tank pressure,	979.3	mm Hg
T_{tf} - Final pressurized tank temperature,	297	°K
C_{tm} - Measured concentration of gas sample tank,	154	ppm CH_4
C_T - Source concentration of non-condensibles,	270	ppm CH_4

Run number CB0-2A

3.0 Source concentration of condensible organics, trap fraction

$$C_c = 0.386 \left(\frac{V_v \times P_f}{V_s \times T_f}\right) C_{cm}$$

V_v - Volume of intermediate collection tank, 6.369×10^{-3} dscm

P_f - Final pressure intermediate collection tank, 973.3 mm Hg

T_f - Final temperature intermediate collection tank, 297 °K

C_{cm} - Measured concentration of intermediate tank, 117.1 ppm CH_4

C_c - Source concentration condensible organics, 202.5 ppm CH_4

4.0 Total gaseous non-methane organic (TGNMO) concentration at source

$$C = C_t + C_c$$

C - TGNMO source concentration, 472.5 ppm CH_4

Note: standard conditions - 293°K, 760 mm Hg.

METHOD 25 CALCULATIONS

Field Data and Results:

Plant 3 M Test date 5/26/81

Sampling location Bake oven exhaust Run number CBO-2B

Calculated by _____

1.0 Sample volume

$$V_s = 0.386\ V\ \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

V - Volume of sample tank, 6.400×10^{-3} dscm

P_{ti} - Sample tank pre-test pressure, 1.0 mm Hg

T_{ti} - Sample tank pre-test temperature, 293 °K

P_t - Sample tank post-test pressure, 547 mm Hg

T_t - Sample tank post-test temperature, 297 °K

V_s - Volume of gas sampled, 4.541×10^{-3} dscm

2.0 Source concentration non-condensible organics, tank fraction

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \times C_{tm}$$

P_{tf} - Final pressurized tank pressure, ~~1003.3~~ 957.3 mm Hg

T_{tf} - Final pressurized tank temperature, 297 °K

C_{tm} - Measured concentration of gas sample tank, 162.2 ppm CH_4

C_T - Source concentration of non-condensibles, ~~298.1~~ 284.4 ppm CH_4

Run number CB0-2B

3.0 Source concentration of condensible organics, trap fraction

$$C_c = 0.386 \left(\frac{V_v \times P_f}{V_s \times T_f}\right) C_{cm}$$

V_v - Volume of intermediate collection tank, 6.368x10^{-3} dscm

P_f - Final pressure intermediate collection tank, 1003.3 mm Hg

T_f - Final temperature intermediate collection tank, 297 °K

$V_s = 4.541 \times 10^{-3}$ m^3

C_{cm} - Measured concentration of intermediate tank, 158.6 ppm CH_4

C_c - Source concentration condensible organics, 290.0 ppm CH_4

4.0 Total gaseous non-methane organic (TGNMO) concentration at source

$$C = C_t + C_c$$

C - TGNMO source concentration, ~~588~~ 574.4 ppm CH_4

Note: standard conditions - 293°K, 760 mm Hg.

METHOD 25 CALCULATIONS

Field Data and Results:

Plant 3M Test date 5/20/81

Sampling location Bake oven exhaust Run number CBO-3A

Calculated by M.A. Khalifa

1.0 Sample volume

$$V_s = 0.386\ V\ \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

V - Volume of sample tank, 6.440×10^{-3} dscm

P_{ti} - Sample tank pre-test pressure, 2.0 mm Hg

T_{ti} - Sample tank pre-test temperature, 296.9 °K

P_t - Sample tank post-test pressure, 339 mm Hg

T_t - Sample tank post-test temperature, 296.9 °K

V_s - Volume of gas sampled, 2.822×10^{-3} dscm

2.0 Source concentration non-condensible organics, tank fraction

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \times C_{tm}$$

P_{tf} - Final pressurized tank pressure, ~~1002.3~~ 944.3 mm Hg

T_{tf} - Final pressurized tank temperature, 296 °K

C_{tm} - Measured concentration of gas sample tank, 94.2 ppm CH_4

C_T - Source concentration of non-condensibles, ~~284.0~~ 264.8 ppm CH_4

Run number CB0-3A

3.0 Source concentration of condensible organics, trap fraction

$$C_c = 0.386 \left(\frac{V_v \times P_f}{V_s \times T_f}\right) C_{cm}$$

V_v - Volume of intermediate collection tank, 6.378 x 10^{-3} dscm

P_f - Final pressure intermediate collection tank, 1002.3 mm Hg

T_f - Final temperature intermediate collection tank, 296 °K

C_{cm} - Measured concentration of intermediate tank, 148.7 ppm CH_4

V_s = 2.822 x 10^{-3}

C_c - Source concentration condensible organics, 439.3 ppm CH_4

4.0 Total gaseous non-methane organic (TGNMO) concentration at source

$$C = C_t + C_c$$

C - TGNMO source concentration, 704.1 ~~720.3~~ ppm CH_4

Note: standard conditions - 293°K, 760 mm Hg.

METHOD 25 CALCULATIONS

Field Data and Results:

Plant 3M Chattanooga Test date 5-20-81

Sampling location Bake out oven exhaust Run number CBO-3B

Calculated by D. Hensley

1.0 Sample volume

$$V_s = 0.386\ V\ \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

V - Volume of sample tank,	6.413×10^{-3}	dscm
P_{ti} - Sample tank pre-test pressure,	2.0	mm Hg
T_{ti} - Sample tank pre-test temperature,	296.9	°K
P_t - Sample tank post-test pressure,	364	mm Hg
T_t - Sample tank post-test temperature,	296.9	°K
V_s - Volume of gas sampled,	3.02×10^{-3}	dscm

2.0 Source concentration non-condensible organics, tank fraction

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \times C_{tm}$$

P_{tf} - Final pressurized tank pressure,		mm Hg
T_{tf} - Final pressurized tank temperature,		°K
C_{tm} - Measured concentration of gas sample tank,	0	ppm CH_4
C_T - Source concentration of non-condensibles,	0	ppm CH_4

Run number CB0-3B

3.0 Source concentration of condensible organics, trap fraction

$$C_c = 0.386 \left(\frac{V_v \times P_f}{V_s \times T_f}\right) C_{cm}$$

V_v - Volume of intermediate collection tank, 6.376x10^3 ~~6.4~~ dscm

P_f - Final pressure intermediate collection tank, 1004.3 mm Hg

T_f - Final temperature intermediate collection tank, 296 °K

C_{cm} - Measured concentration of intermediate tank, 217.4 ppm CH_4

C_c - Source concentration condensible organics, 601.1 ppm CH_4

4.0 Total gaseous non-methane organic (TGNMO) concentration at source

$$C = C_t + C_c$$

C - TGNMO source concentration, 601.1 ppm CH_4

Note: standard conditions - 293°K, 760 mm Hg.

METHOD 25 CALCULATIONS

Field Data and Results:

Plant 3M Test date 5/21/81

Sampling location Bake oven exhaust Run number UCRO-1A

Calculated by M. A. Khalifa

1.0 Sample volume

$$V_s = 0.386\ V\ \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

V - Volume of sample tank, 6.472×10^{-3} dscm

P_{ti} - Sample tank pre-test pressure, 5.0 mm Hg

T_{ti} - Sample tank pre-test temperature, 290.2 °K

P_t - Sample tank post-test pressure, 546 mm Hg

T_t - Sample tank post-test temperature, 295.8 °K

V_s - Volume of gas sampled, 4.568×10^{-3} dscm

2.0 Source concentration non-condensible organics, tank fraction

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \times C_{tm}$$

1.8266

P_{tf} - Final pressurized tank pressure, ~~737.8~~ 931.8 mm Hg

T_{tf} - Final pressurized tank temperature, 296.5 °K

C_{tm} - Measured concentration of gas sample tank, 60.3 ppm CH_4

C_T - Source concentration of non-condensibles, ~~126.5~~ 103.6 ppm CH_4

Run number UCBO-1A

3.0 Source concentration of condensible organics, trap fraction

$$C_c = 0.386 \left(\frac{V_v \times P_f}{V_s \times T_f}\right) C_{cm}$$

V_v - Volume of intermediate collection tank, 6.346×10^{-3} dscm

P_f - Final pressure intermediate collection tank, 1132.8 mm Hg

T_f - Final temperature intermediate collection tank, 296.5 °K

C_{cm} - Measured concentration of intermediate tank, 119.1 ppm CH_4

C_c - Source concentration condensible organics, 246.3 ppm CH_4

4.0 Total gaseous non-methane organic (TGNMO) concentration at source

$$C = C_t + C_c$$

C - TGNMO source concentration, 349.9 ~~372.4~~ ppm CH_4

Note: standard conditions - 293°K, 760 mm Hg.

METHOD 25 CALCULATIONS

Field Data and Results:

Plant 3M Test date 5/21/81

Sampling location Date oven exhaust Run number UCRO-1B

Calculated by M.A. Khalifa

1.0 Sample volume

$$V_s = 0.386\ V\ \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

V - Volume of sample tank, 6.386×10^{-3} dscm

P_{ti} - Sample tank pre-test pressure, 4.10 mm Hg

T_{ti} - Sample tank pre-test temperature, 292 °K

P_t - Sample tank post-test pressure, 482 mm Hg

T_t - Sample tank post-test temperature, 296 °K

V_s - Volume of gas sampled, 3.86×10^{-3} dscm

2.0 Source concentration non-condensible organics, tank fraction

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \times C_{tm}$$

P_{tf} - Final pressurized tank pressure, 889.8 mm Hg

T_{tf} - Final pressurized tank temperature, 296.5 °K

C_{tm} - Measured concentration of gas sample tank, 62.5 ppm CH_4

C_T - Source concentration of non-condensibles, ~~115.9~~ 116.2 ppm CH_4

Run number VCB0-1B

3.0 Source concentration of condensible organics, trap fraction

$$C_c = 0.386 \left(\frac{V_v \times P_f}{V_s \times T_f}\right) C_{cm}$$

1.5678

V_v - Volume of intermediate collection tank, 6.432x10⁻³ dscm

P_f - Final pressure intermediate collection tank, 887.8 mm Hg

T_f - Final temperature intermediate collection tank, 296.5 °K

C_{cm} - Measured concentration of intermediate tank, 84.9 ppm CH_4

C_c - Source concentration condensible organics, 158.6 ppm CH_4

4.0 Total gaseous non-methane organic (TGNMO) concentration at source

$$C = C_t + C_c$$

C - TGNMO source concentration, 274.8 ppm CH_4

Note: standard conditions - 293°K, 760 mm Hg.

METHOD 25 CALCULATIONS

Field Data and Results:

Plant 3M Test date 5-21-81

Sampling location Bake oven exhaust Run number UCBO-24

Calculated by Khalifs

1.0 Sample volume

$$V_s = 0.386\ V\ \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

V - Volume of sample tank, 6.380×10^{-3} dscm

P_{ti} - Sample tank pre-test pressure, 4.0 mm Hg

T_{ti} - Sample tank pre-test temperature, 290.2 °K

P_t - Sample tank post-test pressure, 554.85 mm Hg

T_t - Sample tank post-test temperature, 300.2 °K

V_s - Volume of gas sampled, 4.514×10^{-3} dscm

2.0 Source concentration non-condensible organics, tank fraction

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \times C_{tm}$$

P_{tf} - Final pressurized tank pressure, 851 mm Hg

T_{tf} - Final pressurized tank temperature, 297 °K

C_{tm} - Measured concentration of gas sample tank, 178.6 ppm CH_4

C_T - Source concentration of non-condensibles, ~~307.0~~ 282.3 ppm CH_4

Run number UCBO-2A

3.0 Source concentration of condensible organics, trap fraction

$$C_c = 0.386 \left(\frac{V_v \times P_f}{V_s \times T_f}\right) C_{cm}$$

V_v - Volume of intermediate collection tank, 6.401x10 → dscm

P_f - Final pressure intermediate collection tank, 946 mm Hg

T_f - Final temperature intermediate collection tank, 297 °K

C_{cm} - Measured concentration of intermediate tank, 72 ppm CH_4

C_c - Source concentration condensible organics, 125.6 ppm CH_4

4.0 Total gaseous non-methane organic (TGNMO) concentration at source

$$C = C_t + C_c$$

C - TGNMO source concentration, ~~432.6~~ 407.8 ppm CH_4

Note: standard conditions - 293°K, 760 mm Hg.

METHOD 25 CALCULATIONS

Field Data and Results:

Plant 3M Test date 5/21/81

Sampling location Bake oven exhaust Run number UC80-2R

Calculated by W. H. Khalil

1.0 Sample volume

$$V_s = 0.386\ V\ \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

V - Volume of sample tank, 6.424×10^{-3} dscm

P_{ti} - Sample tank pre-test pressure, 7.0 mm Hg

T_{ti} - Sample tank pre-test temperature, 290.2 °K

P_t - Sample tank post-test pressure, 548.5 mm Hg

T_t - Sample tank post-test temperature, 300.2 °K

V_s - Volume of gas sampled, 4.471×10^{-3} dscm

2.0 Source concentration non-condensible organics, tank fraction

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \times C_{tm}$$

1.803

P_{tf} - Final pressurized tank pressure, 906 mm Hg

T_{tf} - Final pressurized tank temperature, 297 °K

C_{tm} - Measured concentration of gas sample tank, 184.2 ppm CH_4

C_T - Source concentration of non-condensibles, 331.9 ppm CH_4

Run number UC80-2B

3.0 Source concentration of condensible organics, trap fraction

$$C_c = 0.386 \left(\frac{V_v \times P_f}{V_s \times T_f}\right) C_{cm}$$

V_v - Volume of intermediate collection tank, 6.418X10^{-3} dscm

P_f - Final pressure intermediate collection tank, 924 mm Hg

T_f - Final temperature intermediate collection tank, 297 °K

C_{cm} - Measured concentration of intermediate tank, 81.2 ppm CH_4

C_c - Source concentration condensible organics, 140.0 ppm CH_4

4.0 Total gaseous non-methane organic (TGNMO) concentration at source

$$C = C_t + C_c$$

C - TGNMO source concentration, 471.9 ppm CH_4

Note: standard conditions - 293°K, 760 mm Hg.

METHOD 25 CALCULATIONS

Field Data and Results:

Plant 3M Test date 5/21/81

Sampling location Bake oven exhaust Run number MCB0-3A

Calculated by M.A. Khalifs

1.0 Sample volume

$$V_s = 0.386\ V\ \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

V - Volume of sample tank, 6.406×10^{-3} dscm

P_{ti} - Sample tank pre-test pressure, 9.0 mm Hg

T_{ti} - Sample tank pre-test temperature, 291.3 °K

P_t - Sample tank post-test pressure, 493.5 mm Hg

T_t - Sample tank post-test temperature, 301.3 °K

V_s - Volume of gas sampled, 3.974×10^{-3} dscm

2.0 Source concentration non-condensible organics, tank fraction

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)_{1.607}} \times C_{tm}$$

P_{tf} - Final pressurized tank pressure, 902 mm Hg

T_{tf} - Final pressurized tank temperature, 287 °K

C_{tm} - Measured concentration of gas sample tank, 188.1 ppm CH_4

C_T - Source concentration of non-condensibles, 355.5 ppm CH_4

Run number UCRC-24

3.0 Source concentration of condensible organics, trap fraction

$$C_c = 0.386 \left(\frac{V_v \times P_f}{V_s \times T_f}\right) C_{cm}$$

V_v - Volume of intermediate collection tank, 6.369×10^{-3} dscm

P_f - Final pressure intermediate collection tank, 942 mm Hg

T_f - Final temperature intermediate collection tank, 297 °K

C_{cm} - Measured concentration of intermediate tank, 134.8 ppm CH_4

C_c - Source concentration condensible organics, 264.7 ppm CH_4

4.0 Total gaseous non-methane organic (TGNMO) concentration at source

$$C = C_t + C_c$$

C - TGNMO source concentration, 620.2 ppm CH_4

Note: standard conditions - 293°K, 760 mm Hg.

METHOD 25 CALCULATIONS

Field Data and Results:

Plant 3M Test date 5/21/81

Sampling location Bake oven exhaust Run number UCBO-3B

Calculated by M. A. Chatfs

1.0 Sample volume

$$V_s = 0.386\ V\ \left(\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right)$$

V - Volume of sample tank,	6.377×10^{-3}	dscm
P_{ti} - Sample tank pre-test pressure,	6.0	mm Hg
T_{ti} - Sample tank pre-test temperature,	295.8	°K
P_t - Sample tank post-test pressure,	524.5	mm Hg
T_t - Sample tank post-test temperature,	301.3	°K
V_s - Volume of gas sampled,	4.235×10^{-3}	dscm

2.0 Source concentration non-condensible organics, tank fraction

$$C_T = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \times C_{tm}$$

1.720

P_{tf} - Final pressurized tank pressure,	903.5	mm Hg
T_{tf} - Final pressurized tank temperature,	297	°K
C_{tm} - Measured concentration of gas sample tank,	231.4	ppm CH_4
C_T - Source concentration of non-condensibles,	409.1	ppm CH_4

Run number UCR03B

3.0 Source concentration of condensible organics, trap fraction

$$C_c = 0.386 \left(\frac{V_v \times P_f}{V_s \times T_f}\right) C_{cm}$$

V_v - Volume of intermediate collection tank, 6.387x10^{-3} dscm

P_f - Final pressure intermediate collection tank, 93515 mm Hg

T_f - Final temperature intermediate collection tank, 297 °K

C_{cm} - Measured concentration of intermediate tank, 107.7 ppm CH_4

C_c - Source concentration condensible organics, 197.3 ppm CH_4

4.0 Total gaseous non-methane organic (TGNMO) concentration at source

$$C = C_t + C_c$$

C - TGNMO source concentration, ~~607.4~~ 606.6 ppm CH_4

Note: standard conditions - 293°K, 760 mm Hg.

APPENDIX B

FIELD DATA

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Plant 3M - Corp

Date 5-20-81

Sampling location Bake Out Oven Exhaust (walking vane)

Inside of far wall to outside of nipple _____

Inside of near wall to outside of nipple (nipple length) _____

Stack I.D. 6.0 inch

Nearest upstream disturbance > 2 dd

Nearest downstream disturbance > 8 dd

Calculated by D. Hankey

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	NIPPLE LENGTH	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	4.4	6.0 IN.	0.26	–	0.5
2	14.6		0.88	–	0.88
3	29.6		1.78	–	1.78
4	70.4		4.22	–	4.22
5	85.4		5.12		5.12
6	95.6		5.74		5.50

velocity BN: 34-5179
Hershey

GAS VELOCITY AND VOLUME DATA

	PLANT AND CITY	RUN DATE
1.	3M Chattanooga	5/30/81

SAMPLING LOCATION	CLOCK TIME
Bake oven Exhaust	14:00

	RUN NUMBER	OPERATOR	AMB. TEMP. (°F)	BAR. PRESS (in. Hg)	STATIC PRESS (in. H_2O)
2.	V-1	Heashey	65	29.33	+.025

MOLECULAR WT.	STACK INSIDE DIMENSION (in.) DIAM OR SIDE 1	SIDE 2	PITOT TUBE Cp	MOISTURE %
28.81	60		1.00	17

FIELD DATA

TRAVERSE POINT NUMBER	POSITION (in.)	VELOCITY HEAD (Δp_s), in.H_2O	STACK TEMP, °F
1		.085	148
2		.120	
3		.127	
4		.13	
5		.123	
6		0.11	
1		0.11	
2		.118	
3		.135	
4		.126	
5		.115	
6		.10	

$\overline{\Delta p} = 0.34$

$P_s = 29.33$

$T_s = 608$

V_s 24.66 fps

A_s .196 ft^2

291 acfm

248 scfm

244 dscfm

GAS VELOCITY AND VOLUME DATA

	PLANT AND CITY	RUN DATE
1.	3M Chattanooga	5 / 7 / 81

SAMPLING LOCATION	CLOCK TIME
Bake oven Exhaust	15:10

	RUN NUMBER	OPERATOR	AMB. TEMP. (°F)	BAR. PRESS (in. Hg)	STATIC PRESS (in. H_2O)
2.	VE-2	Hershey	67	29.33	+ .025

MOLECULAR WT.	STACK INSIDE DIMENSION (in.) DIAM OR SIDE 1	SIDE 2	PITOT TUBE Cp	MOISTURE %
28.81	6.0		1.00	1.7

FIELD DATA

TRAVERSE POINT NUMBER	POSITION (in.)	VELOCITY HEAD (Δp_s), in.H_2O	STACK TEMP, °F
1		0.11	153
2		0.116	
3		0.127	
4		.129	
5		.112	
6		.092	
1		.095	
2		.115	
3		.125	
4		.132	
5		.102	
6		.095	

.333 $\sqrt{\Delta P}$

T_s 612

24.23 fps

285 acfm

241 scfm

237 dscfm

GAS VELOCITY AND VOLUME DATA

PLANT AND CITY	RUN DATE
1. 3M Chattanooga	5/31/81

SAMPLING LOCATION	CLOCK TIME
Bake Oven Exhaust	9:00

RUN NUMBER	OPERATOR	AMB. TEMP. (°F)	BAR. PRESS (in. Hg)	STATIC PRESS (in. H_2O)
2. V-3	Hensley	68	29.57	+.025

MOLECULAR WT.	STACK INSIDE DIMENSION (in.) DIAM OR SIDE 1	SIDE 2	PITOT TUBE Cp	MOISTURE %
28.82	6.0		1.00	1.6

FIELD DATA

TRAVERSE POINT NUMBER	POSITION (in.)	VELOCITY HEAD (Δp_s), in.H_2O	STACK TEMP, °F
7,8,9,10	11,12,13,14	25,26,27,28,29	38,39,40,41
1		.135 ~~.175~~	102
2		.165	
3		.170	
4		.170	
5		.160	
6		.140	
1		.150	
2		.163	
3		.175	
4		.172	
5		.157	
6		.132	

wet bulb
72°F

$\overline{\sqrt{\Delta p}}$ = .396

A_s .196 ft^2

T_s 562

P_s 27.57

V_s: 27.49 fps

323 acfm

300 scfm

295 dscfm

GAS VELOCITY AND VOLUME DATA

	PLANT AND CITY	RUN DATE
1.	3M Chattanooga	5/21/81

SAMPLING LOCATION	CLOCK TIME
Bake oven exhaust	10:20

	RUN NUMBER	OPERATOR	AMB. TEMP. (°F)	BAR. PRESS (in. Hg)	STATIC PRESS (in. H_2O)
2.	V-4	Horsley	68	29.57	+.025

MOLECULAR WT.	STACK INSIDE DIMENSION (in.) DIAM OR SIDE 1	SIDE 2	PITOT TUBE Cp	MOISTURE %
28.82	6		1.00	1.6

FIELD DATA

TRAVERSE POINT NUMBER	POSITION (in.)	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMP, °F
1		.110	101
2		.120	
3		.191	
4		.145	
5		.135	
6		.116	
1		.115	
2		.130	
3		.145	
4		.142	
5		.140	
6		.120	

WET 70°F

T_s 561

P_s 29.57

$\overline{\sqrt{\Delta p}}$ .359

24.90 fps

293 acfm

268 dscfm

GAS VELOCITY AND VOLUME DATA

	PLANT AND CITY	RUN DATE
1.	3M Chattanooga	5/21/81

SAMPLING LOCATION	CLOCK TIME
Boko oven exhaust	11:30

	RUN NUMBER	OPERATOR	AMB. TEMP. (°F)	BAR. PRESS (in. Hg)	STATIC PRESS (in. H_2O)
2.	V-5	Hershey	70	27.61	+.025

MOLECULAR WT.	STACK INSIDE DIMENSION (in.) DIAM OR SIDE 1	SIDE 2	PITOT TUBE Cp	MOISTURE %
28.82	60		1.00	1.60

FIELD DATA

TRAVERSE POINT NUMBER	POSITION (in.)	VELOCITY HEAD (Δp_s), in.H_2O	STACK TEMP, °F
7,8,9,10	11,12,13&14	25,26&27,28,29	38,39,40,41
1		.100	
2		.130	104
3		.146	
4		.147	
5		.135	
6		.125	
1		.120	
2		.140	
3		.150	
4		.149	
5		.142	
6		.133	

70°F w B

.367 $\overline{\sqrt{\Delta p}}$

25.51 fps

300 acfm

273 dscfm

365 325 743

METHOD 25 FIELD DATA

Plant 3-M, Chattanooga Sample location walking beam K.I.N Bake out oven exh. Date 5-20-81

City Chattanooga Operator Hershey Run no. C-B-O-1A

Tank No. 13 Tank volume 6.399, liters Trap No. 44 Flow meter setting 86 cc/min

102 97 99

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	745	68	743	26	0	0
Post-test	747	75	199	5	0	0

397 366 743

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
~~14:02~~ 0	14:02	26			
15	14:17	20			
25	14:27	16			
32	14:34	13			
42	14:44	10			
52	14:54	7			
60	15:02	5			

B-8

Comments: CONTROLLED

walking Vane Bake-out oven

METHOD 25 FIELD DATA

Plant 3M Sample location Walk in boom Bake out oven exhaust Date 5-20-81

City Chattanooga Operator Hershey Run no. CB-0-1B

Tank No. 37 Tank volume 6.434, liters Trap No. 37 Flow meter setting 87 cc/min

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	745	68	743	27	0	0
Post-test	747	75	254	9	0	0

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
0	14:07	27			
15	14:17	22			
25	14:27	18			
32	14:34	16			
42	14:44	13			
52	14:54	10			
60	15:02	9			

Comments: Controlled

* sample not recovered due to fracture in trap, *

METHOD 25 FIELD DATA

Plant 3M Sample location Bake out oven Exhaust Date 5-20-81

City Chattanooga Operator Hershey Run no. CB-02A

Tank No. 42 Tank volume 6.4208, liters Trap No. 40 Flow meter setting 90 cc/min

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	745	68	744	30	0	0
Post-test	747	75	188	8.5	0	0

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
0	15:16	30			
10	15:26	25.5			
20	1536	21.0			
30	1546	17.0			
40	1556	13.0			
50	1606	10			
60	1616	8.5			

Comments: Controlled Emissions - Catalytic Converter On

METHOD 25 FIELD DATA

Plant 3M Sample location Coke oven exhaust Date 5-20-81

City Chattanooga Operator Hensley Run no. CB02B

Tank No. 27 Tank volume 6.400, liters Trap No. 22 Flow meter setting 93 cc/min

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	745	68	744	29	0	0
Post-test	747	75	200	8.5	0	0

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
0	15:16	29			
10	1526	25.0			
20	1536	20.75			
30	1546	16.5			
40	1556	13.0			
50	1604	11			
60	1616	8.5			

Comments: Controlled Emissions - Catalytic Converter On

METHOD 25 FIELD DATA

Plant 3M Sample location Bake oven Exhaust Date 5-20-81

City Chattanooga Operator Hershey Run no. CBO-3A

Tank No. 38 Tank volume 6.440, liters Trap No. 31 Flow meter setting 80 cc/min

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	747	75	745	29	0	0
Post-test	747	75	406	16	0	0

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
~~10~~ 480	16:18	29			
10	16:28	25			
13	~~16:38~~ 41	20			
37	16:55	16			

Comments: Controlled

METHOD 25 FIELD DATA

Plant 3M Sample location Bake Oven Exhaust Date 5-21-81

City Chattanooga Operator Hershey Run no. UC80-3B

Tank No. 7 Tank volume 6.377, liters Trap No. 21 Flow meter setting 86 cc/min

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	752	73	746	26	0	0
Post-test	752.5	83	228	6	0	0

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
0	11:34	26			
10	11:44	22			
20	11:54	18			
30	12:04	14.5			
40	12:14	11			
50	12:24	8			
60	12:34	6			

Comments: UNCONTROLLED EMISSIONS

METHOD 25 FIELD DATA

Plant 3M Sample location Bake oven Exhaust (Walking Vane) Date 5-21-81

City Chattanooga Operator Hershey Run no. UCBO-1A

Tank No. 32 Tank volume 6.472, liters Trap No. 38 Flow meter setting 86 cc/min

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	751	63	746	26	0	0
Post-test	752	73	206	6	0	0

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
0	9:07		26		
6	9:17		23		
20	9:37		18		
30	9:37		14		
40	9:47		11		
50	6957		8		
60	10 07		6		

Comments: uncontrolled emissions

Process feed rate ~ 3 boats/h (2450 g/boat)

132
138
270

METHOD 25 FIELD DATA

Plant 3M Sample location Bakeoven Exhaust Date 5-21-81

City Chattanooga Operator Hersher Run no. UC BO-1B

Tank No. 2 Tank volume 6.386, liters Trap No. 34 Flow meter setting 87 cc/min

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	751	63	747	27	0	0
Post-test	752	73	270	9	0	0

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
0	9:07	27			
10	9:17	24			
20	9:27	20			
30	9:37	17			
40	9:47	14			
50	9:57	11			
60	10:07	9			

Comments: uncontrolled emissions

METHOD 25 FIELD DATA

Plant 3M Sample location Bake oven Exhaust Date 5-21-81

City Chattanooga Operator Hershey Run no. UCBO-2A

Tank No. 4 Tank volume 6,350, liters Trap No. 42 Flow meter setting 93 cc/min

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	757	63	747	30	0	0
Post-test	752.5	81	198	8.5	0	0

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
0	10:22	29			
10	10:32	22.5			
~~32~~	10:54	17			
~~44~~	11:06	13			
60	11:22	~~8.5~~ 8.5			

Comments: uncontrolled emission

METHOD 25 FIELD DATA

Plant 3M Sample location Bake oven exhaust Date 5-21-81

City Chattanooga Operator Hershey Run no. UCBO-2B

Tank No. 36 Tank volume 6.424, liters Trap No. 45 Flow meter setting 90 cc/min

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	751	63	744	30	0	0
Post-test	752.5	81	204	9	0	0

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
0	10:22	30			
10	10:32	23.5			
32	10:54	17			
44	11:06	13			
60	11:22	9			

Comments: Uncontrolled emissions

METHOD 25 FIELD DATA

Plant 3M Sample location Bake Oven Exhaust Date 5-21-81

City Chattanooga Operator Hershey Run no. UC BO-3A

Tank No. 31 Tank volume 6.406, liters Trap No. 20 Flow meter setting 80 cc/min

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	751	65	742	28	0	0
Post-test	752.5	83	259	10	0	0

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
0 ~~HG~~	11:34	28			
10	11:44	25.5			
20	11:54	21			
30	12:04	18			
40	12:14	15			
50	12:24	12			
60	12:34	10			

Comments: UNCONTROLLED EMISSIONS

130
124
254

METHOD 25 FIELD DATA

Plant 3M Sample location Bake oven Exhaust Date 5-20-81

City Chattanooga Operator Hooshar Run no. CB03B

Tank No. 12 Tank volume 6.413, liters Trap No. 26 Flow meter setting 86 cc/min

Sampling Conditions

Parameter	Barometric pressure, mm Hg	Ambient temperature, °F	Tank vacuum		Leak check	
			Manometer, mm Hg	Gauge, in. Hg	Tank half, visible gauge movement	Trap half, mm Hg/5 min.
Pre-test	747	75	745	26	0	0
Post-test	747	75	383	12	0	0

Sampling Data

Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg	Sampling time, min.	Clock time, 24 h	Gauge vacuum, in. Hg
0	16:18	26			
10	16:28	22			
23	16:41	19.5			
37	16:55	12.5			

Comments: CONTROLled OXIDIZER ON

APPENDIX C

LABORATORY RESULTS

METHOD 25 (TGNMO) ANALYTICAL DATA

Plant 3M Chattanooga City Chattanooga

Sample location Walking Beam Kiln Run No. C-B.O. 1A
Bake out over each.

Tank Fraction (Non-condensible Organics)

Date of analysis 5/27/81 Signature of analyst M.A. Khalifa

Laboratory conditions: Temperature 23.5, °C Barometric pressure 744, mm Hg

Tank no. 13 Tank volume 6.399, liters

Tank pressure 948, mm Hg Tank temperature 23.5, °C

Propane (C_3H_8) calibration factor: 1.736×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	81180 VOID	
2	70340	
3	71080 76060 VOID	
Average	75360 70540 VOID	122.6

average 70627

Trap Fraction (Condensible Organics)

Date of analysis 5/28/81 Signature of analyst M.A. Khalifa

Laboratory conditions: Tempeature 23.5, °C Barometric pressure 744, mm Hg

Trap no. 44 Date of oxidation 5/27/81

Collection tank no. 9 Collection tank volume 6.380, liters

Collection tank pressure 920, mm Hg Collection tank temperature 23.5, °C

Carbon dioxide (CO_2) calibration factor: 1.379×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	48980	
2	49560	
3	49620	
Average	49387	68.1

METHOD 25 (TGNMO) ANALYTICAL DATA

Plant 3M City Chattanooga

Sample location Bake out oven Exhaust Run No. CRO-2A

Tank Fraction (Non-condensible Organics)

Date of analysis 5/28/81 Signature of analyst M.A. Chalfant

Laboratory conditions: Temperature 24.0, °C Barometric pressure 747.3, mm Hg

Tank no. 42 Tank volume 6.4208, liters

Tank pressure 979.3, mm Hg Tank temperature 24.0, °C

Propane (C_3H_8) calibration factor: 1.753×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	~~87500 VOID~~	
2	~~87020~~ 87700	
3	87860	
Average	87827	154

Trap Fraction (Condensible Organics)

Date of analysis 5/29/81 Signature of analyst M.A. Chalfant

Laboratory conditions: Tempeature 24, °C Barometric pressure 747.3, mm Hg

Trap no. 40 Date of oxidation 5/28/81

Collection tank no. 1 Collection tank volume 6.365, liters

Collection tank pressure 973.3 mm Hg Collection tank temperature 24, °C

Carbon dioxide (CO_2) calibration factor: 1.379×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	85440	
2	84780	
3	84600	
Average	84940	117.1

METHOD 25 (TGNMO) ANALYTICAL DATA

Plant 3M City Chattanooga

Sample location Bake oven exhaust Run No. CBO-2B

Tank Fraction (Non-condensible Organics)

Date of analysis 5/28/81 Signature of analyst M.A. Khalifa

Laboratory conditions: Temperature 24, °C Barometric pressure 747.3, mm Hg

Tank no. 27 Tank volume 6.400, liters

Tank pressure 957.3, mm Hg Tank temperature 24.0, °C

Propane (C_3H_8) calibration factor: 1.753×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	~~83840~~ Void ~~89020~~	
2	94340	
3	~~94180~~	
Average	92513	162.2

Trap Fraction (Condensible Organics)

Date of analysis 5/29/81 Signature of analyst M.A. Khalifa

Laboratory conditions: Tempeature 24, °C Barometric pressure 747.3, mm Hg

Trap no. 22 Date of oxidation 5/28/81

Collection tank no. 17 Collection tank volume 6.368, liters

Collection tank pressure 1003.7, mm Hg Collection tank temperature 24, °C

Carbon dioxide (CO_2) calibration factor: 1.379×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	115400	
2	114800	
3	114800	
Average	115000	158.6

METHOD 25 (TGNMO) ANALYTICAL DATA

Plant 3M City Chattanooga

Sample location Bake oven exhaust Run No. CBO-3A

Tank Fraction (Non-condensible Organics)

Date of analysis 6-2-81 Signature of analyst M.A. Khalifa

Laboratory conditions: Temperature 23, °C Barometric pressure 748.3 mm Hg

Tank no. 38 Tank volume 6.440, liters

Tank pressure 944.3, mm Hg Tank temperature 23, °C

Propane (C_3H_8) calibration factor: 1.771×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	52770	
2	53670	
3	53230	
Average	53223	94.2

Trap Fraction (Condensible Organics)

Date of analysis 6-1-81 Signature of analyst M.A. Khalifa

Laboratory conditions: Tempeature 23, °C Barometric pressure 748.3, mm Hg

Trap no. 31 Date of oxidation 5/29/81

Collection tank no. 8 Collection tank volume 6.378, liters

Collection tank pressure 1002.3, mm Hg Collection tank temperature 23, °C

Carbon dioxide (CO_2) calibration factor: 1.370×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	109000	
2	108300	
3	108300	
Average	108533	148.7

METHOD 25 (TGNMO) ANALYTICAL DATA

Plant 3M City Shakopee

Sample location Bake oven exhaust Run No. CBO-3B

Tank Fraction (Non-condensible Organics)

Date of analysis 6-2-81 Signature of analyst M. A. Khalifa

Laboratory conditions: Temperature 23, °C Barometric pressure 748.3, mm Hg

Tank no. 12 Tank volume 6.413, liters

Tank pressure 966.3, mm Hg Tank temperature 23, °C

Propane (C_3H_8) calibration factor: 1.771×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	Undetectable.	
2		
3		
Average		

Trap Fraction (Condensible Organics)

Date of analysis 6-1-81 Signature of analyst M. A. Khalifa

Laboratory conditions: Tempeature 23, °C Barometric pressure 748.3 mm Hg

Trap no. 26 Date of oxidation 5/29/81

Collection tank no. 6 Collection tank volume 6.376, liters

Collection tank pressure ~~748.3~~ 1004.3, mm Hg Collection tank temperature 23, °C

Carbon dioxide (CO_2) calibration factor: 1.370×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	159300	
2	158900	
3	157800	
Average	158667	217.4

METHOD 25 (TGNMO) ANALYTICAL DATA

Plant 3M City Chattanooga

Sample location Bake oven exhaust Run No. UCBO-1A

Tank Fraction (Non-condensible Organics)

Date of analysis 6-2-81 Signature of analyst M.A. Khalifa

Laboratory conditions: Temperature 23.5, °C Barometric pressure 749.8, mm Hg

Tank no. 32 Tank volume 6.472, liters

Tank pressure 931.8, mm Hg Tank temperature 23.5, °C

Propane (C_3H_8) calibration factor: 1.771×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	33340	
2	34130	
3	34730	
Average	34067	60.3

Trap Fraction (Condensible Organics)

Date of analysis 6-1-81 Signature of analyst M.A. Khalifa

Laboratory conditions: Tempeature 23.5, °C Barometric pressure 749.8, mm Hg

Trap no. 38 Date of oxidation 6-1-81

Collection tank no. 10 Collection tank volume 6.346, liters

Collection tank pressure 1137.8, mm Hg Collection tank temperature 23.5, °C

Carbon dioxide (CO_2) calibration factor: 1.370×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	87466	
2	87160	
3	87600	
Average	87407	119.7

METHOD 25 (TGNMO) ANALYTICAL DATA

Plant 3M City Chattanooga

Sample location Bake oven exhaust Run No. UCBO-1B

Tank Fraction (Non-condensible Organics)

Date of analysis 6-2-81 Signature of analyst M. A. Khaliq

Laboratory conditions: Temperature 23.5, °C Barometric pressure 749.8, mm Hg

Tank no. 2 Tank volume 6.386, liters

Tank pressure 889.8, mm Hg Tank temperature 23.5, °C

Propane (C_3H_8) calibration factor: 1.771×10^{-5} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	33690	
2	36530	
3	35600	
Average	35273	62.5

Trap Fraction (Condensible Organics)

Date of analysis 6-1-81 Signature of analyst M. A. Khaliq

Laboratory conditions: Tempeature 23.5, °C Barometric pressure 749.8, mm Hg

Trap no. 34 Date of oxidation 6-1-81

Collection tank no. 40 Collection tank volume 6.432, liters

Collection tank pressure 887.8, mm Hg Collection tank temperature 23.5, °C

Carbon dioxide (CO_2) calibration factor: 1.370×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	62260	
2	62370	
3	61330	
Average	61 987	94.9

METHOD 25 (TGNMO) ANALYTICAL DATA

Plant 3M City Chattanooga

Sample location Bake oven exhaust Run No. UCBO-2A

Tank Fraction (Non-condensible Organics)

Date of analysis 6-3-81 Signature of analyst M.A. Khalil

Laboratory conditions: Temperature 24.0, °C Barometric pressure 748.0, mm Hg

Tank no. 4 Tank volume 6.380, liters

Tank pressure 856, mm Hg Tank temperature 24.0, °C

Propane (C_3H_8) calibration factor: 1.754×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	99620	
2	100100	
3	107400	
Average	102373	179.6

Trap Fraction (Condensible Organics)

Date of analysis 6-4-81 Signature of analyst M.A. Khalil

Laboratory conditions: Tempeature 24, °C Barometric pressure 748.6, mm Hg

Trap no. 42 Date of oxidation 6-2-81

Collection tank no. 23 Collection tank volume 6.401, liters

Collection tank pressure 946, mm Hg Collection tank temperature 24.0, °C

Carbon dioxide (CO_2) calibration factor: 1.34×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	53950	
2	53720	
3	53540	
Average	53737	72.0

METHOD 25 (TGNMO) ANALYTICAL DATA

Plant 3M City Chattanooga

Sample location Bake oven exhaust Run No. MCBO-2B

Tank Fraction (Non-condensible Organics)

Date of analysis 6-3-81 Signature of analyst M.A. Hall

Laboratory conditions: Temperature 24, °C Barometric pressure 748.0, mm Hg

Tank no. 36 Tank volume 6.424, liters

Tank pressure 906, mm Hg Tank temperature 24.0, °C

Propane (C_3H_8) calibration factor: 1.754×10^{-7} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	109200	
2	113400	
3	117000	
Average	111867	196.2

Trap Fraction (Condensible Organics)

Date of analysis 6-4-81 Signature of analyst M.A. Hall

Laboratory conditions: Tempeature 24, °C Barometric pressure 748, mm Hg

Trap no. 45 Date of oxidation 6-2-81

Collection tank no. 39 Collection tank volume 6.418, liters

Collection tank pressure 924, mm Hg Collection tank temperature 24, °C

Carbon dioxide (CO_2) calibration factor: 1.34×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	60860	
2	60350	
3	60581	
Average	60597	81.2

METHOD 25 (TGNMO) ANALYTICAL DATA

Plant 3M City Chattanooga

Sample location bake oven exhaust Run No. UCRO-3A

Tank Fraction (Non-condensible Organics)

Date of analysis 6-3-81 Signature of analyst M.A. Kloff

Laboratory conditions: Temperature 24, °C Barometric pressure 748, mm Hg

Tank no. 31 Tank volume 6.406, liters

Tank pressure 902, mm Hg Tank temperature 24, °C

Propane (C_3H_8) calibration factor: 1.754×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	106400	
2	109800	
3	105600	
Average	107267	188.1

Trap Fraction (Condensible Organics)

Date of analysis _____ Signature of analyst _____

Laboratory conditions: Tempeature 24, °C Barometric pressure 748, mm Hg

Trap no. 20 Date of oxidation 6-2-81

Collection tank no. 5 Collection tank volume 6.369, liters

Collection tank pressure 942, mm Hg Collection tank temperature 24, °C

Carbon dioxide (CO_2) calibration factor: 1.34×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	101000	
2	100900	
3	100200	
Average	100700	134.9

METHOD 25 (TGNMO) ANALYTICAL DATA

Plant 3M City Chattanooga

Sample location Rotc ave exhaust Run No. UCBO-3B

Tank Fraction (Non-condensible Organics)

Date of analysis 6-3-81 Signature of analyst M.A Khaliq

Laboratory conditions: Temperature 24, °C Barometric pressure 747.5, mm Hg

Tank no. 7 Tank volume 6.377, liters

Tank pressure 903.5, mm Hg Tank temperature 24, °C

Propane (C_3H_8) calibration factor: 1.754×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	131000	
2	135500	
3	129300	
Average	131933	231.4

Trap Fraction (Condensible Organics)

Date of analysis 6-4-81 Signature of analyst M.A Khaliq

Laboratory conditions: Tempeature 24, °C Barometric pressure 747.5, mm Hg

Trap no. 41 Date of oxidation 6-3-81

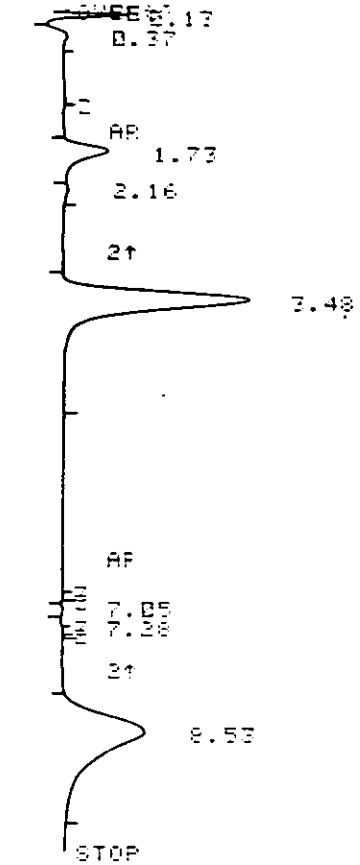
Collection tank no. 25 Collection tank volume 6.387, liters

Collection tank pressure 935.5, mm Hg Collection tank temperature 24, °C

Carbon dioxide (CO_2) calibration factor: 1.74×10^{-3} ppm as methane/area unit

Run no.	FID response, area units	Tank concentration, ppm as CH_4
1	79560	
2	80740	
3	80760	
Average	80353	107.7

Example Chromatograms From Sample Analyses



HP 5830A
AREA %

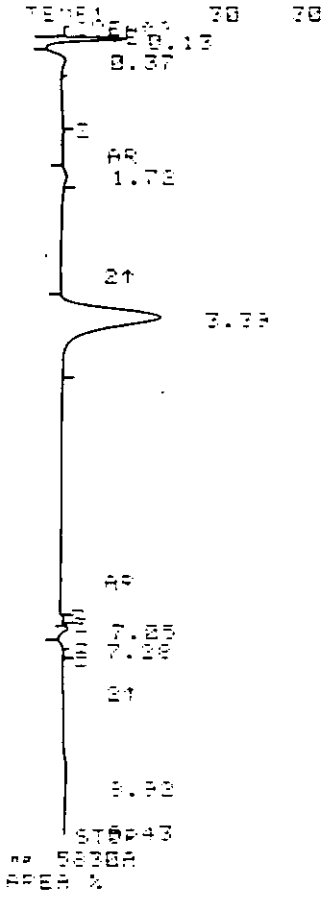
RT	AREA	AREA %
1.73	18830	1.018
2.16	1739	0.096
3.48	1749000	93.841
8.53	94130	5.053

XF: 1.0000 E+ 0

PN 5179
DATE 5/28/81 TIME
SAMPLE I. D. CBG-2B
STD. CONC. TANK
SOLVENT air
METHOD TGNMO

☐ BYPASS ☒ ORIG. ☑ RED.
VOLUME INJECTED 2.0 µl
☐ SYRINGE ☑ VALVE

C-14

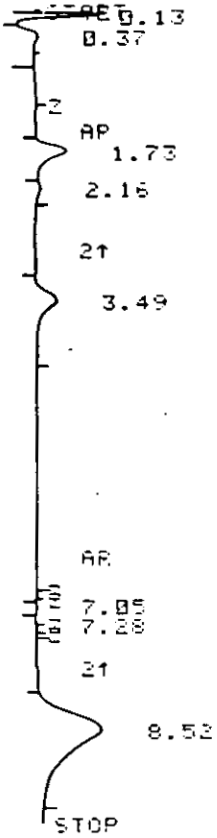


PT	AREA	AREA %
1.72	1314	1.126
3.39	115488	98.874

XF: 1.0000 E+ 0

PN 5179
DATE 5/21/81 TIME
SAMPLE I. D. CBO-2B
STD. CONC. TRAP
SOLVENT 90/10
METHOD T.O N.MO

☐ BYPASS ☑ O... ☑ RED.
VOLUME INJECTED 2.0 µl
☐ SYRINGE ☑ ...VE



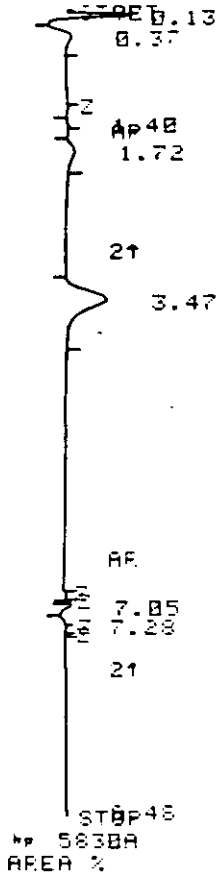
PN 5179
DATE 5/27/91 TIME
SAMPLE I. D. CBO-1A
STD. CONC. TANIC
SOLVENT air
METHOD TCNPKD

☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE

hp 5830A
AREA %

RT	AREA	AREA %
1.73	13590	4.708
2.16	2147	0.744
3.49	202600	70.182
8.52	70340	24.366

WF: 1.0000 E+ 0



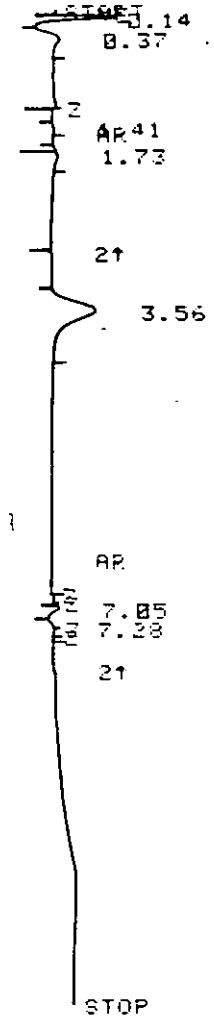
HP 5830A
AREA %

RT	AREA	AREA %
1.72	3430	6.545
3.47	48988	93.455

XF: 1.0000 E+ 0

PN 5179
DATE 5/29/91 TIME
SAMPLE I. D. CBD-1A
STD. CONC. TRAP
SOLVENT air
METHOD TONMO

☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE

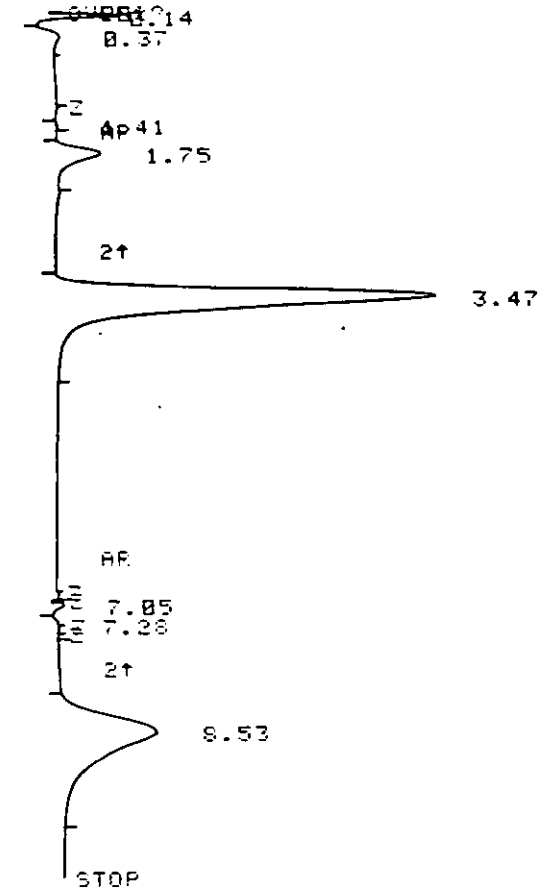


PN 5179
DATE 6-4-91 TIME
SAMPLE I. D. UCBO-2A
STD. CONC. TRAP
SOLVENT
METHOD
☐ BYPASS ☐ ON... ☐ RED.
VOLUME INJECTED 2.0 µL
☐ SYRINGE ☐

** 5930A
AREA %

RT	AREA	AREA %
1.73	1648	2.964
3.56	53950	97.036

XF: 1.0000 E+ 0



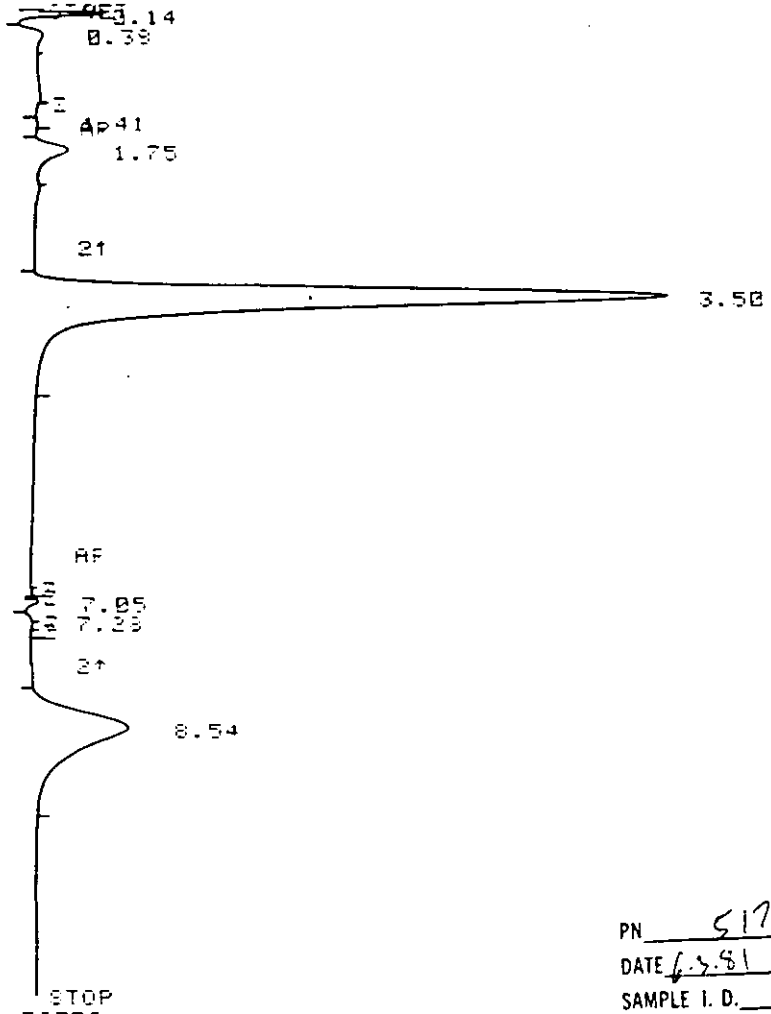
5830A
AREA %

PT	AREA	AREA %
1.75	18300	3.176
3.47	448100	77.768
8.53	109800	19.056

XF: 1.0000 E+ 0

PN 5175
DATE 6-3-86 TIME
SAMPLE I. D. MCBO-3A
STD. CONC. TANK
SOLVENT DW
METHOD TOTHC

☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☒ VALVE



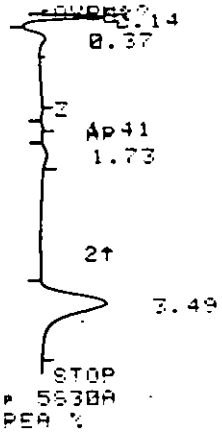
hp 5830A
AREA %

RT	AREA	AREA %
1.75	13818	1.535
3.58	776408	86.323
8.54	109208	12.141

XF: 1.0000 E+ 0

PN 5179
DATE 6.3.81 TIME
SAMPLE I. D. UI 80-26
STD. CONC. T19 NIC
SOLVENT
METHOD GC NMe

☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 µl
☐ SYRINGE ☑ VALVE

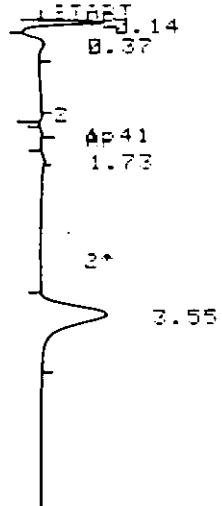


hp 5830A
AREA %

RT	AREA	AREA %
1.73	1863	2.255
3.49	80748	97.745

XF: 1.0000 E+ 0

TEMP1 30 30



hp 5830A
AREA %

RT	AREA	AREA %
1.73	525	0.646
3.55	80760	99.354

XF: 1.0000 E+ 0

PN 5179
DATE 6-4-91 TIME
SAMPLE I. D. HCBD-36
STD. CONC. TRAP
SOLVENT Air
METHOD TO-WMO

☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 mL
☐ SYRINGE ☑ VALVE

Pre-Test Equipment Blank Checks

```
TEMP1 1 3 0 @
TEMP1 3 0 @
 TEMP1        30    62
 TEMP1        70    37
 TEMP1        30    32
 TEMP1        30    30
  LOWEN?
      0.14
      0.58
      30    31
      BP
      200
      AP42
       1.73
       4.28
       AR
       7.05
       7.36
       2T
       8.60
       8.97
      STOP
** 5830A
AREA %
```

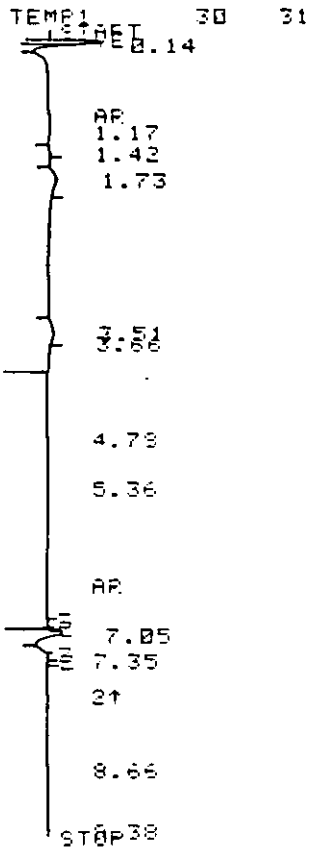
RT	AREA	AREA %
1.42	644	22.772
1.73	2184	77.228

XF: 1.0000 E+ 0

```
TEMP1 1 5 0 @
TEMP1 3 0 @
 TEMP1        30    90
 TEMP1        30    38
 TEMP1        30    31
 TEMP1        30    30
```

PN _____
DATE 5-12-21 TIME _____
SAMPLE I. D. TRAP # 44
STD. CONC. _____
SOLVENT BLANK CHECK
METHOD NMO

☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 30 mL
☐ SYRINGE ☒ VALVE



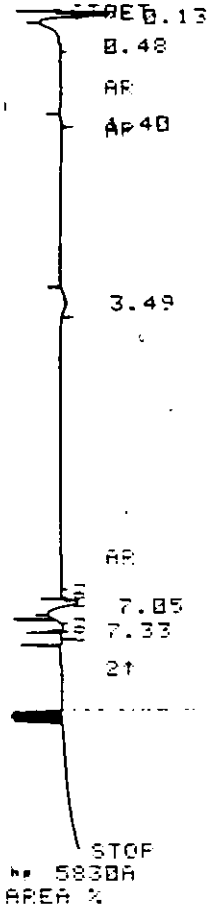
PN _____
DATE 5.12.81 TIME _____
SAMPLE I. D. IRF P#39
STD. NO. BLANK desk
METHOD NMG
☐ BYPASS ☒ O... ☒ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☒ VALVE

hp 5830A
AREA %

RT	AREA	AREA %
1.17	16598	76.336
1.42	468	2.153
1.73	3847	17.688
3.51	1828	8.411

XF: 1.0000 E+ 0

```
 TEMP1        30    56
 TEMP1        30    51
TEMP1 5 3 @
TEMP1 3 0 @
TEMP1 3 0 @
ESCAPE
TEMP1 3 0 @
 TEMP1        30    30
```



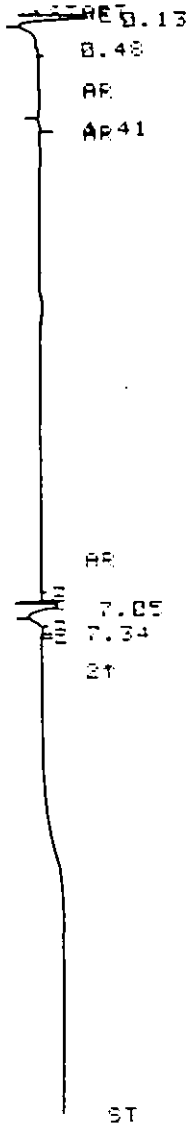
** 5830A
AREA %

RT	AREA	AREA %
1.40	437	15.782
3.49	2332	84.218

XF: 1.0000 E+ 0

PN_____
DATE 5/15/91 TIME 11:15 AM
SAMPLE I. D. Trap # 4
STD. CONC._____
SOLVENT Cl-ANR Check
METHOD NMB

☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☒ VALVE



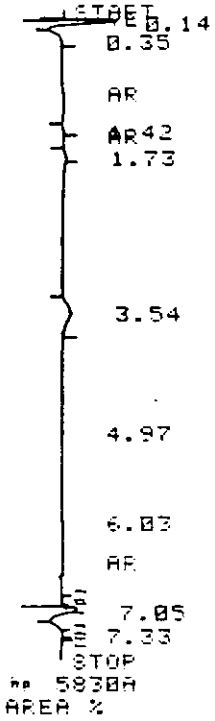
DATE 5/15/21 TIME 4:30
SAMPLE I. D. BAG # 40
STD CONC. BLANK (Hex)
SOLVENT
METHOD NM3

☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 2.0 (ml)
☐ SYRINGE ☒ VALVE

hp 5890A
AREA %

RT	AREA	AREA %
1.41	387	100.000
	KF:	1.0000 E+ 0

TEMP1 30 30



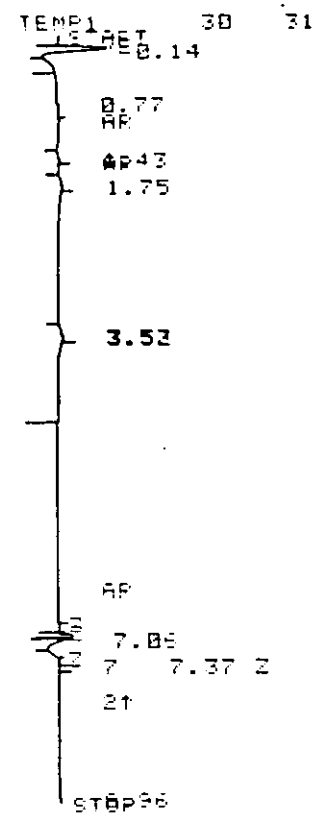
** 5830A
AREA %

RT	AREA	AREA %
1.42	249	5.005
1.73	445	8.945
3.54	4281	86.050

XF: 1.0000 E+ 0

N
DATE 5-14-81 TIME
SAMPLE I. D. TRAP # 35
TYPE CONT. BLANK
SOIL WT. CHECK
METHOD NMP

☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 2.0 mL
☐ SYRINGE ☐ VALVE



PN_____

DATE 5-13-81 TIME_____

SAMPLE I. D. TRAP #34

STD. CONC._____

SOLVENT BLANK CHECK

METHOD_____

☐ BYPASS ☑ OXID. ☑ RED.

VOLUME INJECTED 2.0 ml

☐ SYRINGE ☑ VALVE

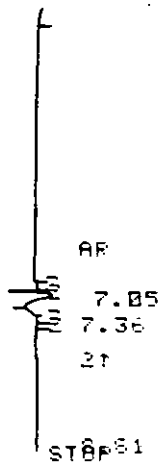
** 5830A

AREA %

RT	AREA	AREA %
1.43	307	18.387
1.75	681	40.808
3.52	689	41.085

XF: 1.0000 E+ 0

TEMP1 1 3 0 0
TEMP1 3 0 0
TEMP1 30 86
TEMP1 30 30



PN
DATE 5-12-81 TIME
SAMPLE I. D. TRAP 31
STD. CONC.
SOLVENT
METHOD NM 0
☐ BYPASS ☒ QUAD. ☒ RES.
VOLUME INJECTED
☐ SYRINGE ☒ VALVE

** 5330A
AREA %

RT	AREA	AREA %
1.43	245	2.772
1.73	1198	13.557
2.49	7394	83.671

XF: 1.0000 E+ 0

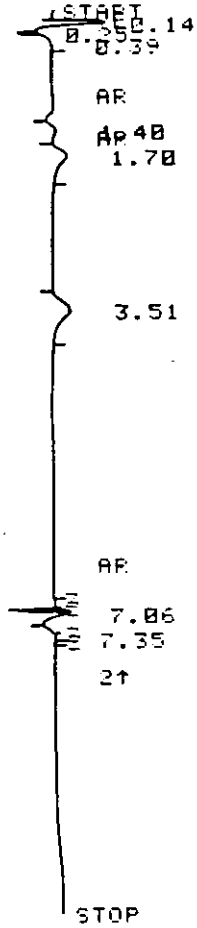
hp 5830A
AREA %

PN 3530-7
DATE 5-8-81 TIME
SAMPLE I. D. BLANK
STD. CONC. TLA CH#39
SOLVENT Air
METHOD TO-NMO

☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 mL
☐ SYRINGE ☑ VALVE

RT	AREA	AREA %
1.40	1805	15.775
1.70	4850	42.388
3.51	4787	41.837

XF: 1.0000 E+ 0



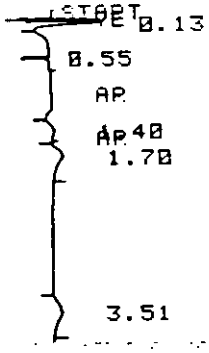
PN 3530-7
DATE 5-8-81 TIME
SAMPLE I. D. Blank
STD. CONC. TRAP #39
SOLVENT air
METHOD TCNMD

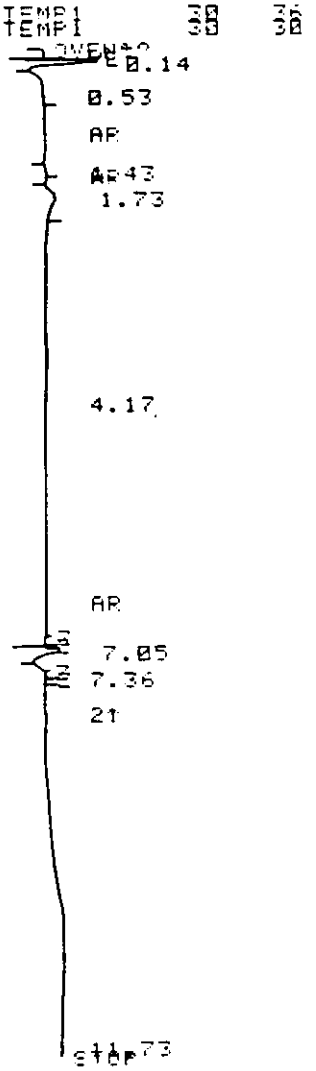
☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 2.0 mL
☐ SYRINGE ☒ VALVE

Wp 5838A
AREA %

RT	AREA	AREA %
1.40	3299	14.653
1.70	9066	40.267
3.51	10150	45.081

XF: 1.0000 E+ 0



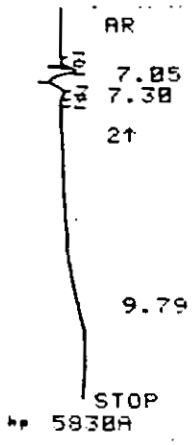


DATE 5-12-8 TIME
SAMPLE I.D. TRAP #45
TRAP BLANK
METHOD UMC
2.0 ml

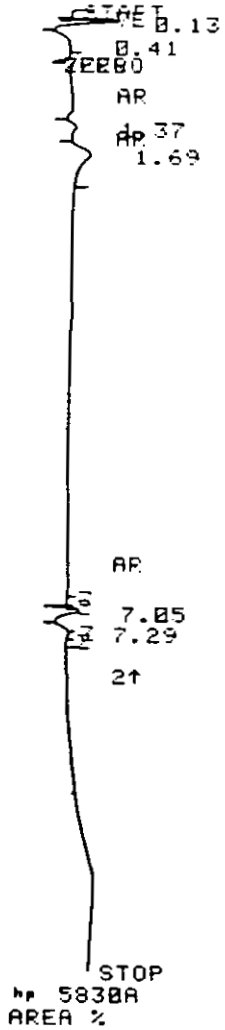
hp 5830A
AREA %

RT	AREA	AREA %
1.43	299	6.348
1.73	4411	93.652

XF: 1.0000 E+ 0



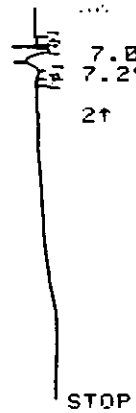
STD. CONC. N2
SOLVENT
METHOD TGWMO
☐ BYPASS ☑ OXID. ☐ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE



PN 3570-9
DATE 5-7-91 TIME
SAMPLE I. D. Blank
STD. CONC. TRAP #26
SOLVENT Air
METHOD TGWMO
☐ BYPASS ☑ OXID. ☐ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☐ VALVE

AREA %

RT	AREA	AREA %



PN 3530-7
DATE 5-8-81 TIME
SAMPLE I. D. Blank TKAP#42
STD. CONC.
SOLVENT air
METHOD TCNMD

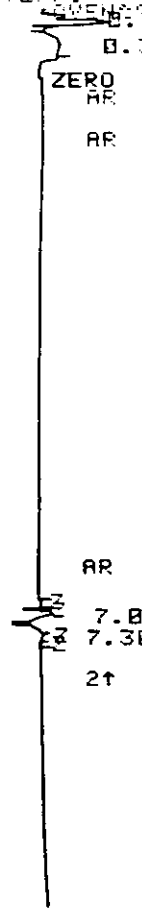
☐ BYPASS ☒ OXID. ☐ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☒ VALVE

5830A
AREA %

RT	AREA	AREA %
1.38	2292	11.264
1.69	12530	61.579
3.51	5526	27.158

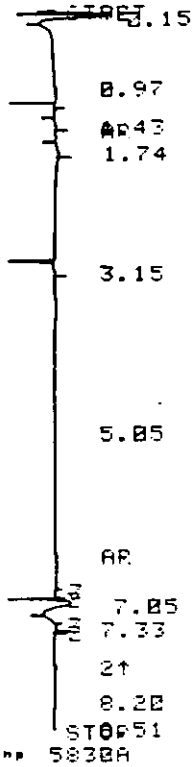
XF: 1.0000 E+ 0

TEMP1 30 30



PN 3530-7
DATE 5-8-81 TIME
SAMPLE I. D. Blank
STD. CONC. TANK #15
SOLVENT N2
METHOD TCNMD

☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☒ VALVE



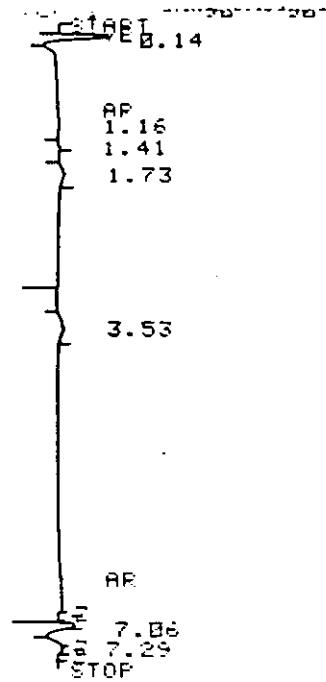
** 5830A
AREA %

RT	AREA	AREA %
1.43	275	9.148
1.74	518	17.232
3.15	2213	73.619

XF: 1.0000 E+ 0

PN
DATE 5-14-81 TIME
SAMPLE I. D. TRAP-20
STD. CONC. BLANK CHECK
SOLVENT
METHOD NMP

☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 20 ml
☐ SYRINGE ☒ VALVE



HP 5830A
AREA %

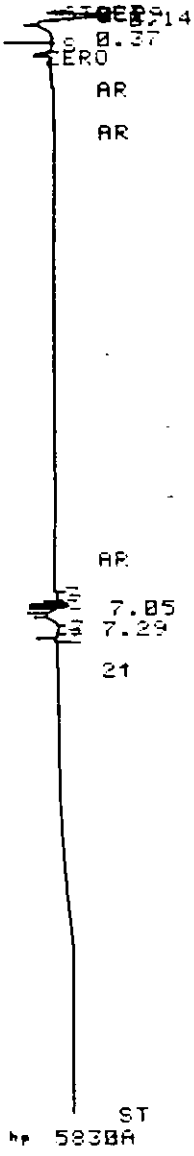
RT	AREA	AREA %
1.16	16130	78.893
1.41	362	1.753
1.73	1717	8.313
3.53	2446	11.842

XF: 1.0000 E+ 0

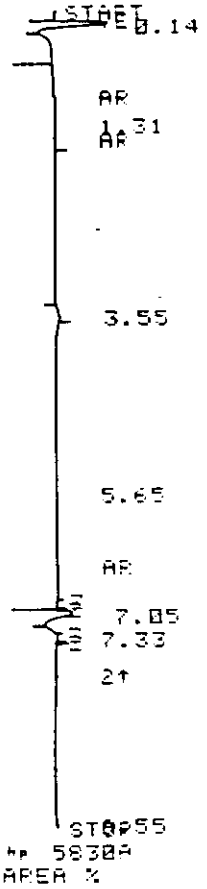
PN _____
DATE 5/14/91 TIME _____
SAMPLE I. D. TRAP #20
STD. CONC. BLANK CHECK
SOLVENT _____
METHOD _____

☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 20mL
☐ SYRINGE ☒ VALVE

Pre-Test Tank Blanks



PN 3530-7
DATE 5-6-81 TIME
SAMPLE I. D. BLANK #37
STD. CONC.
SOLVENT N/A
METHOD
☐ BYPASS ☐ OXID. ☑ RED.
VOLUME INJECTED 2.0 µL
☐ SYRINGE ☑ VALVE



SN _____

DATE 7-2-85 TIME _____

SAMPLE I. D. TANK No. 12

STD. CONC. _____ BLANK check

SOLVENT _____

METHOD NB

☐ BYPASS ☒ OXID. ☒ RED.

VOLUME INJECTED 2.0 mL

☐ SYRINGE ☒ VALVE

RT	AREA	AREA %
1.31	20880	97.393
3.55	559	2.607

XF: 1.0000 E+ 0

```
TEMP1        30    41
TEMP1        30    33
TEMP1        30    31
TEMP1        30    30
TEMP2       200
  START
  0.14
  0.56
  AR
  AR
  3.97
  AR
  7.05
  7.36
  21
  8.72
  STOP
** 5880A
```

PN_____

DATE 5/12/01 TIME_____

SAMPLE I. D. TANK 4

STD. CONC. BLANK check

SOLVENT_____

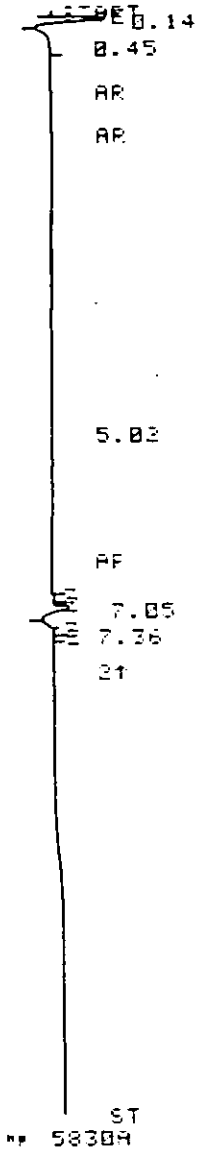
METHOD NMB

☐ BYPASS ☑ OXID. ☐ RED.

VOLUME INJECTED 20 µl

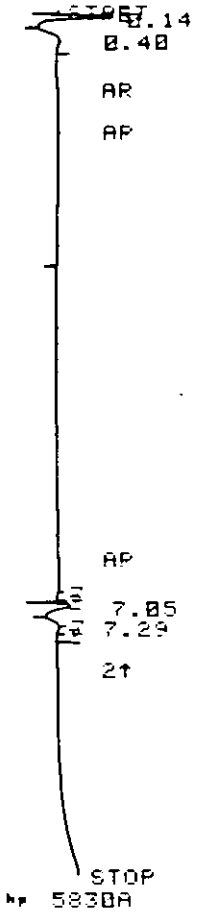
☐ SYRINGE ☑ VALVE

```
ESCAPE

 TEMP1        30   130
 TIME1         3.0
 RATE         24.00
 TEMP2       200
 TIME2         10.0
 INJ TEMP    200   200
 FID TEMP    300   300
 TCD TEMP    170   170
ESCAPE
ESCAPE
```

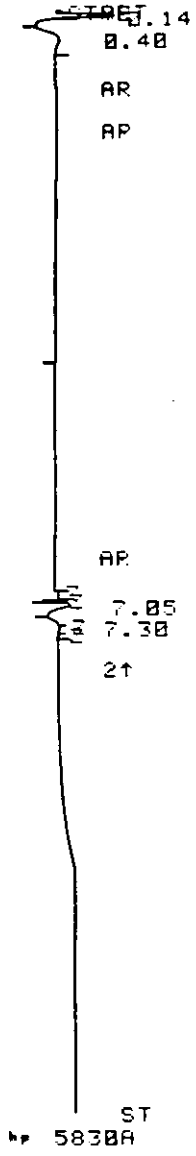


FN
DATE 5-12-81 TIME #38
SAMPLE I.D. TANK
TEST NAME BLANK Check
SOLVENT
METHOD NMC

☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☒ VALVE

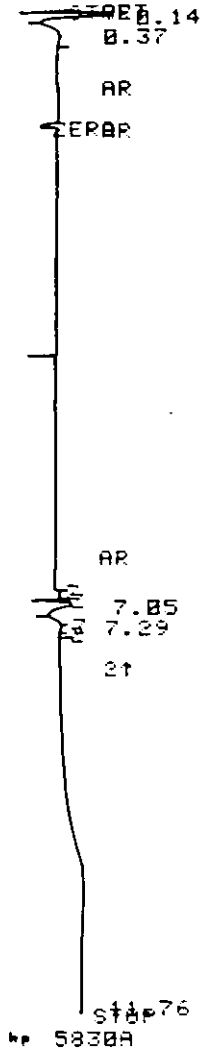


PN 3530-7
DATE 5-3-81 TIME
SAMPLE I. D. TANK # 13
STD. CONC. BLANK
SOLVENT
METHOD
☐ BYPASS ☑ GRID ☐ RED
VOLUME INJECTED 2.0 µL
☐ SYRINGE ☐ VALVE



PN 2556-7
DATE 5-7-81 TIME
SAMPLE I. D. TANK #7
STD. CONC. 67-ppb
SOLVENT
METHOD T-G-N #5

☐ BYPASS ☐ OXID. ☑ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE



PN 3530-7

DATE 5-4-71 TIME

SAMPLE I. D. Blank

STD. CONC. Tank #32

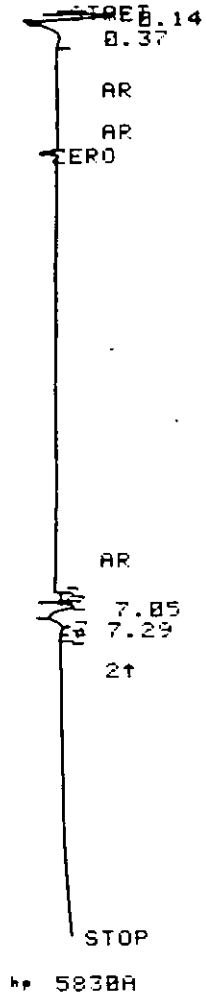
SOLVENT

METHOD TCM

☐ BYPASS ☑ OXID. ☑ RED.

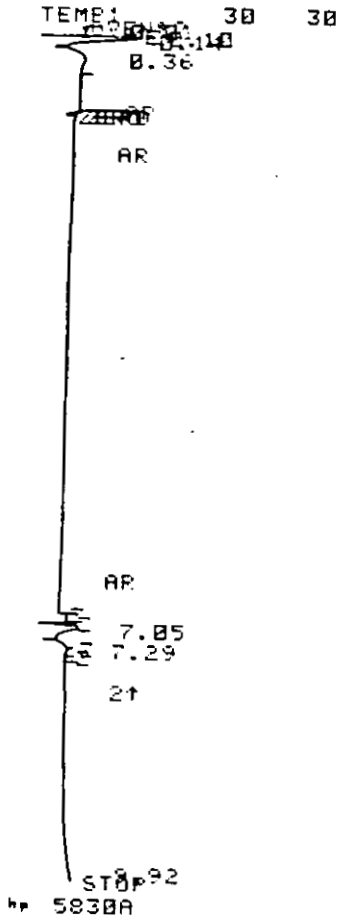
VOLUME INJECTED 2.0 ml

☐ SYRINGE ☑ VALVE



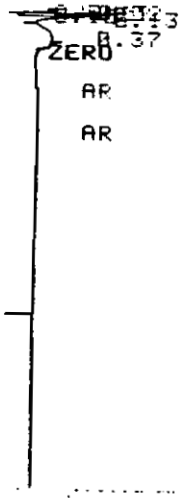
PN 3530-7
DATE 5.4.84 TIME
SAMPLE I. D. Black TANK #2
STD. CONC. TANK
SOLVENT
METHOD TOXIC

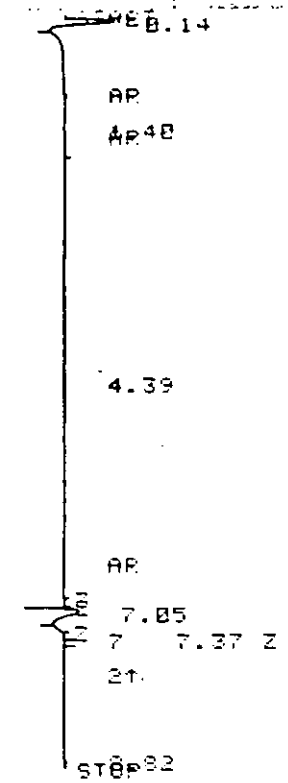
☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 mL
☐ SYRINGE ☑ VALVE



PN 3570.2
DATE 5.2.91 TIME
SAMPLE I. D. Blank
STD. CONC. TANK F31
SOLVENT N2
METHOD TO-1PPO

☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE





PN _____
DATE 5-13-81 TIME _____
SAMPLE I. D. TANK # 27
STD. CONC. BLANK
SOLVENT CHECK
METHOD NMB

☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☒ VALVE

hp 5830A
AREA %

RT	AREA	AREA %
1.40	22550	100.000

XF: 1.0000 E+ 0

TEMP1 1 2 0 0
TEMP1 3 0 0

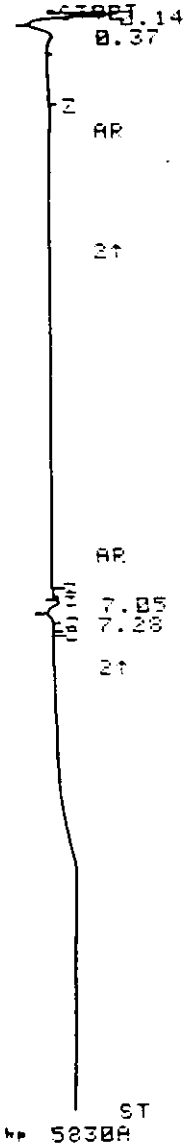
```
TEMP1
TEMP1 3 0 0 100    55
 TEMP1          30    30
  START 0.14

  B 0.83
  AR

  AR

  5.89

  AR
   7.05
  7    7.37 2
  21
   8.30
  STOP
** 5830A
```

```
TEMP1 1 0 0 0
TEMP1 0 1 2 0 0
TEMP1 3 0 0
 A                2
 TEMP1           30    99
 B               45
TEMP1 5 0 0
TEMP1 3 0 0
```

PN_____
DATE 5-13-86 TIME_____
SAMPLE I. D. TANK # 36
STD. CONC. ~~BLANK~~
SOLVENT CHECK
METHOD NIMB

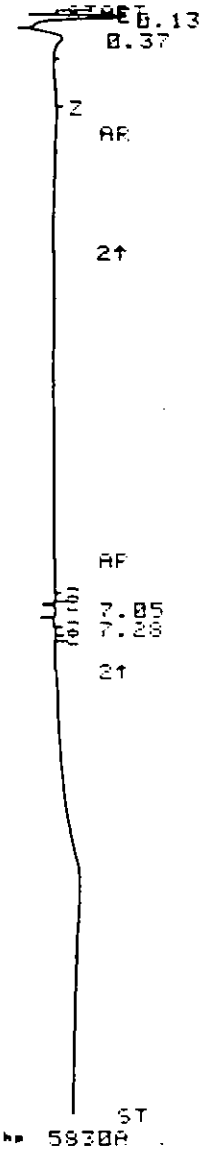
☐ BYPASS ☒ OXID. ☒ RED.
VOLUME INJECTED 2.0ml
☐ SYRINGE ☒ VALVE

Post-Test Trap Blanks



PN sin4
DATE 6-3-81 TIME
SAMPLE I. D. N Standard
STD CONC.
SOLVENT
METHOD X is Vmo

☐ BYPASS ☑ OXID. ☐ RED.
VOLUME INJECTED 2.0 µl
☐ SYRINGE ☑ VALVE



PN _____

DATE 5/26/91 TIME _____

SAMPLE I. D. Air (HCF) - TRAP CARRIER

STD. CONC. Blank

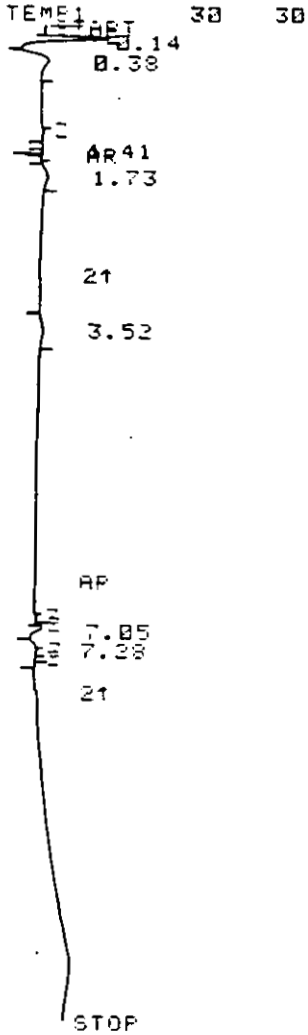
SOLVENT _____

METHOD TGPHV

☐ BYPASS ☑ OXID. ☑ RED.

VOLUME INJECTED 2.0 µL

☐ SYRINGE ☑ VALVE

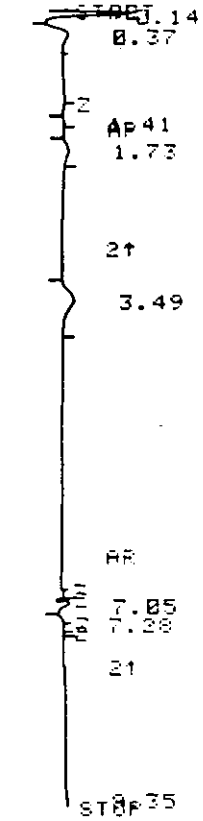


PN 5179
DATE 6-3-91 TIME
SAMPLE I. D. Blank
STD. CONC. 20
SOLVENT
METHOD 16 NMO
☐ BYPASS ☐ ONE ☑ RED.
VOLUME INJECTED 2.0 µl
☐ SYRINGE ☑ VALVE

* 5830A
AREA %

RT	AREA	AREA %
1.73	2153	36.112
3.52	3809	63.888

XF: 1.0000 E+ 0



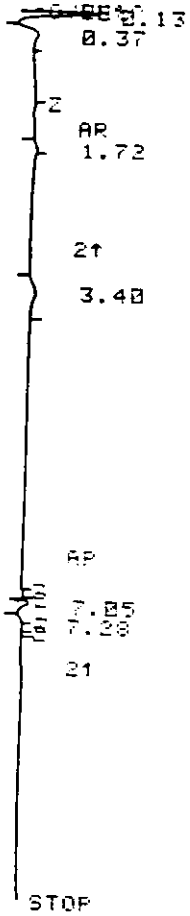
PN 5179
DATE 6-2-81 TIME
SAMPLE I. D. Blank
STD. CONC. MAP #42
SOLVENT CH
METHOD TGNMO

☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE

HP 5830A
AREA %

RT	AREA	AREA %
1.73	2129	13.119
3.49	14100	86.882

XF: 1.0000 E+ 0



AREA %

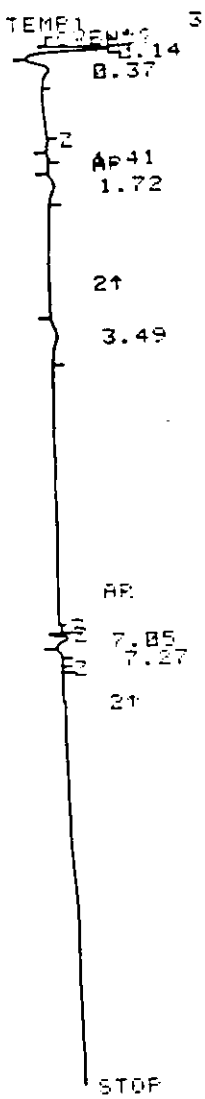
RT	AREA	AREA %
1.72	555	8.088
3.40	6307	91.912

XF: 1.0000 E+ 0

TEMP1 2 0 0 0

FN. 5179
DATE 5/29/81 TIME
SAMPLE I. D. TRAP #26
STD CONC.
SOLVENT DCM
METHOD TGNMR

☐ BYPASS ☑ ORIG. ☐ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE

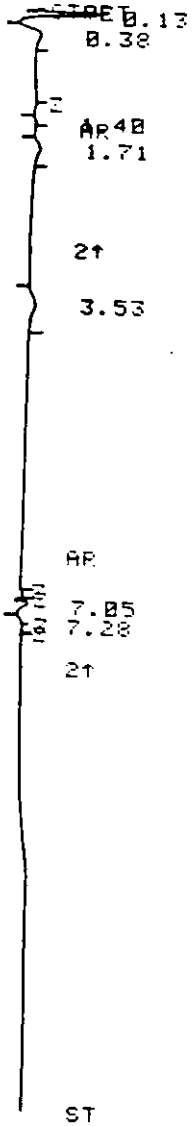


PN 5179
DATE 6-24 TIME
SAMPLE I. D. Blank
STD. CONC. TBHP 45
SOLVENT air
METHOD Topton
☐ BYPASS ☐ OXID. ☑ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE

hp 5890A
AREA %

RT	AREA	AREA %
1.72	2615	28.847
3.49	6450	71.153

XF: 1.0000 E+ 0



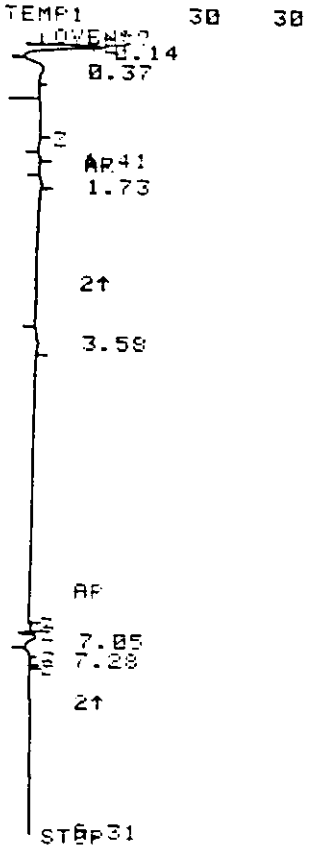
HP 5880A
AREA %

RT	AREA	AREA %
1.71	2484	25.316
3.53	7892	74.684

XF: 1.0000 E+ 0

PN 5179
DATE 5/23/91 TIME
SAMPLE I. D. BLK
STD CONC. TRA # 31
DILUENT
METHOD TCHM1

☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☒ VALVE



PN 5179
DATE 6-1-81 TIME
SAMPLE I. D. TRAP #34
STD. CONC. Blank
SOLVENT air
METHOD TO-2 mod

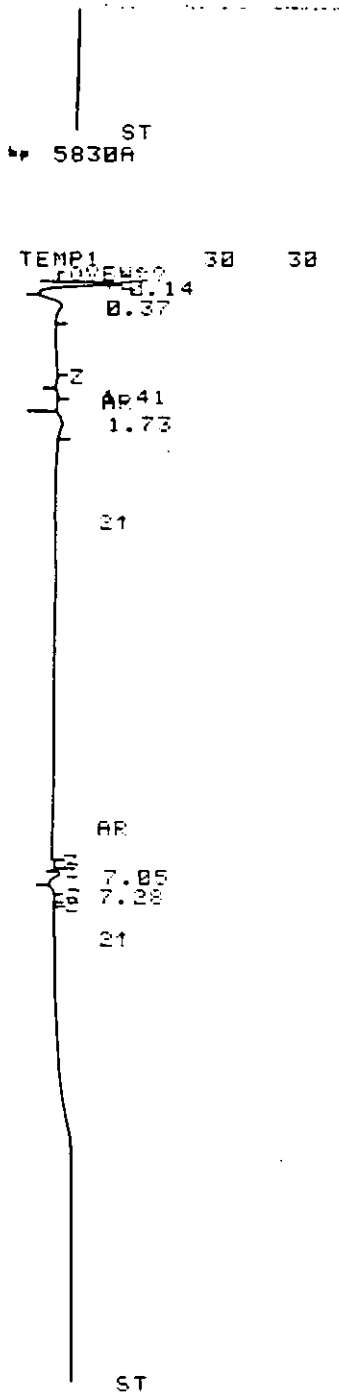
☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE

hp 5830A
AREA %

RT	AREA	AREA %
1.73	419	17.815
3.58	1933	82.185

XF: 1.0000 E+ 0

TEMP1 2 0 0 0 ? ESCAPE
TEMP1 2 0 0 @
ESCAPE
TEMP1 3 0 @



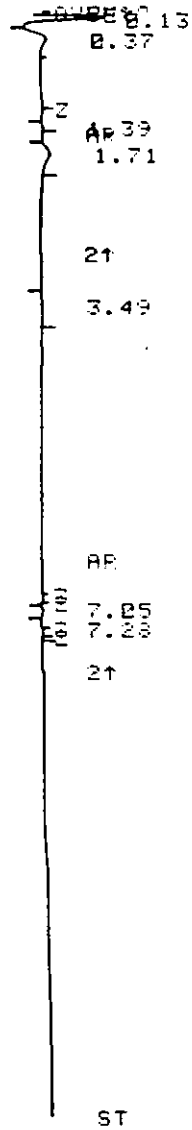
PN 5/79
DATE 2.1-81 TIME
SAMPLE I. D. TRIP # 38
STD. CONC. B/a.wc
SOLVENT air
METHOD TO WMA
☐ BYPASS ☑ D... ✓ REP.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE

AREA %

RT	AREA	AREA %
1.73	2765	100.000

XF: 1.0000 E+ 0

TEMP1 30 30



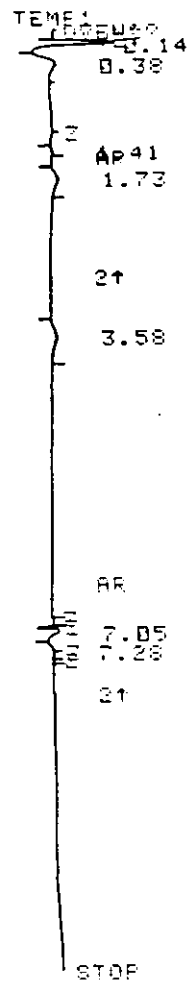
HP 5830A
AREA %

RT	AREA	AREA %
1.71	3431	49.725
3.49	3469	50.275

XF: 1.0000 E+ 0

PN 5179
DATE 5/26/91 TIME
SAMPLE I. D. Blank
STD. CONC. TRAP # 40
SOLVENT
METHOD TONNEL

☐ BYPASS ☒ OXID. ☐ RED.
VOLUME INJECTED 2.5 ml
☐ SYRINGE ☒ VALVE



AREA %

RT	AREA	AREA %
1.73	2690	29.737
3.58	6356	70.263

AF: 1.0000 E+ 0

PN 5175

DATE 6-3-91 TIME

SAMPLE I. D. blank pt 41

STD. CONC.

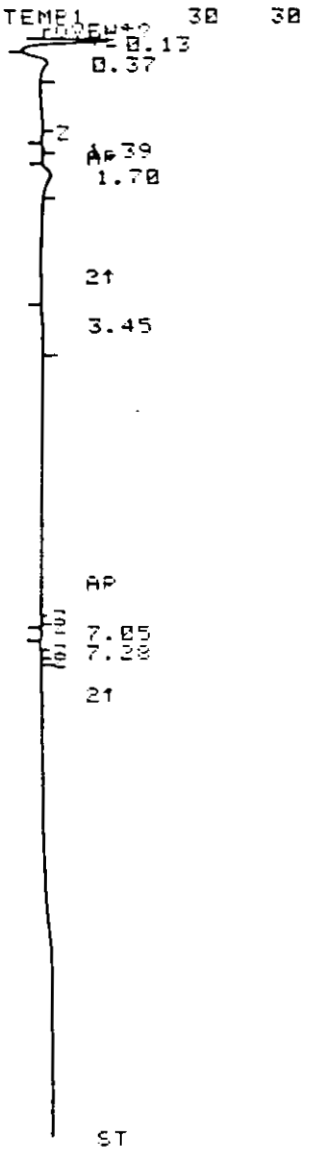
SOLVENT TRAP

METHOD

☐ BYPASS ☑ OXID. ☑ RED.

VOLUME INJECTED 2.0 µl

☐ SYRINGE ☑ VALVE



** 5830A
AREA %

RT	AREA	AREA %
1.70	3675	29.563
3.45	8756	70.437

XF: 1.0000 E+ 0

PN 5179
DATE 5/27/01 TIME
SAMPLE I. D. Blank
STD. CONC.
SOLVENT
METHOD TCN MD

☐ BYPASS ☑ ORIG. ☑ RED
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE

APPENDIX D

SAMPLING AND ANALYTICAL PROCEDURES

DETERMINATION OF TOTAL GASEOUS NONMETHANE ORGANIC EMISSIONS

Sampling and analysis for organic compounds was conducted according to the procedures described in EPA Reference Method 25 of the Federal Register.*

SAMPLING APPARATUS

The sampling apparatus is shown in Figure D-1. The sampling train used in these tests meets design specifications established by the Federal EPA and was assembled by PEDCo personnel. It consists of:

Probe. 1/8 in. O.D. stainless steel tubing with swagelok fittings and caps for connection to the condensate trap.

Condensate trap. Constructed of 316 stainless steel, trap consists of a 3/4 in. diameter by 6 in. cylinder with 1/4 in. O.D. inlet and exit tubes. Cylinder barrel is packed with 316 stainless steel wool.

Gas collection tank. 316 stainless steel with premeasured volume of approximately 6.5 liter. Tank was fitted with a stainless steel quick connect for assembly with the sampling and analytical system.

Sampling regulator system. Vacuum gauge to monitor changes in tank pressure during sampling, stainless steel flow shut-off valve to start and stop sample flow, and adjustable stainless steel needle valve to maintain constant flow rate in the range of 50 to 100 cc/min. Vacuum gauge and valves are connected with 1/4-in. O.D. stainless steel tubing.

Mercury manometer. U-tube manometer - 0 to 1000 mm range to measure tank pressure to the nearest 1 mm of mercury.

*Federal Register, Vol. 45, No. 194, October 3, 1980.

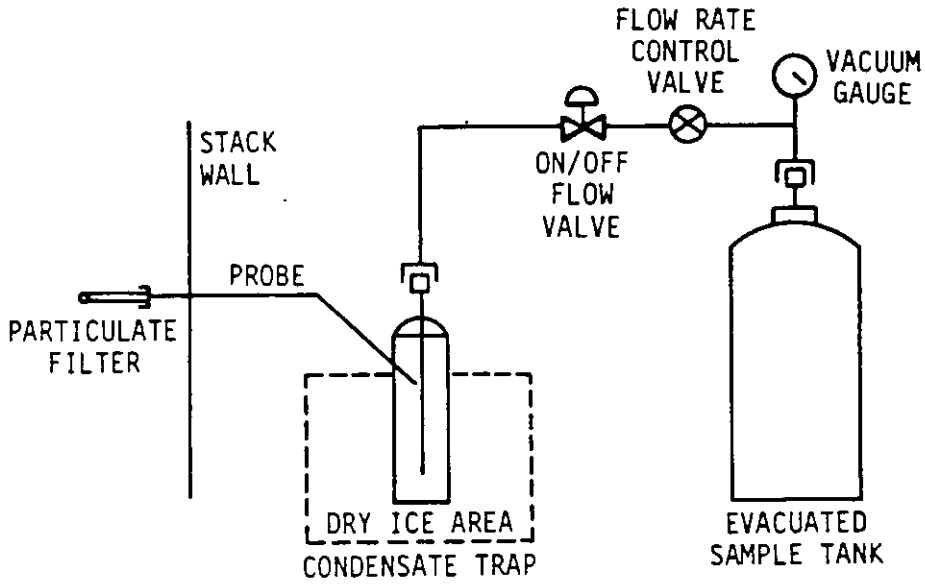


Figure D-1. Method 25 sampling apparatus.

Vacuum pump. Single stage vacuum pump to evacuate sample tanks to an absolute pressure of 5 mm Hg.

Barometer. Aneroid type to measure atmospheric pressure to ±1 mm Hg.

ANALTYICAL APPARATUS

The analytical apparatus consists of two major subsystems; a trap condensate recovery system and a nonmethane organic (NMO) analyzer. The following describes each system in detail.

Trap Condensate Recovery System

Figure D-2 is a schematic of the condensate recovery system. The condensate recovery system was assembly by PEDCo personnel and meets all specifications established by the Federal EPA. It consists of:

Trap heating furnace. Electric tube furnace operated at 650°C.

Oxidizer. 3/8 in. O.D. by 15 inch stainless steel tube packed with Hopcalite^{R} oxidation catalyst and heated in a tube furnace to 900°C.

NDIR detector. Beckman Model 864 NDIR detector capable of indicating CO_2 concentration in the 0 to 5 percent range.

Intermediate collection tank. Stainless steel with pre-measured volume of approximately 6.5 liters. Tank was fitted with a stainless steel quick connect for assembly with condensate recovery system.

Trap carrier gas. Hydrocarbon free air containing less than 0.1 ppm total hydrocarbons.

Nonmethane Organic (NMO) Analyzer

Figure D-3 is a schematic of the NMO analyzer. The analyzer meets all performance specifications established by the Federal EPA. It consists of:

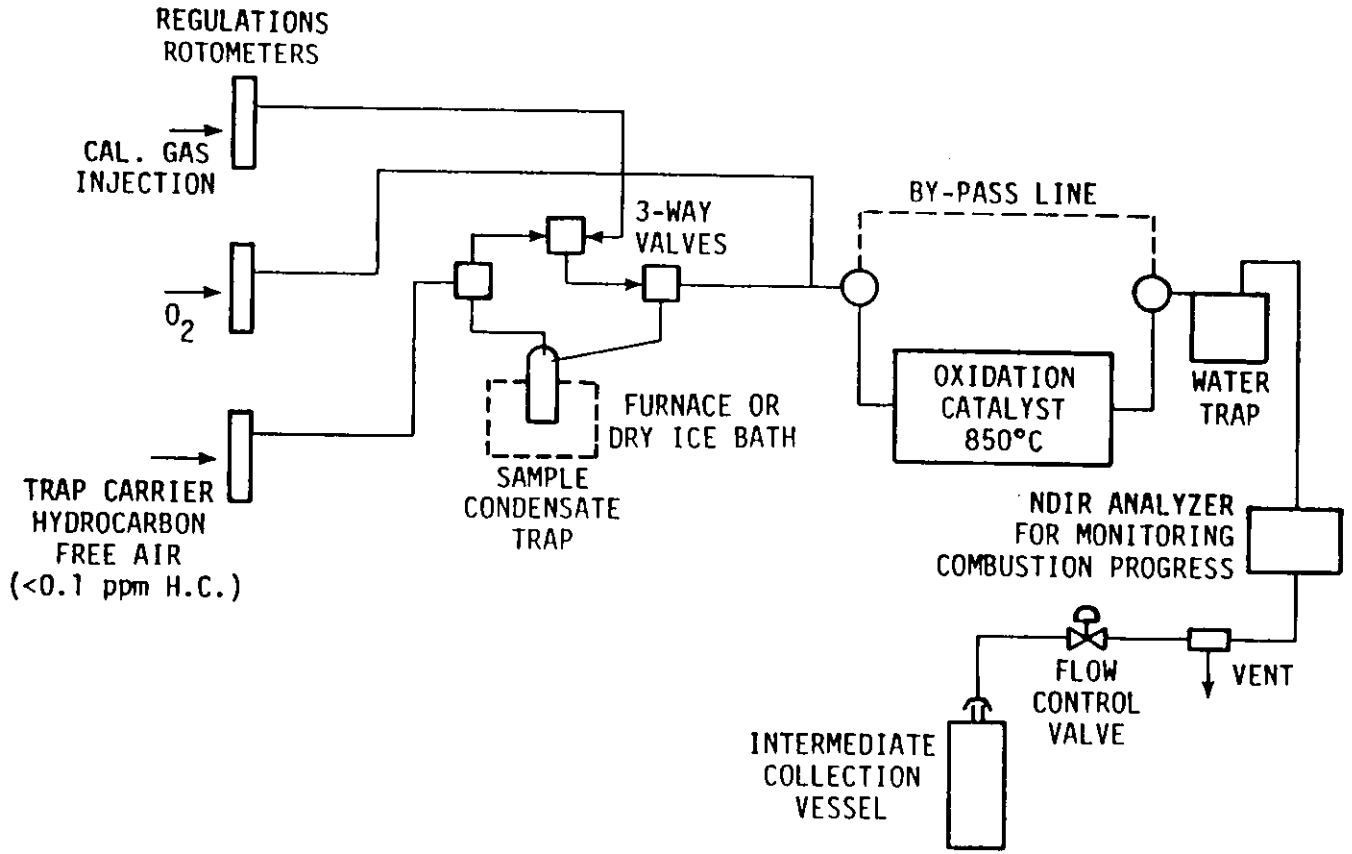


Figure D-2. Condensate recovery and conditioning apparatus.

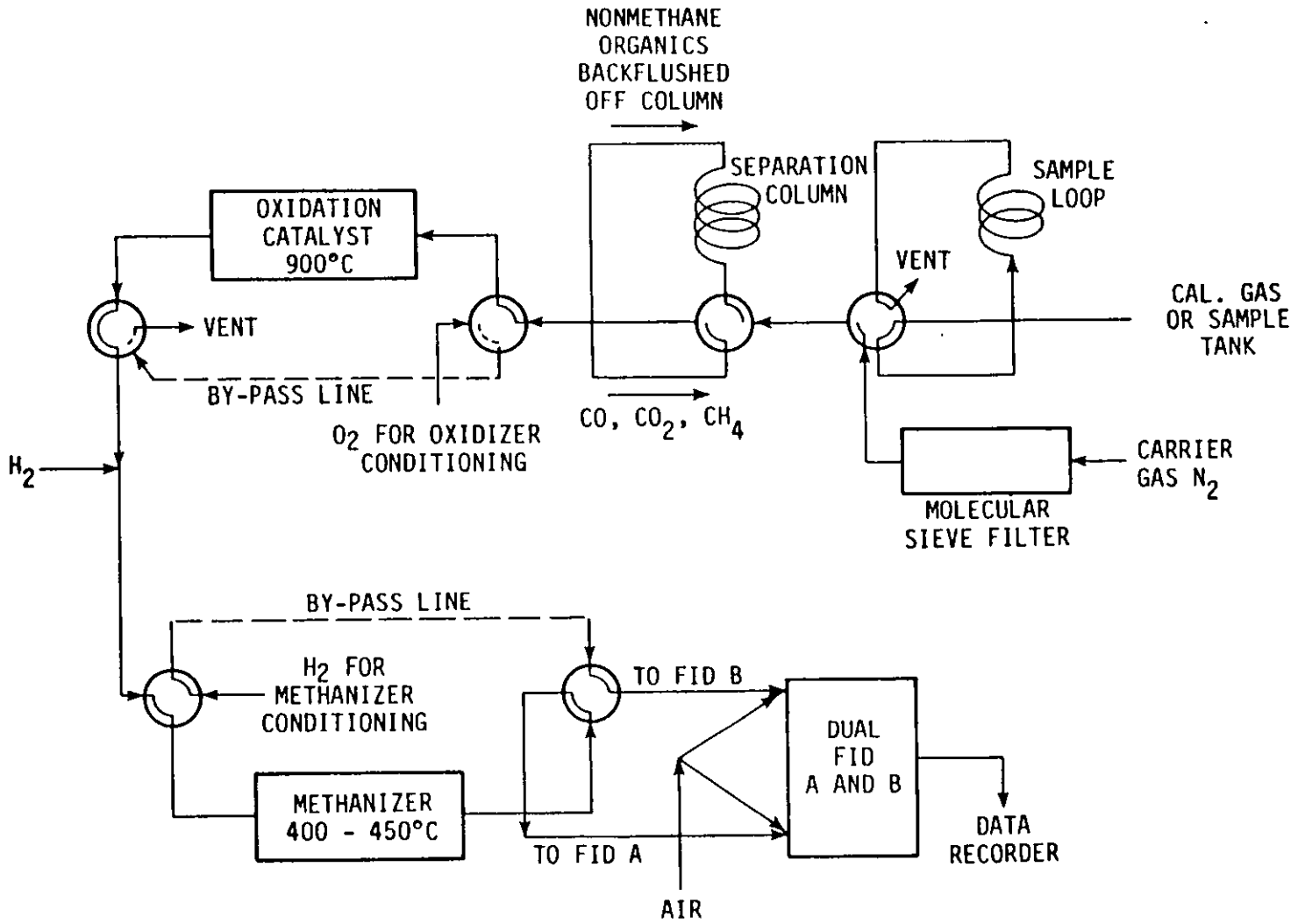


Figure D-3. Method 25 NMO analyzer.

Gas chromatograph (GC). Hewlett-Packard Model 5830-A with a 10-port switching valve to reverse the flow of carrier gas in the column (back flush step) and allow for automatic injection of the sample gas through a 2.0 ml sample loop. The GC also has temperature-programming capability and a microprocessor to integrate component peaks and compile analytical data.

Oxidizer. 3/8 in. O.D. by 15 in. stainless steel tube packed with Hopcalite^{R} oxidation catalyst and heated in a tube furnace to 900°C.

Methanizer. Byron Instruments, Inc., reduction catalyst module operated at approximately 400°C.

Separation column. 9 ft. x 1/8 in. O.D. stainless steel column packed with 60/80 mesh Porakak Q_S.

Carrier gas. Nitrogen, purified by passing through a molecular seive filter before entering analytical system.

Detector. Flame ionization detector (FID) supplied by Hewlett-Packard with the 5830-A GC.

All lines connecting the GC, oxidizer, methanizer, and FID are wrapped with heat trap to prevent condensation of moisture or organics in the sample gas.

SAMPLING PROCEDURES

Prior to sampling, the collection tank was evacuated to 5 mm Hg absolute pressure and connected to a U-tube manometer. The ambient temperature, barometric pressure, and initial tank vacuum were recorded. After a minimum of 15 minutes, the tank vacuum was again recorded. Any change in vacuum was considered an unacceptable leak rate. The sample train was assembled as shown in Figure D-1 and the condensate trap body was immersed in dry ice. The portion of the sample train before the on/off flow valve was leak checked by evacuating this section to at least 500 mm Hg. This vacuum was recorded, and after 5 minutes the vacuum was

again recorded. A leak rate of less than 2 mm Hg per 5 minutes was considered acceptable.

To collect the sample, after positioning the probe in the emission stream, the flow control valve was opened and adjusted to maintain a constant flow rate throughout the sampling period. The gauge vacuum was recorded at 5 minute intervals during the test.

After the test, a leak check was performed by connecting a leg of the U-tube manometer to the probe tip, opening the sample train flow control valve, and allowing the vacuum on the manometer to stabilize. After 5 minutes the final vacuum reading on the manometer and the tank gauge were checked. Any change in vacuum during the five minute leak check was considered unacceptable. The final tank vacuum, ambient temperature, and barometric pressure were recorded. The condensate trap was disconnected from the sampling train, sealed, labeled, and packed in dry ice until analysis.

ANALYTICAL PROCEDURE

Sample analysis consists of recovering the contents of the condensate trap in an intermediate collection tank, and analyzing both the sampling and intermediate collection tanks with the NMO analyzer. The following describes the procedures used by PEDCo for each step of the analysis.

Condensate Trap Recovery

Condensate trap recovery begins by purging the trap of any CO_2 that it may contain. This was accomplished as follows: the

condensate trap was packed in dry ice to prevent loss of condensed organics and attached to the recovery apparatus. The sample tank from the test run was connected to the outlet of the NDIR (see Figure D-2). Carrier gas was switched to by-pass the oxidizer, gas through the trap and NDIR and into the sample tank. The trap was purged until all CO_2 had been removed as indicated by the NDIR. The carrier gas flow was then switched to by-pass the trap and flow was maintained until the sample tank was pressurized to an absolute pressure of approximately 850 mm Hg.

Recovery of the condensed organics was accomplished by heating the trap to 650°C in the trap heating furnace and routing the recovery system carrier gas through the trap, oxidizer, NDIR, and into the intermediate collection tank. The progress of the combustion of the trap contents was monitored with the NDIR, and the carrier flow was continued through the heated trap until the NDIR indicated zero CO_2 in the system and the intermediate collection tank was pressurized to an absolute pressure of approximately 850 mm Hg.

Analysis of Sample and Intermediate Collection Tanks

The contents of both the sampling and intermediate collection tanks were analyzed by making triplicate injections of the tank contents into the MNO analyzer.

Sampling and intermediate collection tanks were heated prior to sample injection to provide a thorough mixing of the tank contents.

To determine the source concentration of noncondensible organic compounds, the sampling tank was analyzed for its total nonmethane organic content. To determine the source concentration of condensible organics, the intermediate collection tank was analyzed for total CO_2 and organic content.

The total nonmethane organic concentration at the source was then determined by adding the concentrations of noncondensible and condensible organics.

To effect separation of the nonmethane organics from CO, CO_2, and methane, the separation column was operated as follows: the column temperature was maintained at 30°C for three minutes to elute the carbon monoxide and methane. The temperature was then raised to 200°C at the rate of 25°C/min. Carbon dioxide was eluted at just under four minutes. The carrier gas flow was reversed to backflush nonmethane organics from the column at 6.5 minutes. If a sample contains ethane, the ethane peak would elute at about 6.4 minutes (just prior to the backflush step).

Calibration Procedures

The following describes the procedures used by PEDCo to calibrate the NMO analyzer before and during the analyses of each set of emission samples.

FID Calibration and Linearity Check--

Prior to analysis of each set of samples the linearity of the NMO analyzer FID is checked. The linearity check consists of a calibration using gas standards of propane in air, with concentrations ranging from 19 to 1500 ppm. The FID linearity

is considered acceptable if the response for each propane standard is within ±5 percent of the mean response from all five standards.

Oxidation and Reduction Catalyst Efficiency Check--

The performance of the oxidation and reduction catalysts are checked prior to analysis of each set of samples. To check the oxidizer performance, triplicate injections of 20,000 ppm methane were made with the carrier gas passing through the oxidizer and by-passing the methanizer. Complete conversion of the methane to CO_2 was confirmed by the fact that no methane response was obtained at the FID. After confirming that the oxidizer was operating at near 100 percent efficiency (no FID response), the reduction catalyst was checked. Triplicate injections of 500 and 10,000 ppm carbon dioxide standard were made with the carrier gas flowing through both the oxidizer and methanizer units. The methanizer catalyst performance was acceptable if the average response of the CO_2 standards was within ±5 percent of the mean response for CO_2 and within ±10 percent of the NMO response factor determined with the propane linearity check.

System Operation Check and Daily Response Factors--

Prior to and at the conclusion of daily analysis of samples, FID response factors were determined and the system operation checked by making triplicate injections of four component gas mixtures through both the oxidation and reduction catalysts. The

four component mixtures consisted of carbon monoxide, carbon dioxide, methane, and propane. The concentration of each component of the standards used for this test is listed in Table D-1.

The response factors for the sample analyses were determined from the integrated peaks created by carbon dioxide and propane. In addition, (for the analyses of the recovered trap contents) gas standards with lower CO_2 concentrations (500 ppm and 1%) were used to determine a daily response factor for carbon dioxide.

TABLE D-1. COMPONENT CONCENTRATIONS OF FOUR COMPONENT GAS STANDARDS USED IN CALIBRATION OF THE METHOD 25 ANALYZER

Cylinder No.	Concentration, ppm[a]			
	CO	CH_4	CO_2	C_3H_8
AAL1687	45.5	48.3	19,200	19.0
H52570	102	98.6	38,900	55.9
AAL7279	47.3	47.7	19,400	996

[a]ppm = parts per million by volume.

APPENDIX E

CALIBRATION PROCEDURES AND RESULTS

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D.C. 20234

July 14, 1975

REPORT OF CALIBRATION

on

One Standard Type Pitot-static Tube
F. W. Dwyer Catalog No. 160-24
Pitot tube No 501
submitted by

PEDCo-Environmental Specialists, Inc.
Suite 13, Atkinson Square
Cincinnati, Ohio 45246

Reference: Req. 1741-0001-2, dated December 17, 1974

The calibration was performed in the five-foot by seven-foot rectangular test section of the NBS closed-circuit dual test section wind tunnel. The tunnel provides an essentially uniform air stream with a very low turbulence intensity. The tube under test was inserted into the air stream through a hole in the tunnel wall and held in place by a clamping arrangement with all fittings outside the tunnel. The tube was aligned with the flow and positioned so that the static holes were approximately 8-1/2 inches from the tunnel sidewall. The boundary layer on the tunnel wall was approximately 1.8 inches thick.

Calibration of the tube consisted of determining the calibration factor K where K is defined as the ratio of the differential pressure indicated by the tube under test to the differential pressure indicated by the NBS laboratory standard. This was done by a direct comparison in which the tube under test and the NBS tube were mounted in the tunnel, 16 inches apart, and at the same distance from the tunnel sidewall.

The coefficient K for a tube of this type may be dependent on the Reynolds number per unit length, V/ν, where V is the air speed, and ν is the kinematic viscosity. This parameter is therefore given in the attached table, along with the corresponding values of V in the units requested, as the properties of the gas in which this instrument is used may be an important consideration. The values of K tabulated are the average of four independent determinations at each of the corresponding values of V/ν.

For the Director
ORIGINAL SIGNED BY
P.S. Klebanoff

P. S. Klebanoff, Chief
Aerodynamics Section
Mechanics Division, NBS

Table I
Pitot-static Tube
F. W. Dwyer Catalog No. 160-24
Pitot tube #501

Reynolds number per foot $V/\nu \times 10^{-5}$, Re_1	True Air Speed fps	K
41	3.6	1.00
47	4.1	1.00
54	5.6	1.00
62	7.1	1.00
58	9.0	1.00
76	10.9	1.00
112	20.6	1.00
119	20.6	0.99
164	14.2	0.99
318	27.1	0.991
453	77.1	1.000
547	33.5	1.000
643	116.3	1.000
737	127.8	1.000
922	160.6	1.000

BAROMETER CALIBRATION LOG

Barometer Number	225	227	237	225	237	225	227
Project Number	5166-B		6174	3530-2	5176	5175	5158
Pre-test	4/11/81	4/16/81	4/17/81	4/29/81	5/1/81	5/5/81	5/15/81
Barometer Reading	29.50	30.15	29.43	29.46	29.33	29.44	29.26
Reference Barometer Reading	29.50	30.12	29.44	29.46	29.37	29.44	29.26
Difference*	0.00	0.03	0.01	0.00	0.04	0.00	0.00
Post-test	4/22/81	5/15/81	5/1/81	5/5/81	5/15/81	5/15/81	5/15/81
Barometer Reading	29.46	29.10	29.33	29.44	29.28	28.72	29.12
Reference Barometer Reading	29.46	29.26	29.37	29.44	29.26	29.26	29.26
Difference**	0.00	0.16	0.04	0.00	0.02	0.54	0.14

* Barometer is adjusted so that difference does not exceed 0.1"Hg.
** Barometer is not adjusted, difference must not exceed 0.2"Hg.

METHOD 25 FLOW REGULATOR CALIBRATION

Date: 5/15/81

Calibrated by: D. Hershey

Calibrated with 250 ml bubble buret (as primary standard) with condensate trap in line using an evacuated sampling tank.

METHOD 25 FLOW REGULATOR CALIBRATION

Regulator No.	Measured flow rate, ml/min			
	Trial No. 1	Trial No. 2	Trial No. 3	Average
1	92.6	92.6	92.3	92.5
2	87.2	87.0	85.0	86.4
3	80.2	80.6	80.2	80.3
4	86.7	87.2	86.2	86.7
5	90.6	90.4	89.6	90.2

Method 25 Analyzer Calibration Results

DAILY CALIBRATION RECORD

Date	Component	Concentration, ppm	Concentration[a] as methane, ppm	FID response, area units (A.U.) Run 1	Run 2	Run 3	Average	Response factor, ppm CH_4/A.U.
[b] 5-20-81	propane, C_3H_8	19	57	35290	35350	35090	35243	1.617×10^{-3}
[b] 5-20-81	C_3H_8	501	1503	948400	950200	950600	949733	1.582×10^{-3}
[b] 5-20-81	C_3H_8	996	2988	1874000	1883000	1889000	1882000	1.588×10^{-3}
[b] 5-20-81	C_3H_8	1530	4590	2826000	2839000	2852000	2839000	1.617×10^{-3}
			AVERAGE PROPANE RESPONSE					1.601×10^{-3}
[c] 5-21-81	CH_4	20000	20,000	NO RESPONSE				
[d] 5-21-81	CO_2	509.6	509.6	356000	360400	361200	359200	1.42×10^{-3}
[d] 5-21-81	CO_2	10000	10 000	7306000	7322000	7322000	7316667	1.37×10^{-3}
			AVERAGE CO_2 Response					1.395×10^{-3}
[e] 5-22-81	CO	45.5	45.5	33240	32350	32850	32813	1.39×10^{-3}
	CH_4	48.3	48.3	34500	34130	34040	34223	1.41×10^{-3}
	CO_2	19200	19200	13280000	13280000	13180000	13246667	1.45×10^{-3}
	C_3H_8	19	57	32300	31090	31840	31743	1.79×10^{-3}
5-27-81	C_3H_8	19	57	32050	32650	33810	32836	1.736×10^{-3}
5-28-81	C_3H_8	55.9	167.7	95200	95800	96020	95673	1.753×10^{-3}
5-29-81	CO_2	509.6	509.6	369400	370200	369100	369567	1.379×10^{-3}

[a] Multiply component concentration by number of carbon atoms in standard gas.

b. FID Linearity Check.

c. OXIDATION CATALYST check. Sample through oxidizer only.

d Reduction catalyst check.

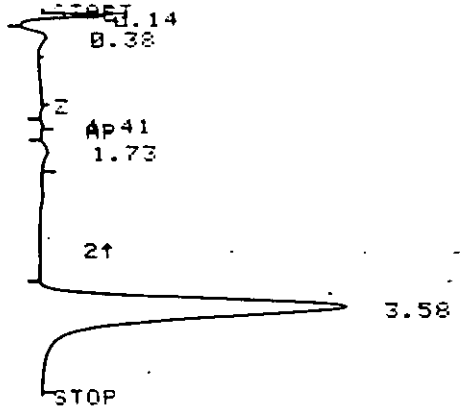
e four component mixture for system check.

DAILY CALIBRATION RECORD

Date	Component	Concentration, ppm	Concentration[a] as methane, ppm	FID response, area units (A.U.)				Response factor, ppm CH_4/A.U.
				Run 1	Run 2	Run 3	Average	
6-1-81	CO_2	509.6	509.6	365300	366000	365300	365533	1.370×10^{-3}
6-2-81	C_3H_8	55.5	167.7	94180	94660	95240	94693	1.771×10^{-3}
6-3-81	C_3H_8	55.3	167.7	95440	95780	95640	95620	1.754×10^{-3}
6-4-81	CO_2	509.6	509.6	381800	380800	380300	380967	1.34×10^{-3}
6-5-81	11	11	11	376500	379800	377500	377933	1.35×10^{-3}
6-8-81	C_3H_8	55.5	167.7	93200	93240	94360	93600	1.792×10^{-3}

[a] Multiply component concentration by number of carbon atoms in standard gas.

Example Chromatograms From Method 25 Analyzer Calibration

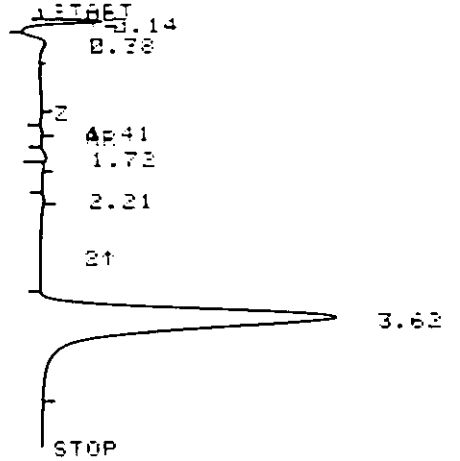


PN 5179
DATE 6-4-81 TIME
SAMPLE I. D. CO_2
STD. CONC. 509.6
SOLVENT Air
METHOD Torch
☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 µl
☐ SYRINGE ☑ VALVE

hp 5830A
AREA %

RT	AREA	AREA %
1.73	2771	0.721
3.58	381500	99.279

XF: 1.0000 E+ 0

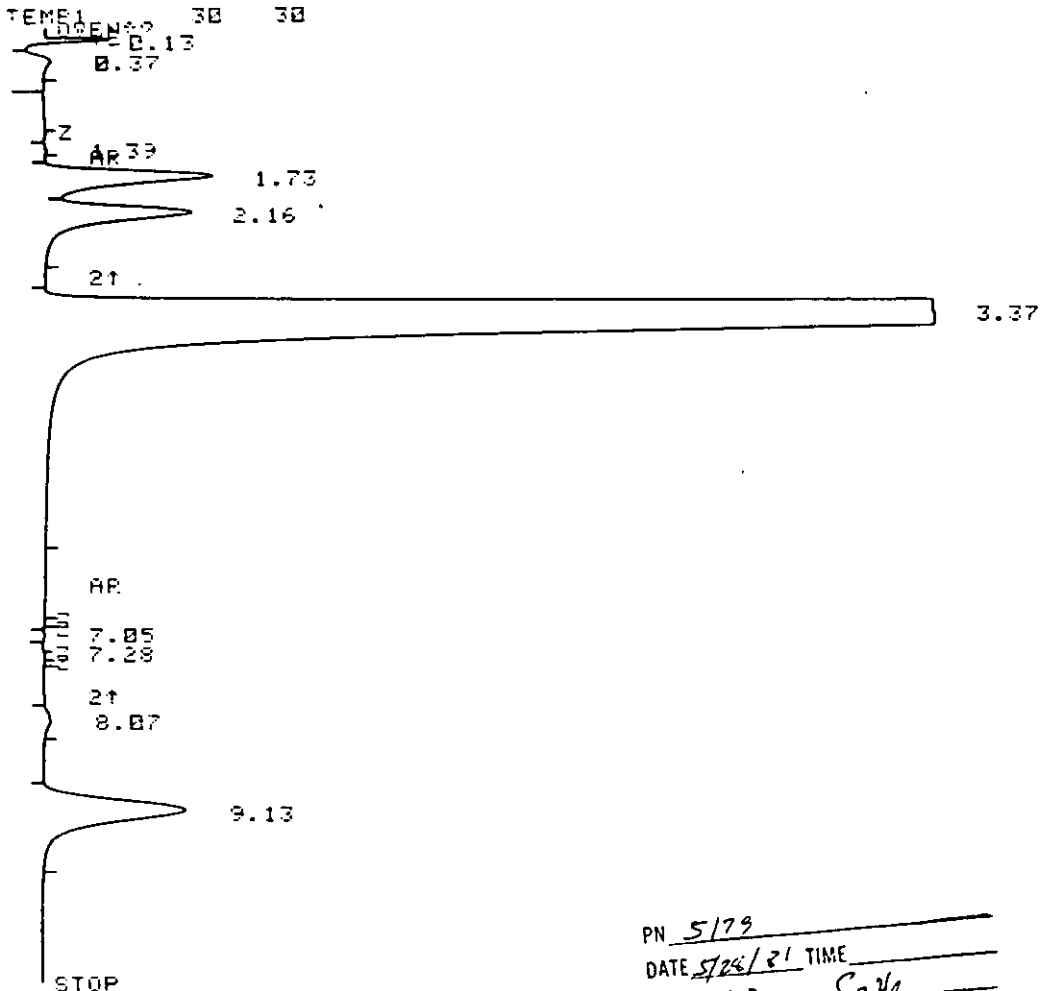


PN 5179
DATE 6.4.81 TIME
SAMPLE I. D. CO_2
STD. CONC. 509.6 ppm
SOLVENT Air
METHOD Torch
☐ BYPASS ☑ OXID. ☑ RED.
VOLUME INJECTED 2.0 µl
☐ SYRINGE ☑ VALVE

hp 5830A
AREA %

RT	AREA	AREA %
1.72	1125	0.300
2.21	263	0.070
3.62	373700	99.630

XF: 1.0000 E+ 0



HP 5830A
AREA %

RT	AREA	AREA %
1.73	69560	0.265
2.16	69760	0.266
3.37	26000000	99.093
8.07	2898	0.011
9.13	95800	0.365

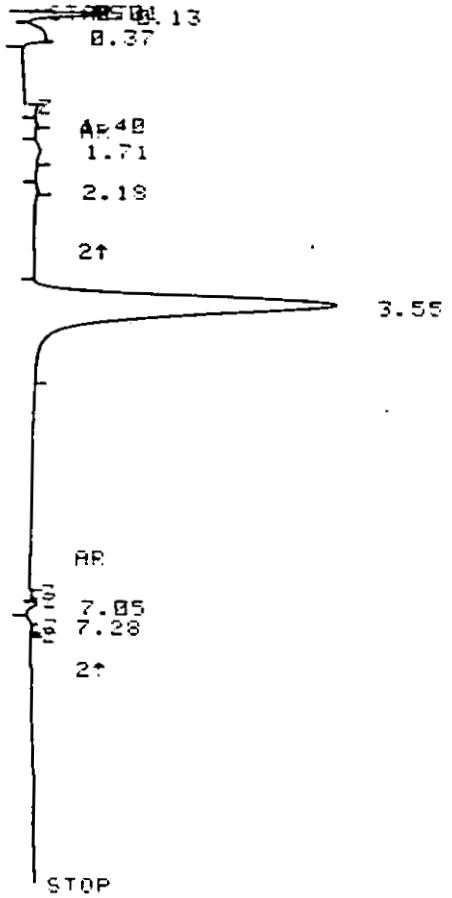
XF: 1.0000 E+ 0

PN 5179
DATE 5/24/91 TIME
SAMPLE I. D. C_2H_6
STD. CONC. 55.9
SOLVENT air
METHOD TCPMD

☐ BYPASS ☑ OXID ☐ RED.
VOLUME INJECTED 2.0 mL
☐ SYRINGE ☑ VALVE

3.55 [illegible] 99.587

XF: 1.0000 E+ 0



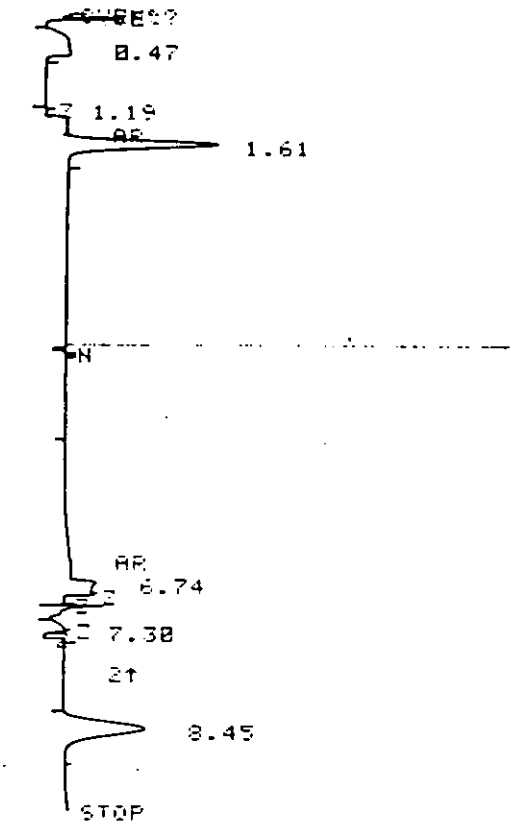
PN 5179
DATE 5/29/81 TIME
SAMPLE I. D. CO_2
STD. CONC. 509.6
SOLVENT air
METHOD TGNMO

☐ BYPASS ☑ OXID. ☑ RED
VOLUME INJECTED 2.0 ML
☐ SYRINGE ☑ VALVE

hp 5830A
AREA %

RT	AREA	AREA %
1.71	1823	0.491
2.18	379	0.102
3.55	369100	99.407

XF: 1.0000 E+ 0



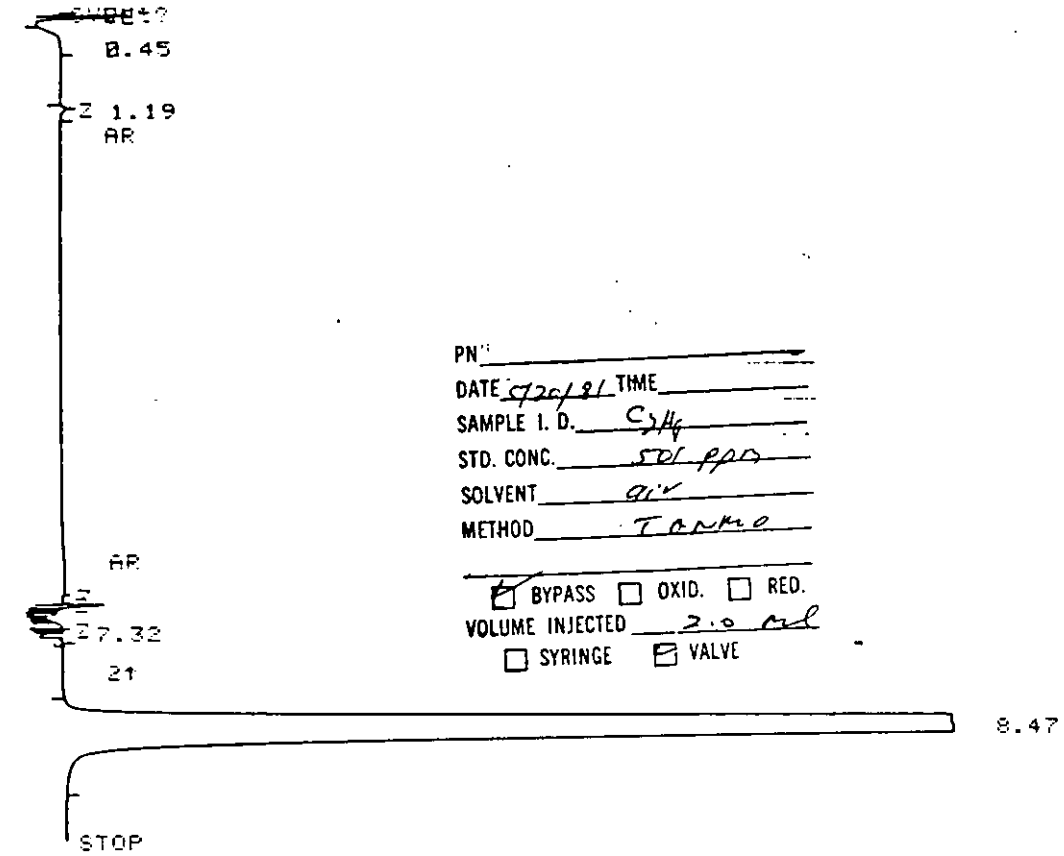
PN _____
DATE 5/20/81 TIME _____
SAMPLE I. D. C_3H_8
STD. CONC. 19.0
SOLVENT air
METHOD TO-NMO

☑ BYPASS ☐ OXID. ☐ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE

hp 5830A
AREA %

RT	AREA	AREA %
1.61	35690	50.395
4.05	40	0.056
8.45	35090	49.548

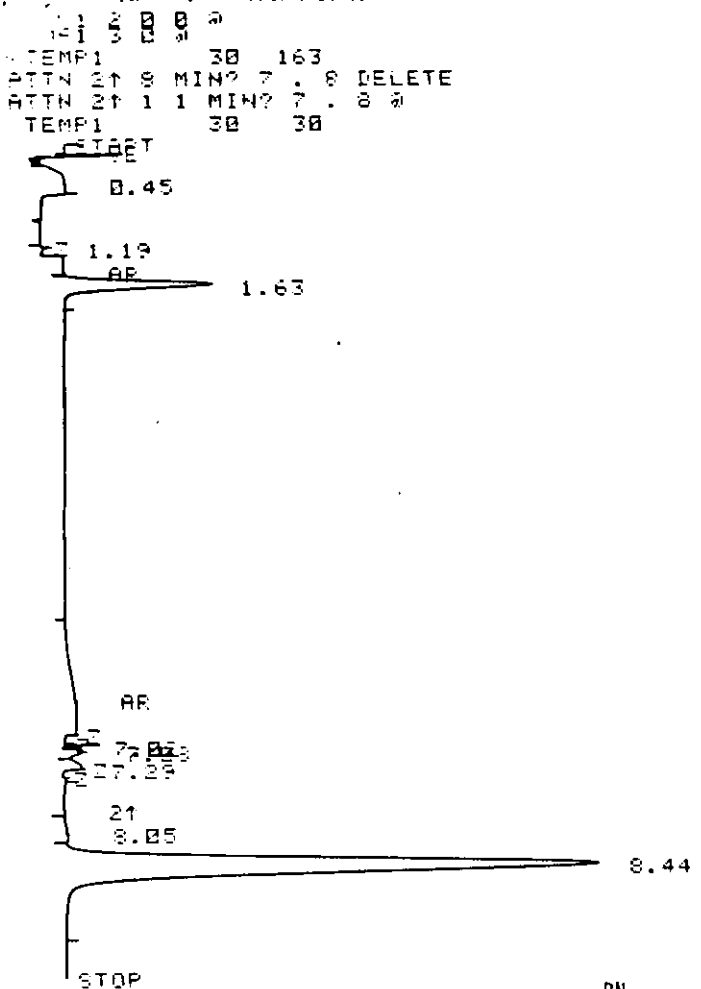
XF: 1.0000 E+ 0



5830A
AREA %

RT	AREA	AREA %
8.47	950600	100.000

XF: 1.0000 E+ 0



** 5830A
AREA %

RT	AREA	AREA %
1.63	35830	1.865
8.05	10660	0.555
8.44	1874000	97.580

XF: 1.0000 E+ 0

PN _____

DATE 5/20/81 TIME _____

SAMPLE I. D. C_{3H_8}

STD. CONC. 996 ppm

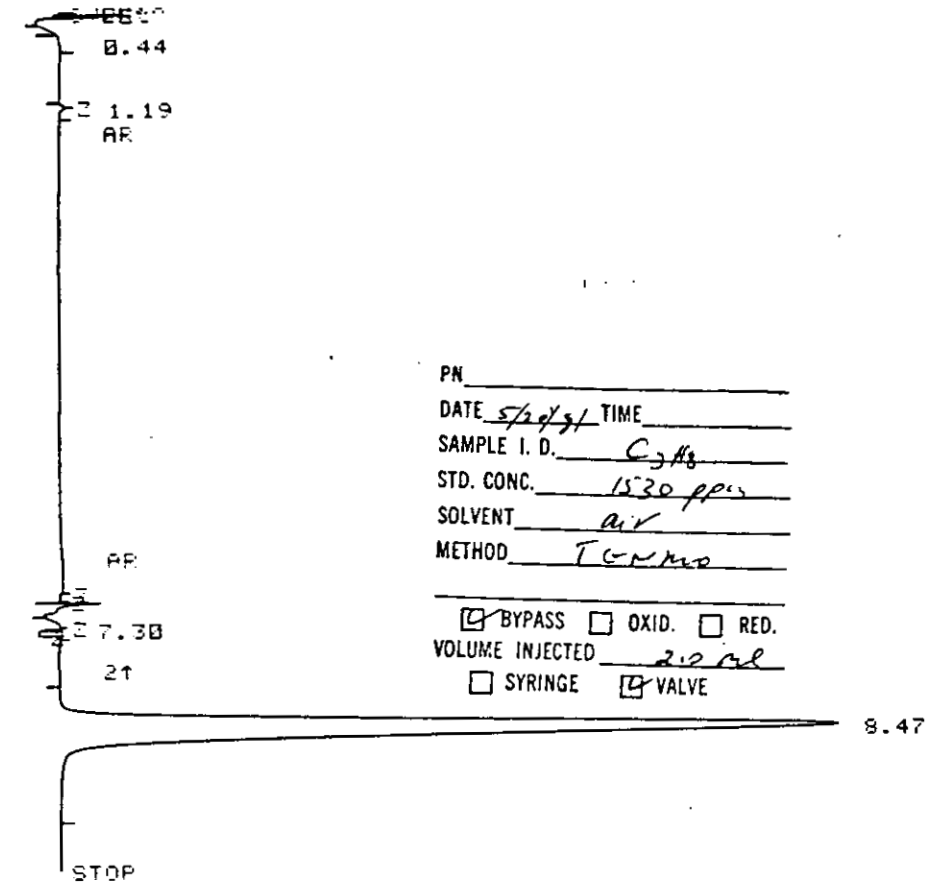
SOLVENT air

METHOD Tedlar

☑ BYPASS ☐ OXID. ☐ RED.

VOLUME INJECTED 2.0 ml

☐ SYRINGE ☑ VALVE



PN_____

DATE 5/20/91 TIME_____

SAMPLE I. D. C_3H_8

STD. CONC. 1530 ppm

SOLVENT air

METHOD TCNMO

☑ BYPASS ☐ OXID. ☐ RED.

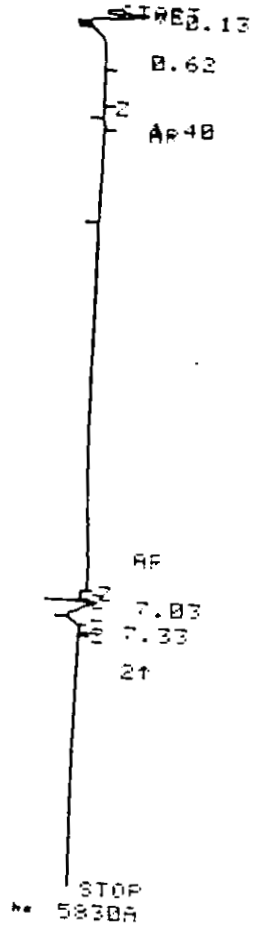
VOLUME INJECTED 2.0 ml

☐ SYRINGE ☑ VALVE

hp 5830A
AREA %

RT	AREA	AREA %
8.47	2852000	100.000

XF: 1.0000 E+ 0



PN _____

DATE 5/21/81 TIME _____

SAMPLE I. D. CH_4

STD. CONC. 2%

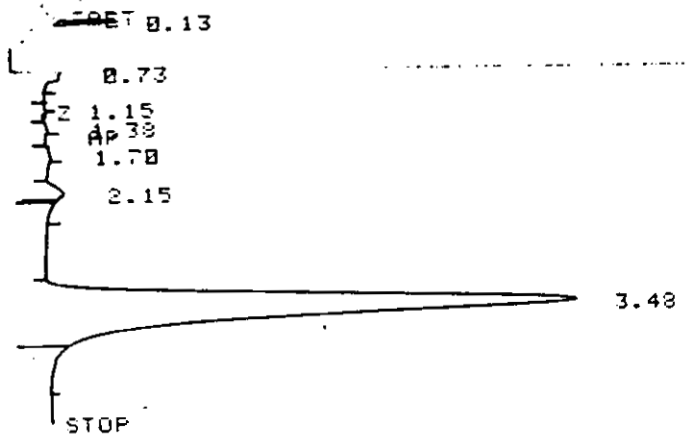
SOLVENT air

METHOD TC-NMO

☐ BYPASS ☒ OXID. ☐ RED.

VOLUME INJECTED 2.0 ml

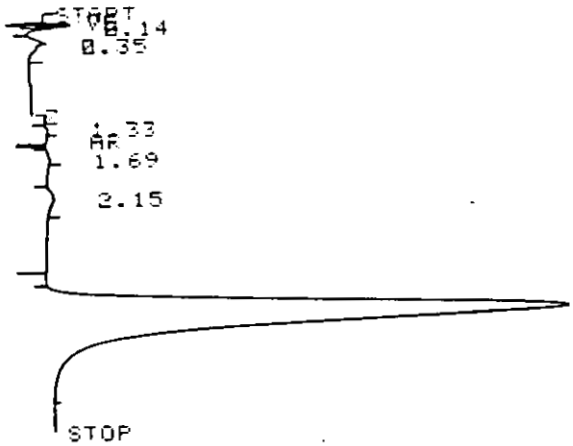
☐ SYRINGE ☒ VALVE



hp 5830A
AREA %

RT	AREA	AREA %
1.70	741	0.203
2.15	7856	2.155
3.48	356000	97.642

XF: 1.0000 E+ 0



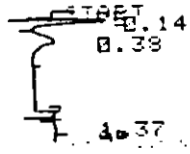
PN _____
DATE 5/21/81 TIME _____
SAMPLE I. D. CO_2
STD. CONC. 509.6 ppm
SOLVENT air
METHOD TCD/MC

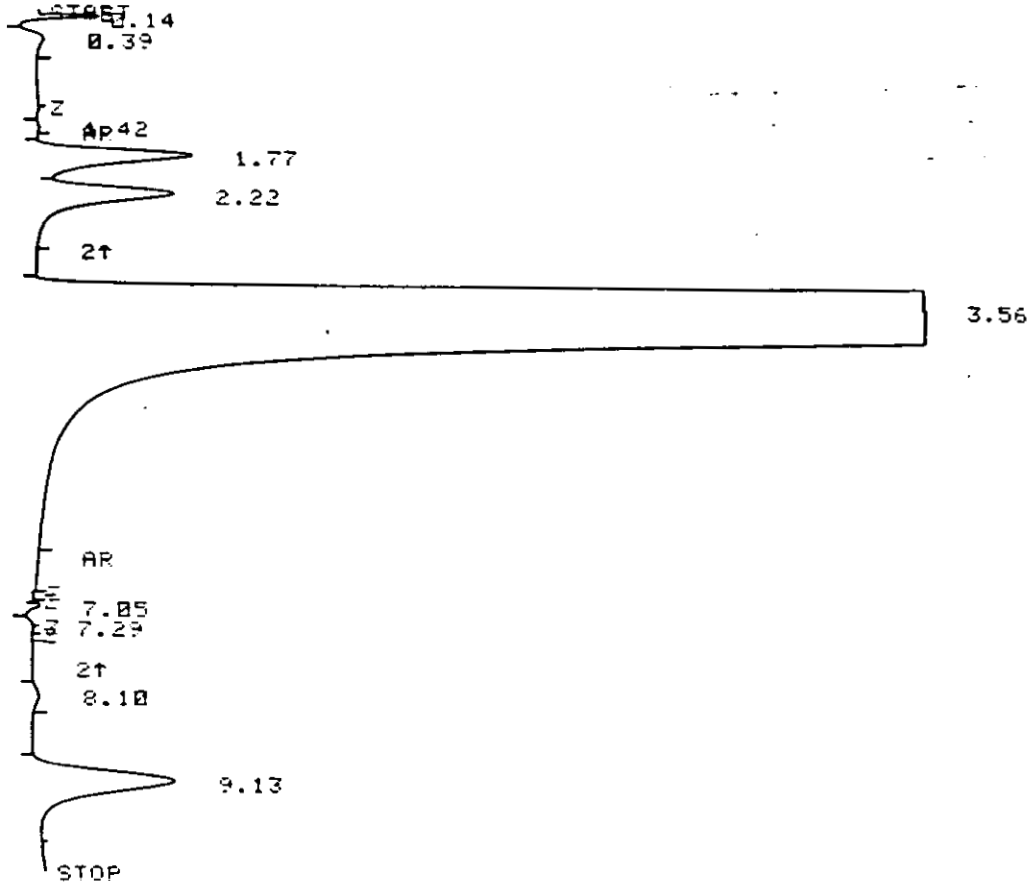
☐ BYPASS ☐ OXID. ☑ RED.
VOLUME INJECTED 2.0 mL
☐ SYRINGE ☑ VALVE

hp 5830A
AREA %

RT	AREA	AREA %
1.69	953	0.262
2.15	2797	0.768
3.51	360400	98.970

XF: 1.0000 E+ 0





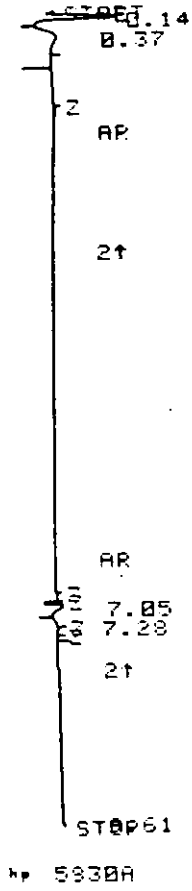
hp 5830A
AREA %

RT	AREA	AREA %
1.77	68900	0.256
2.22	71300	0.265
3.56	26670000	99.119
8.10	2633	0.010
9.13	94360	0.351

XF: 1.0000 E+ 0

PN 5177
DATE 6-8-81 TIME
SAMPLE I. D. C_3H_8
STD. CONC. 55.9
SOLVENT air
METHOD TGTMO

☐ BYPASS ☑ OXID. ☐ RED.
VOLUME INJECTED 2.0 ml
☐ SYRINGE ☑ VALVE



PN 5179
DATE 6-4-81 TIME
SAMPLE I. D.
STD. CONC.
SOLVENT
METHOD
☐ BYPASS ☑ ON ☐ RED.
VOLUME INJECTED 2.0 µl
☐ SYRINGE ☑ VALVE