FERMENTER EMISSIONS

TEST REPORT

PREPARED FOR

UNIVERSAL FOODS CORPORATION
2100 VAN DEMAN STREET
HOLABIRD INDUSTRIAL PARK
BALTIMORE, MARYLAND 21224

OCTOBER 26, 1990

GANNETT FLEMING, INC.
SUITE 200, EAST BLOCK QUADRANGLE
VILLAGE OF CROSS KEYS
BALTIMORE, MARYLAND 21210

Gannett Fleming
ENGINEERS AND PLANNERS

GANNETT FLEMING, INC.
Suite 200
East Quadrangle
The Village of Cross Keys
Baltimore, MD 21210
Fax: (301) 433-6520
Office: (301) 433-8832

October 26, 1990

Mr. Ken Randall
Universal Foods
2100 Van Deman Street
Baltimore, Maryland 21224

Re: VOC Emissions Test

Dear Mr. Randall:

Gannett Fleming conducted an air emissions test on October 18 and 19. The tests were observed by Ms. Christine Wisniewski of your staff and Mr. Pars Ramnarain of the State Air Management Administration. Enclosed are results of that test. If you have any questions, please do not hesitate to call me at 433-8832.

Very truly yours,

GANNETT FLEMING, INC.

Richard Hergenroeder, P.E.
Project Manager

RH/cr

Enclosure

cc: C. Wisniewski, Universal Foods
M. Kindig, Gannett Fleming

GF: 27340.000

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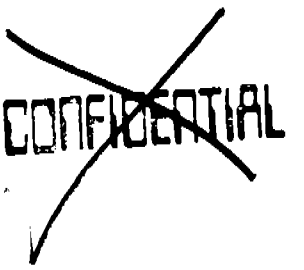


1.0 INTRODUCTION

Gannett Fleming, Inc. conducted a field test to sample and analyze stack gas emitted from Yeast Fermenter Number 3 at the Universal Foods facility in Baltimore City, Maryland, on October 18 and 19, 1990. Tests were conducted to demonstrate compliance with State air quality regulations. Volatile Organic Carbon (VOC) was measured with a flame ionization analyzer employing U.S. EPA Reference Method (RM) 25A. Flow was measured by Maryland Air Management Administration (AMA) Stack Test Methods 1001 and 1002. The test was a continuous test run over the course of a 15 hour batch process cycle.

1.1 TEST PURPOSE

The purpose of these tests was to determine regulatory compliance of the emission rates with respect to VOCs from Fermenter Number 3. Maryland General Emissions Standards, Prohibitions and Restrictions (COMAR 26.11.06) requires reports of VOCs emissions.

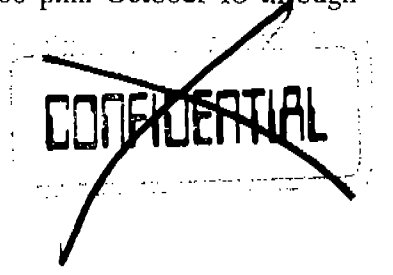
1.2 TEST LOCATION AND PROCESS

Universal Food's facility is located in the Holabird Industrial Park at 2100 Van Deman Street, Baltimore, Maryland, 21224. The facility is in an unclassified industry, and is thus subject to the general air quality standards described in COMAR 26.11.06 and 26.11.15.

Fermenter Number 3 is operated over a 15-hour batch with one fermentation per day. The fermenter uses yeast cultures, molasses and air as raw materials. Air is vented from the system at approximately 95°F and 20,000 standard cubic feet per minute (SCFM).

1.3 TEST DATES

The field test was performed by Gannett Fleming personnel from 2:00 p.m. October 18 through 5:00 a.m. October 19.



1.4 POLLUTANTS TESTED

The field tests were performed for VOCs by a flame ionization analyzer, employing U.S. EPA RM 25A.

1.5 OBSERVERS' NAMES (INDUSTRY AND AGENCY)

State of Maryland, AMA

Pars Ramnarain - Engineer

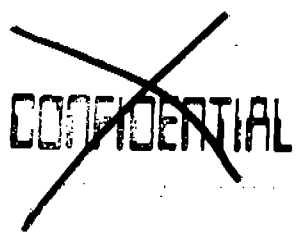
Universal Foods

Christine Wisniewski - Engineer

Gannett Fleming, Inc.

Scott Furlong - Test Technician

Anthony Staeger - Test Technician



2.0 SUMMARY OF RESULTS

2.1 EMISSION RESULTS

Continuous VOC measurements were recorded over a 15-hour period. The average VOC measured as propane, was 136 parts per million (ppm). The peak level, measured as propane, was 212.9 ppm and the lowest level was 9.3 ppm. The average flow was 19,899 SCFM. The average emissions rate was 18 pounds per hour of VOC measured as propane.

2.2 ALLOWABLE EMISSIONS

According to the State of Maryland AMA Regulations COMAR 26.11.06B(2), emissions rates greater than 20 lbs/day should be reported. No emissions limits have been established for this facility.

2.3 DESCRIPTION OF COLLECTED SAMPLES

The samples were collected under the referenced EPA field methods for VOCs.

2.4 MEASUREMENT ERRORS

The measurement error was within 2.2 percent error according to the beginning and ending of potentiometer settings.

3.0 SAMPLING AND ANALYSIS PROCEDURES

3.1 SAMPLING PORT LOCATION

The air flow was measured at the outlet to Fermenter Number 3. Figure 3-1 shows the sampling port location. Sample gases were extracted from the same location and were drawn through 20 feet of tubing to a point inside the building. The tubing was heated with an electric resistance coil to prevent condensation inside the tubing. The VOC test apparatus was set-up inside the building because of adverse weather conditions. Tornadoes were reported in the metropolitan area later that day.

3.2 SAMPLE TRAIN DESCRIPTION

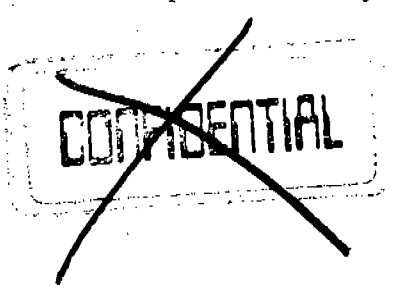
The sampling train employed to measure VOCs in the gas stream was provided by Gannett Fleming in compliance with U.S. EPA RM 25A.

3.3 SAMPLING PROCEDURES

Air flow was determined using AMA Method 1002 at the first, third and seventh hours of the test. Hourly measurements were not taken as specified in the test protocol because of adverse weather conditions. Tornadoes were reported in the metropolitan area during the day of the test. Test technicians reported very high winds on the building's roof.

The temperature of the fermenter exhaust stream was determined using a thermocouple and readout device.

The VOC content of the exhaust stream was determined by extracting a sample of gas from the duct for the duration of the 15-hour batch cycle. Zero and span gas calibrations were performed every hour.

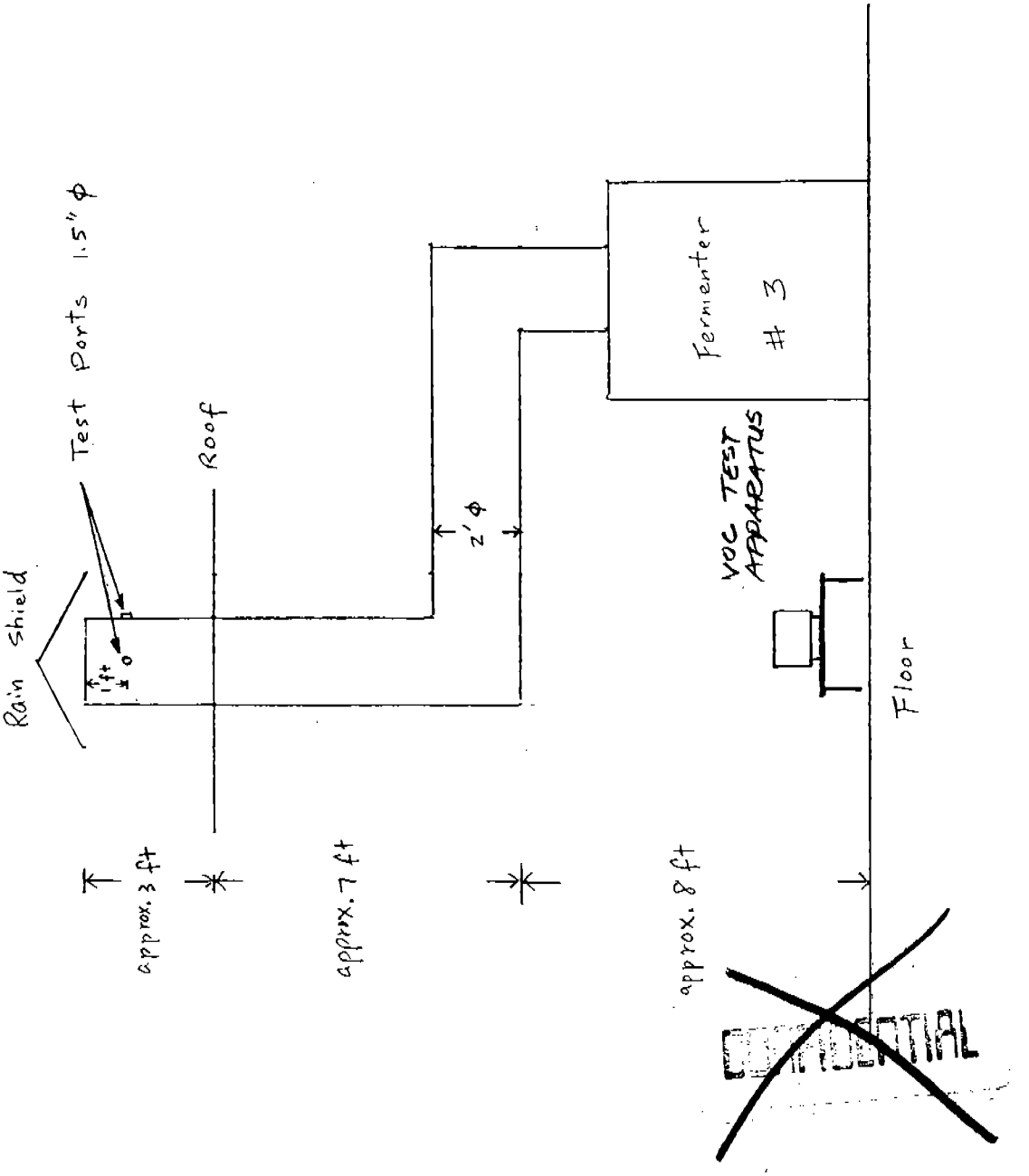


Gannett Fleming
ENGINEERS AND PLANNERS

SUBJECT Universal Foods
Test Protocol
BY RJL DATE 10/5/90 CHKD. BY DATE

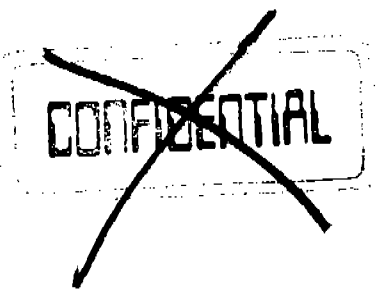
SHEET NO. 1 OF 1
JOB NO. 27340.000

FIGURE 3-1. SAMPLING PORT LOCATION



3.4 ANALYTICAL PROCEDURES

The analytical procedures to determine the concentration of VOC measured as propane referenced to U.S. EPA RM 25A. The exhaust stream from Fermenter Number 3 was sampled with flame ionization detectors (FID) following the procedures outlined in EPA RM 25A (40 CFR, Part 50, App. A) (see attached copy of RM 25A). The JUM Model portable FIDs were calibrated for a range of 0-1000 ppm. Strip chart recorders continuously recorded analyzer output. Quality assurance consisted of zero, and calibration span gas passes every hour of sampling. The primary span gases consisted of various concentrations of propane in air (301 ppm, 495 ppm and 843 ppm). In addition, the response curves were developed in a controlled laboratory environment, after the instrument had been calibrated with a primary calibrant gas (propane in air).



4.0 RESULTS AND CALCULATIONS

4.1 TEST RESULTS

Test results of air flow rate (cfm) and VOCs concentration (ppm) in the test period are presented in Table 4-1. VOC data were recorded on continuous strip recorders. Appendix A contains examples of the strip chart readings. Copies of the hourly span and zero calibration check data sheets are in Appendix B. Flow rates were determined at 1400, 1600 and 2000. Flow velocity traverse data are in Appendix A. A Kurz velometer was used, therefore a specified correction factor of 1.01 must be used to calculate flow with following equation:

Velocity (fpm) x 1.01 x Area (ft^2) = Flow (cfm)

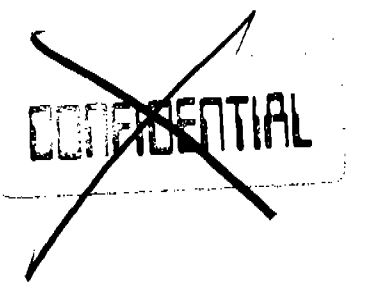
Hour 1400 -- 2700 x 1.01 x 7.07 ft^2 = 19280 cfm
Hour 1600 -- 2780 x 1.01 x 7.07 ft^2 = 19851 cfm
Hour 2000 -- 2880 x 1.01 x 7.07 ft^2 = 20565 cfm
Average = 19899 cfm

4.2 CALCULATION OF VOCs AS PROPANE

VOC was recorded as parts per million of propane, the calibrant gas. The mass flow rate of VOC is reported in Table 4-1 in pounds per hour. An example calculation for the time period 1400 to 1500 is shown below.

$$145.8\ ppm \times 10^{-6} \times 44.096\ \frac{lb\text{-}propane}{lb\text{-}mole} \times \frac{1\ lb\text{-}mole}{385.1\ ft^3} \times \frac{19280\ ft^3}{\text{min}} \times \frac{60\ \text{min}}{hr} = 19.3\ lb/hr\ VOCs$$

where 385.1 ft^3 is the standard volume for 1 lb-mole of propane at actual conditions.



4.3 CALCULATION OF PERCENT ERROR

The percent error is based on the potentiometer (pot) setting and is calculated by the following formula:

$$\text{percent error} = \frac{\text{beginning pot setting - ending pot setting}}{\text{beginning pot setting}}$$

Percent error was determined each hour for the zero potentiometer and the span potentiometer. Results are shown in Table 4-2.

TABLE 4-1

TEST RESULTS

UNIVERSAL FOODS CORPORATION

Test Period (Hour)	VOC, as propane (ppm)	Flow Rate (1) (ft^3/min)	VOC (lb/hr)
1400-1500	145.8	19280	19.3
1500-1600	180.2	19280	23.9
1600-1700	188.4	19851	25.7
1700-1800	146.0	19851	19.9
1800-1900	160.5	19851	21.9
1900-2000	186.0	19851	25.4
2000-2100	212.9	20565	30.0
2100-2200	196.5	20565	27.8
2200-2300	182.2	20565	25.7
2300-2400	163.9	20565	23.2
2400-0100	143.6	20565	20.3
0100-0200	71.2	20565	10.1
0200-0300	35.1	20565	5.0
0300-0400	18.6	20565	2.6
0400-0500	9.3	20565	1.3
Average	136	19899 (2)	18 (3)

Note: 1) Flow rate was not determined every hour because of adverse weather conditions. Tornadoes were reported in the Baltimore area during the tests which made flow sampling on the building roof unsafe.

2) Average flow is calculated as the mean of 19280, 19851 and 20565 ft^3/min.

3) Average VOC (lb/hr) is based on the average VOC concentration and the average flow rate.

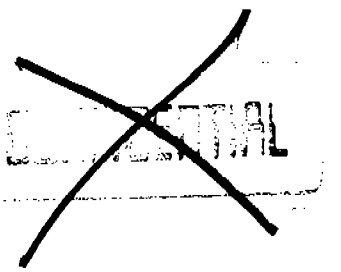
TABLE 4-2

CALCULATED INSTRUMENT ERROR

UNIVERSAL FOODS CORPORATION

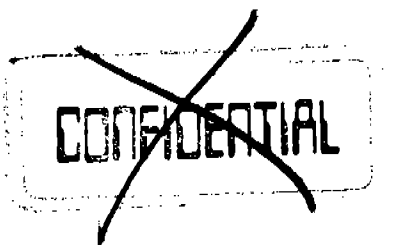
Test Period (Hour)	Percent Error	
	Zero Potentiometer	Span Potentiometer
1400-1500	None	5.5
1500-1600	None	1.7
1600-1700	None	None
1700-1800	None	3.3
1800-1900	None	None
1900-2000	None	None
2000-2100	None	0.8
2100-2200	None	None
2200-2300	(1)	None
2300-2400	(1)	None
2400-0100	None	None
0100-0200	None	None
0200-0300	None	None
0300-0400	6.5	None
0400-0500	1.1	None

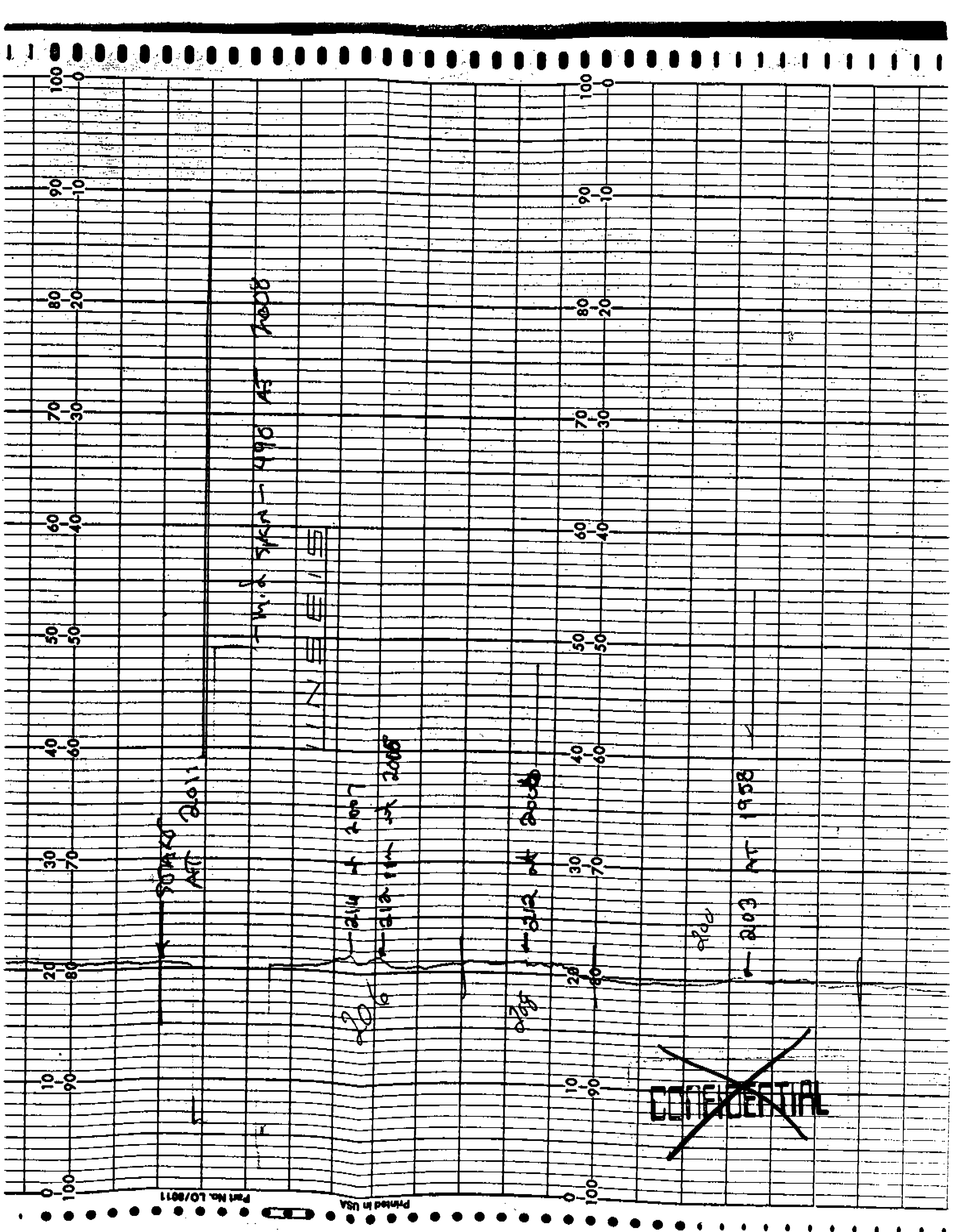
Note: 1) Defective tedlar bag affected measurement. Ran check one hour later.



APPENDIX A

SUMMARY OF FIELD DATA





214 at 2007
203 AT 1958
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Part No. LO/8011
Printed in USA

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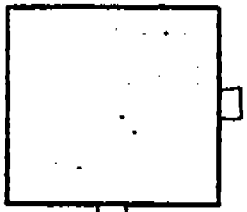
Part No. LO/8011
USA

PLANT Universal Foods
DATE 25 oct 90
RUN NO. Hour 1
STACK DIAMETER, in. 36
BAROMETRIC PRESSURE, in. Hg. 29.76
STATIC PRESSURE IN STACK (P_g), in. Hg.
OPERATORS Furlong / STAGER
Pitot Coefficient NA


SCHEMATIC OF STACK CROSS SECTION

Last Calibrated 89
6pm

Traverse point number	Velocity head, in. H_2O	$\sqrt{\Delta_p}$	Stack Temperature (T_s), °F
1	0.5	4000	94.8
2	0.5	3200	95
3	0.5	2100	95
4	0.5	2200	95
5	0.5	2200	95
	AVERAGE:	2700	95

Figure 2-2. Velocity traverse data.

* correction for gas temperature and pressure by specifications of manufacturer of Kurz velometer 1.01.

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PLANT Universal Foods

DATE

RUN NO. HOUR 3

STACK DIAMETER, in. 36

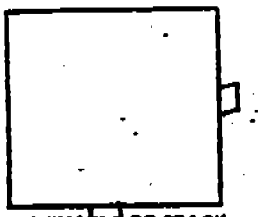
BAROMETRIC PRESSURE, in. Hg.

STATIC PRESSURE IN STACK (P_g), in. Hg.

OPERATORS Furlong / STAGER

Pitot Coefficient

Last Calibrated



SCHEMATIC OF STACK CROSS SECTION

Traverse point number	Velocity head in. H_2O	$\sqrt{\Delta_p}$	Stack Temperature (T_s), °F
1	.5	3900	91
2	.5	3400	91
3	.6	2240	92
4	.5	2200	91
5	.5	2200	92
AVERAGE:		2780	91

Figure 2-2. Velocity traverse data.

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DIE conversion factor 1.01

cu ft x 1.01

RECEIVED
OCT 25 '90
GANNETT FLEMING
BALTIMORE

PLANT Universal Foods

DATE

RUN NO. Hour 7

STACK DIAMETER, in. 36

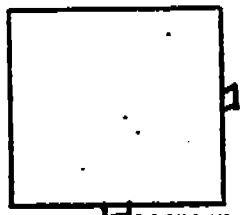
BAROMETRIC PRESSURE, in. Hg.

STATIC PRESSURE IN STACK (P_g), in. Hg.

OPERATORS Furlong / Stacy

Pitot Coefficient

Last Calibrated



SCHEMATIC OF STACK CROSS SECTION

Traverse point number	Velocity head, in. H_2O	$\sqrt{\Delta_p}$	Stack Temperature (T_s), °F
1	.5	4000	92
2	.4	3500	92
3	.5	2700	92
4	.5	2400	92
5	.5	2800	92
AVERAGE:		2880	92

Figure 2-2. Velocity traverse data.

USE Conversion factor 1.01

cfm x 1.01

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APPENDIX B

CALIBRATION PROCEDURES AND RESULTS

Method 25A
V.O.C. Sampling

Operator : Furlong \ STAGER
Date : 10 Oct 90
Job No. :
F.I.D. No.: 14398

Visual Checks

1.) F.I.D. Temp. 175 °F
2.) Sample Pressure 3 psi
3.) Recorder Channel
4.) Sampling line temperature 400 °F
5.) Barometric Pressure 29.76
6. Ambient Temperature ____

Tanks:

Gas Nomenclature	Gas Concentration	Tank* Pressure	Tank* Outlet Pressure	Comments
0	PROPANE	—	—	
301	"	—	—	
495	"	—	—	
843	"	—	—	

Stack Parameters
At Sampling Point

Stack Number	Velocity (fpm)	Temp.	Static Pressure	Stack dia.	Stack Description	wet bulb
1	2700	94°F	.6" H_2O	36"	metal -	81°F

System temp. 75.26

*Note: Span gas should be @ 15 psi
Fuel gas should be @ 43 psi

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Multicalibration Points

	Zero (<.1%)* Span	Low (25-35%)* Level Span	Mid (45-55%)* Level Span	High (80-90%)* Level Span	Pot Setting Zero	Pot Setting Span	Range Selection	Time Start	Time Finish
*Pre-Test	0.00	296	521	843	356	135	3	1340	1401
	6.00	300	500	843	356	127	3	1455	1500
Post-Test	____	SEE SHEET TWO							

Span Checks

Strip Test No.	Zero Span**	Mid Level Span**	Time Start	Time Finish	Pot Setting Zero	Pot Setting Span	Range Selection	
1	0	842500	1500	1509	356	127	3	1500
1	0	843501	1600	1600/1705	356	120	3	1600
1	0	843498	1700	1705	356	122	3	1700
1	0	495	1802	1805	356	122	3	1900
1	0	487	1906	1912	356	126	3	1900
1	0	490	2008	2010	356	126	3	2000
1	0	491	2100	2105	356	126	3	2100

HOURS	AVG VOC	PEAK VOC	% ERROR @ 0	% ERROR @ SPAN
1400 - 1500		400	NONE	5%
1500 - 1600		430	NONE	5%
1600 - 1700		150	NONE	1.7%
1700 - 1900		203	NONE	NONE
1800 - 1900		188	NONE	3.3
1900 - 2000		214	NONE	NONE
2000 - 2100		224	NONE	NONE
2100 - 2200				

* - Calibration Error <±5% of Span gas concentration.
** - Drift <±3% of Span value.

* calibration error of 5% allow flame to balance
Check drift & cal error at 1500

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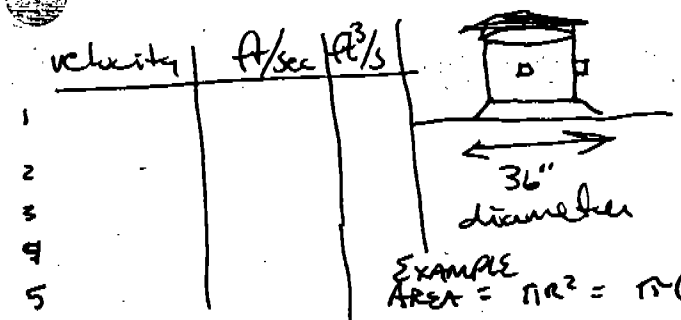
Sampling Diagram:



Pressure
.6 in H_2O at 1
.6 at 3
.6 at 5
.6 at 12
.6 at 15

Example Area = $\pi R^2 = \pi(18)^2 = 56.55$ 7.06 $ft^2 \times 2700 = 19{,}035$

Note: Diagram shall include stack diameter and sampling position of probe in stack.

Comments:

NOTES

① 400 ppm SPIKE AT 1454 HOURS

② MATCHED UNIVERSAL FED AT MID of FIRST SHEET
6FEB/79 — UNIVERSAL 121

③ 1400 Begin — 20,150 ft^3/min
1630 19,085 ft^3/min.

24088
JLBPS003.006

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Method 25A
V.O.C. Sampling

Operator : Furlong | STAGER
Date : 18 OCT 96 — MACT96
Job No. :
F.I.D. No.: 14598

Visual Checks

1.) F.I.D. Temp. 181 °F
2.) Sample Pressure 3 psi
3.) Recorder Single
4.) Sampling line temperature 400 °F
5.) Barometric Pressure ____
6. Ambient Temperature ____

Tanks:

Gas Nomenclature	Gas Concentration	Tank* Pressure	Tank* Outlet Pressure	Comments
Propane	0	—	—	
	301	—	—	
	455	—	—	
↓	843	—	—	

Stack Parameters
At Sampling Point

Stack Number	Velocity (fpm)	Temp.	Static Pressure	Stack dia.	Stack Description	wet dry
1	2700	94°F	.5" H_2O	36"	metal	91°F

*Note: Span gas should be @ 15 psi
Fuel gas should be @ 43 psi

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Multicalibration Points

	Zero (<.1%)* Span	Low (25-35%)* Level Span	Mid (45-55%)* Level Span	High (80-90%)* Level Span	Pot Setting Zero	Pot Setting Span	Range Selection	Time Start	Time Finish
Pre-Test	0.00	300	500	843	356	127	3	1500	1505
Post-Test	0.00	289 301	494 494	808 842	362	152	3	0500	0505

Span Checks

Start ~~Test~~ No.	Zero Span**	Mid Level Span**	Time Start	Time Finish	Pot Setting Zero	Pot Setting Span	Range Selection	
1	0.0	491	2100	2105	356	127	3	2100
1	0.0	494	2157	2200	356	127	3	2200
1	2.0	498	2255	2300	**317	127	3	2300
1	-6.2	490	2400	0405	•383	127	3	2400
1	0.0	488	0100	0105	383	127	3	0100
1	0.0	487	0200	0205	383	127	3	0200
1	-0.01	487	0300	0305	358	127	3	0500
1	-0.01	488	0400	0405	362	127	3	0400

Hour	Avg VOC	Peak VOC	% error on Zero	% error Calib
2100-2200 →	→	245	NONE	NONE
2200-2300 →	→	310	— seconds	NONE
2300-2400 →	→	184	—	NONE
2400-0100 →	→	180	NONE	NONE
0100-0200 →	→	145	NONE	NONE
0200-0300 →	→	51	Back background	NONE
0300-0400 →	→	39	.83%	NONE
0400-0500 →	→			

* - Calibration Error <±5% of Span gas concentration.
** - Drift <±3% of Span value.

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Test Run From 2-3 pm's Data Reflected instrumentation error. — Sad Tedlar bag. evacuated bag and began test run at 3 pm

• Problem in TEDLAR BAG Zero Pot returned to normal

Sampling Diagram:

measurements at
1"
3"
5"
9"
12"
15"

Note: Diagram shall include stack diameter and sampling position of probe in stack.

Comments:

System temp ranges from 21°C – 24°C

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JLBPS003.006

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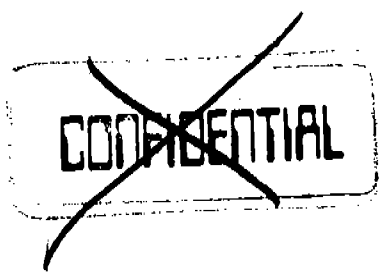
APPENDIX C

AMA METHODS 1001 AND 1002 AND

U.S. EPA REFERENCE METHOD (RM) 25A



Method 1001 - Sample Site and Sample Point Location for Stationary Sources.*

1. Principle and Applicability

1.1 Principle. A sampling site and the number of sample points are selected to aid in the extraction of a representative sample.

1.2 Applicability. This method is applicable to flowing gas streams in ducts, stacks and flues. The method cannot be used when: (1) flow is cyclonic or swirling; (2) a stack is smaller than about 0.30 meter (12 in) in diameter; or 0.071 m^3 (113 in^2) in cross-sectional area, or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow distrubance.

2. Procedure

2.1 Selection of a sampling site and minimum number of sample points.

2.1.1 Select a sampling site that is at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, contraction or visible flame. For rectangular cross section, determine an equivalent diameter from the following equation:

$$\text{equivalent diameter} = 2 \times \frac{\text{length} \times \text{width}}{\text{length} + \text{width}}$$

Equation 1-1

2.1.2 When the above sampling site criteria can be met, the minimum number of sample points is twelve (12) if the stack diameter is sufficiently large as indicated in 2.1.5.

2.1.3 Some sampling situations render the above sampling site criteria impractical. When this is the case, choose a convenient sampling location and use Figure 1-1 to determine the recommended number of sample points.

2.1.4 To use Figure 1-1, first measure the distance from the chosen sampling location to the nearest upstream and downstream disturbances. Determine the corresponding number of sample points for each distance from Figure 1-1. Select the higher of the two numbers of sample points, or a greater value, such that for circular stacks, the number is a multiple of 4 and for rectangular stacks, the number follows the criteria of section 2.2.2.

2.1.5 For circular stacks, after determining the recommended number of sample points from Figure 1-1; consult Table 1-1 to see if that number may actually be sampled. Table 1-1 indicates the minimum stack diameter required for a given number of sample points if each point is to represent an equal amount of area of the sampling cross section and not lie within 1 inch of the stack wall. Under no circumstances are points that lie within one inch of the stack wall or points that do not represent equal areas of the sampling cross-section to be sampled. If the number of sample points determined from Figure 1-1 may not be sampled, select from Table 1-1 the highest possible number of points for the stack diameter.

*Adapted from the Federal Register, Vol. 42, No. 160-Thursday, August 18, 1977, pp. 41755-41758.

2.2 Cross-sectional layout and location of sample points.

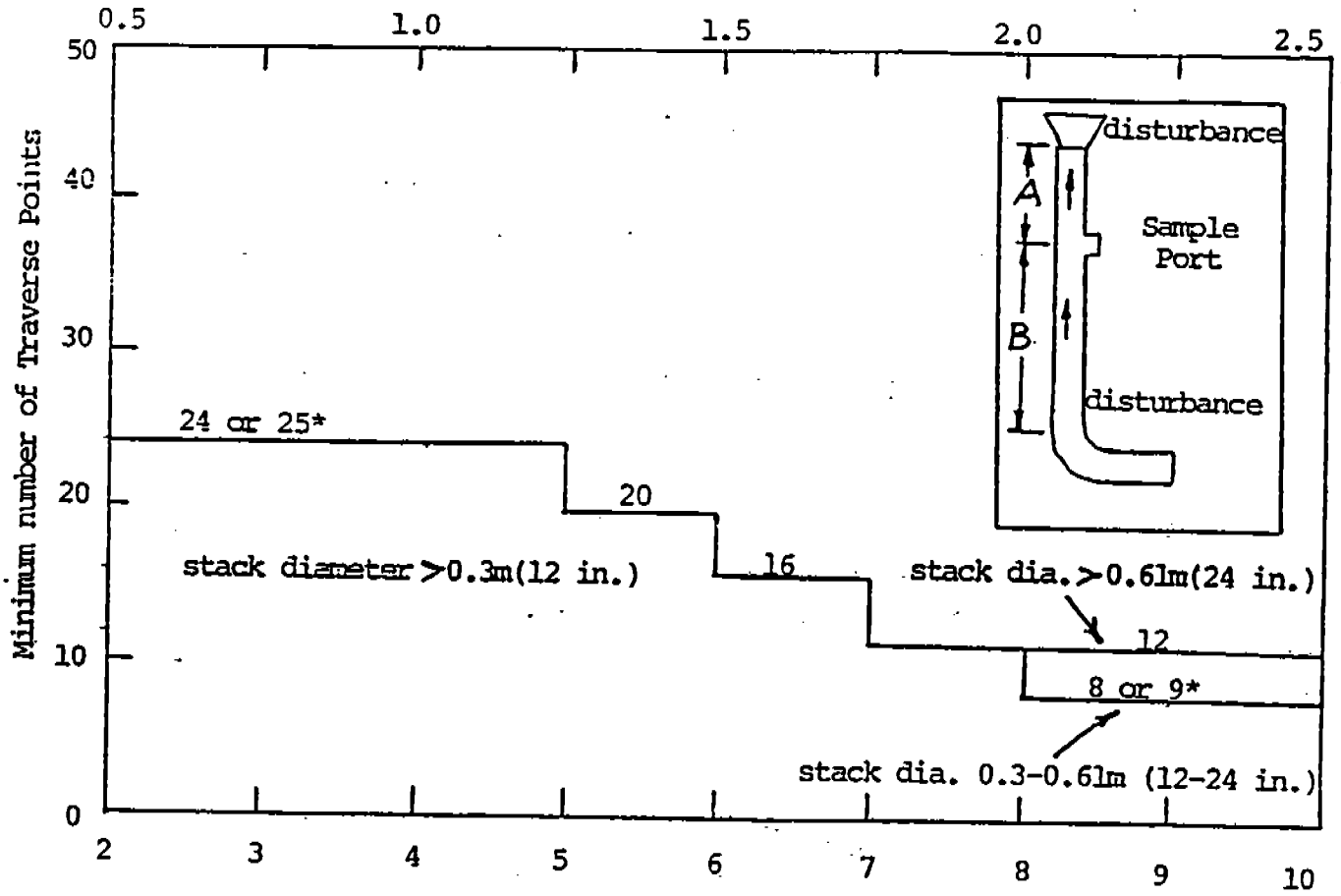
2.2.1 For circular stacks, locate the sample points on two diameters according to Table 1-2. The sample axes shall divide the stack cross section into equal parts.

2.2.2 For rectangular stacks, divide the cross section into as many equal rectangular areas as sample points, such that the ratio of the length to the width of the elemental areas is between one and two. Locate the sample points at the centroid of each equal area according to Table 1-3 and Figure 1-2.

2.3 Verification of Absence of Cyclonic Flow. In most stationary sources, the direction of stack gas flow is essentially parallel to the stack walls. However, cyclonic flow may exist (1) after such devices as cyclones and inertial demisters following venturi scrubbers, or (2) in stacks having tangential inlets or other duct configurations which tend to induce swirling; in these instances, the presence or absence of cyclonic flow at the sampling location must be determined. The following techniques are acceptable for this determination.

Level and zero the manometer. Connect a Type S pitot tube to the manometer. Position the Type S pitot tube at each traverse point, in succession, so that the planes of the face openings of the pitot tube are perpendicular to the stack cross-sectional plane: when the Type S pitot tube is in this position, it is at "0° reference". Note the differential pressure (Δp) reading at each traverse point. If a null (zero) pitot reading is obtained at 0° reference at a given traverse point, an acceptable flow condition exists at that point. If the pitot reading is not zero at 0° reference, rotate the pitot tube (up to $\pm$ 90° yaw angle), until a null reading is obtained. Carefully determine and record the value of the rotation angle (a) to the nearest degree. After the null technique has been applied at each traverse point, calculate the average of the absolute values of a; assign a values of 0° to those points for which no rotation was required, and include these in the overall average. If the average value of a is greater than 10°, the overall flow condition in the stack is unacceptable and alternative methodology, subject to the approval of the Administration, must be used to perform accurate sample and velocity traverses.

Figure 1-1. Recommended No. of Traverse Points



* for rectangular stack

Table 1-1

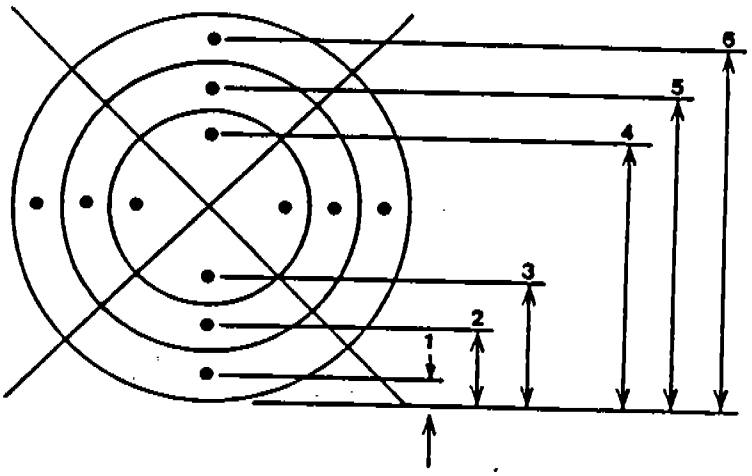
No. of Sample Points	Minimum Stack Diameter for Circular Stacks [a] (In.)
8	14.9
12	22.7
16	30.3
20	40.0
24	47.6

[a] To sample points which represent equal areas of the stack cross section such that no point lies within 1 inch of the stack wall.

Table 1.2. LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

Example Showing Circular Stack Cross Section Divided Into 12 Equal Areas With Location of Traverse Points Indiciated

Traverse point	Distance, % of diameter
1	4.4
2	14.6
3	29.6
4	70.4
5	85.4
6	95.6



Percent of Stack Diameter From Inside Wall to Traverse Point

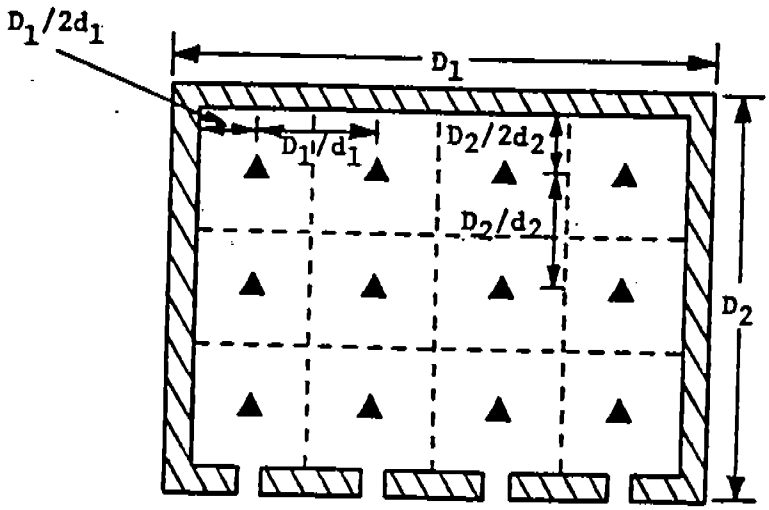
Traverse point number on a diameter[a]	Number of traverse points on a diameter[b]											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

[a] Points numbered from outside wall toward opposite wall.

[b] The total number of points along two diameters would be twice the number along a single diameter.

Table 1.3. LAYOUT OF CROSS-SECTIONAL SUBAREAS IN RECTANGULAR DUCTS

Number of traverse points	Subarea layout matrix
9	3 × 3
12	4 × 3
16	4 × 4
20	5 × 4
25	5 × 5
30	6 × 5
36	6 × 6
42	7 × 6
49	7 × 7



where:

▲ = sampling point

d_1= number of areas across flue width

d_2= number of areas across flue perpendicular to width

Figure 1.2. Example showing rectangular stack cross section divided into twelve equal areas, with a traverse point at the centroid of each area.

Method 1002 - Determination of Stack Gas Velocity (Type S Pitot Tube).*

1. Principle and Applicability

1.1 Principle. Stack gas velocity is determined from the gas density and from measurement of the velocity head using a Type S (Stausscheibe or reverse type) pitot tube.

1.2 Applicability. This method is applicable for measurement of the average velocity of a gas stream and for quantifying gas flow. If the minimum criteria of Method 1 are not met or if the measurement site has a swirling or cyclonic gas stream, the procedures outlined in Method 2 for stack gas velocity determination are not applicable. When unacceptable flow conditions exists, alternative procedures such as the use of flow straightening devices or stack extensions must be employed as necessary to make accurate flow rate determinations. These alternative procedures are subject to approval by the Air Management Administration.

2. Apparatus

2.1 Pitot Tube - Type S (Figure 2-1), or equivalent, with a coefficient within ±5% over the working range. See specifications in the "Nozzle and Pitot Tube Calibration Sheet" and Figure 2-3.

2.2 Differential pressure gauge - Inclined manometer, or equivalent, to measure velocity head to within 10% of the minimum value.

2.3 Temperature gauge - Thermocouple or equivalent attached to the pitot tube to measure stack temperature to within 1.5% of the minimum absolute stack temperature.

2.4 Pressure gauge - Mercury-filled U-tube manometer, or equivalent, to measure stack pressure to within 0.1 in. Hg.

2.5 Barometer - To measure atmospheric pressure to within 0.1 in. Hg. (Barometeric pressure may be obtained from the nearest weather service station.)

2.6 Gas analyzer - To analyze gas composition for determining molecular weight. Use Methods 1003, 1004 or 1005.

2.7 Pitot Tube - Standard type, to calibrate Type S pitot tube. Unit should be traceable to NBS standard type pitot tube.

3. Procedure

3.1 Set up the apparatus as shown in Figure 2-1. Make sure all connections are tight and leak free. Level and zero the manometer at the beginning and relevel and zero periodically during the traverse. Measure the velocity head and temperature at the sample points specified by Method 1001.

3.2 Measure the static pressure in the stack.

*Adapted from the Federal Register, Vol. 42, No. 160-Thursday, August 18, 1977, pp. 41758-41768.

3.3 Obtain the barometeric pressure from the nearest weather service station and correct to sample site elevation by subtracting 2.5mm for each 100 foot difference between the weather station and sampling site.

3.4 Determine the stack gas molecular weight by gas analysis and appropriate calculations as indicated in Method 1003.

4. Calibration

4.1 Type S Pitot Tube. Before each use carefully examine the type S pitot tube in top, side, and end views to verify that the face openings of the tube are aligned within the specifications illustrated on the "Nozzle and Pitot Tube Calibration Sheet". Measure each of the parameters called for on this Calibration Sheet and record them on the Sheet. If any of the alignments are not within the specifications listed on Figure 2-3, than another pitot must be used.

Normal practice is to use the baseline coefficient value of 0.84 if all of the alignments of the "Nozzle and Pitot Tube Calibration Sheet" and Figure 2-3 are correct. However, the calibration procedure of 4.1.1 through 4.1.3 can be used if desired and is preferable if the facilities for calibration are available.

4.1.1 To calibrate the pitot tube, measure the velocity head at some point in a flowing gas stream with both a Type S pitot tube and a standard type pitot tube with known coefficient. Calibration should be done in the laboratory and the velocity of the flowing gas stream should be varied over the normal working range. It is recommended that the pitot tube be inspected after each use and recalibrated if it has become disfigured.

4.1.2 Calculate the pitot tube coefficient using equation 2-1.

$$Cp\ test = Cp_{std}\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$$

Equation 2-1

$Cp\ test$ = Pitot tube coefficient of Type S pitot tube.

Cp_{std} = Pitot tube coefficient of standard type pitot tube (if unknown, use 0.99).

$\Delta Pstd$ = Velocity head measured by standard type pitot tube.

$\Delta Ptest$ = Velocity head measured by Type S pitot tube.

4.1.3 Compare the coefficients of the Type S pitot tube determined first with one leg and then the other pointed downstream. Use the pitot tube only if the two coefficient differ by no more than 0.01.

4.2 Temperature Gauge. After each field use calibrate all temperature indicators used by comparison to a reference ASTM mercury-in-glass thermometer for a temperature range up to 405°C. For temperatures above 405°C use an NBS

calibrated reference thermocouple-potentiometer system. If the absolute temperatures measured during calibration differ by more than ±1.5 percent, appropriate adjustments to the test results shall be made or the test shall be considered invalid.

5. Calculations

Use equation 2-2 to calculate the stack gas velocity.

Average Velocity of Stack Gas at Sample Site, V_s (ft/sec)

$$V_s = (Kp)\ (Cp)\ (\Delta P)^{\frac{1}{2}}\ avg\ \left[T_{savg}/(P_{savg} \times M_w)\right]^{\frac{1}{2}}$$ where:

Equation 2-2

Kp = constant, (85.48 ft/sec (lb · in. Hg/lb mole · in. H_2O · °F)$^{\frac{1}{2}}$)
Cp = pitot tube coefficient, (dimensionless)
$(\Delta P)^{\frac{1}{2}}$ avg = average square root of velocity head of stack gas, (in. $H_2O)^{\frac{1}{2}}$
T_{savg} = average absolute stack temperature, (°R)
P_{savg} = average absolute stack pressure, (in. Hg)
Mw = molecular weight of stack gas, wet basis, (lb/lb mole)

K_p is derived from:

$$K_p = \left(\frac{2g\ R\ {}^{n}\Delta P}{{}^{n}p_s}\right)^{\frac{1}{2}} = \left(\frac{2 \times 32.14 \times 1543 \times \frac{62.4}{12}}{\frac{14.7 \times 144}{29.92}}\right)^{\frac{1}{2}}$$

$$= 85.48 \text{ ft/sec (lb · in Hg/lb mole · in. } H_2O \text{ · °R)}^{\frac{1}{2}}$$

where g = acceleration due to gravity ft/sec^2

R = gas constant ft lbs/Mol °R

${}^{n}\Delta P$ = conversion factor $\frac{\text{lb}}{\text{ft}^2 - \text{in W.C.}}$

${}^{n}p_s$ = conversion factor $\frac{\text{lbs}}{\text{ft}^2 - \text{in Hg}}$

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Figure 2-2 shows a sample recording sheet for velocity traverse data. Other forms may be used. Use the averages in the last two columns of Figure 2-2 to determine the average stack gas velocity from Equation 2-2.

Actual Stack Gas Volumetric Flow Rate, Dry Basis, Q_s (acfm)

Equation 2-3

$Q_s = 60\ (1 - Bw)\ (Vs)\ (As)$ where:

Bw = moisture content of stack gas, (mole fraction, dimensionless)
Vs = average velocity of stack gas at sample site, (ft/sec)
As = cross sectional area of stack at sample site, (ft^2)
60 = conversion factor, (sec/min)

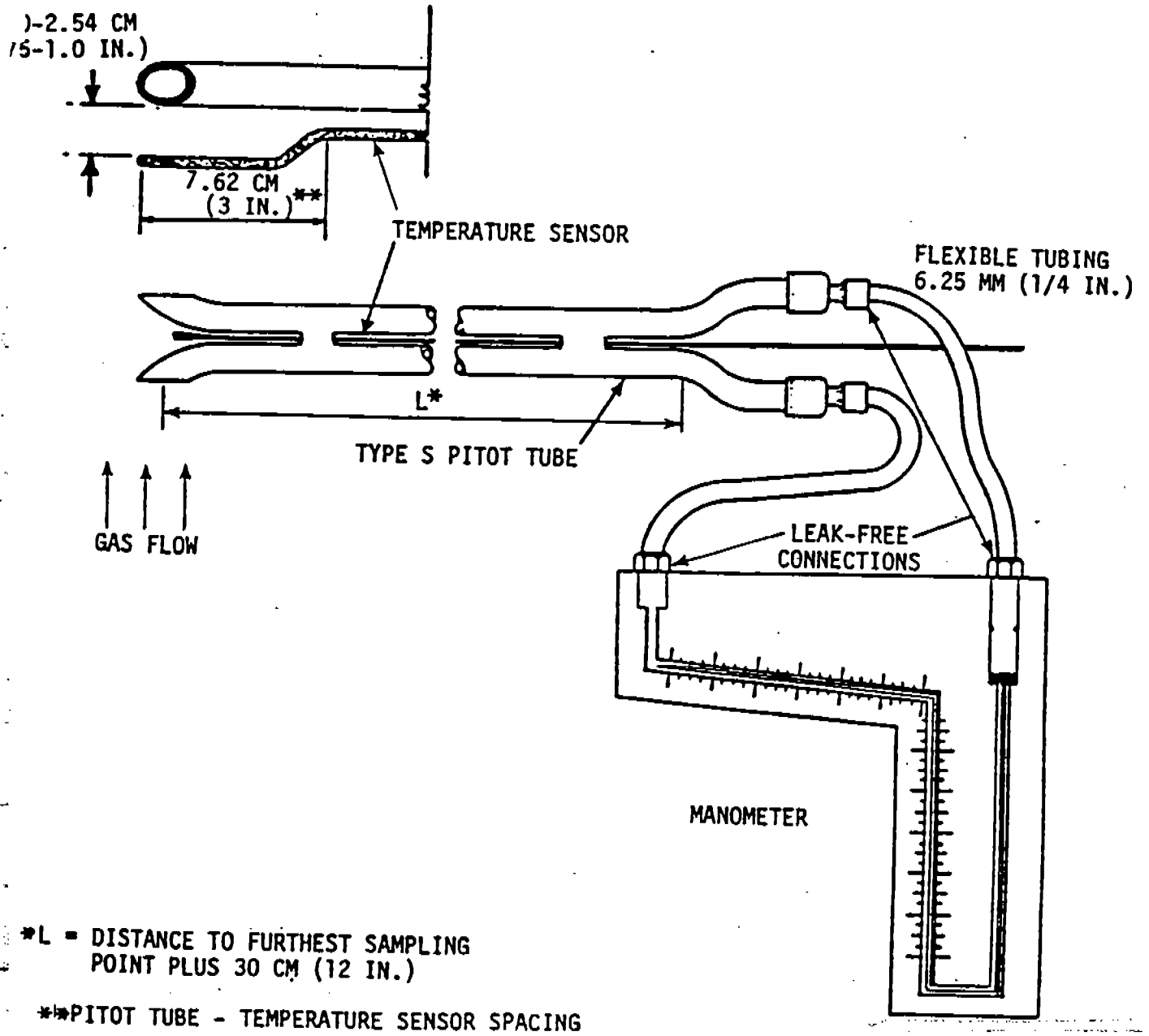


Figure 2.1 Type S pitot tube-manometer assembly.

PLANT _____

DATE _____

RUN NO. _____

STACK DIAMETER, in. _____

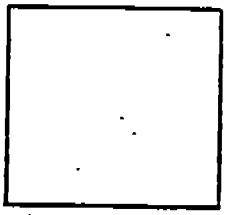
BAROMETRIC PRESSURE, in. Hg. _____

STATIC PRESSURE IN STACK (P_g), in. Hg. _____

OPERATORS _____

Pitot Coefficient _____

Last Calibrated _____



SCHEMATIC OF STACK CROSS SECTION

Traverse point number	Velocity head, in. H_2O	$\sqrt{\Delta_p}$	Stack Temperature (T_S), °F
	AVERAGE:		

Figure 2-2. Velocity traverse data.

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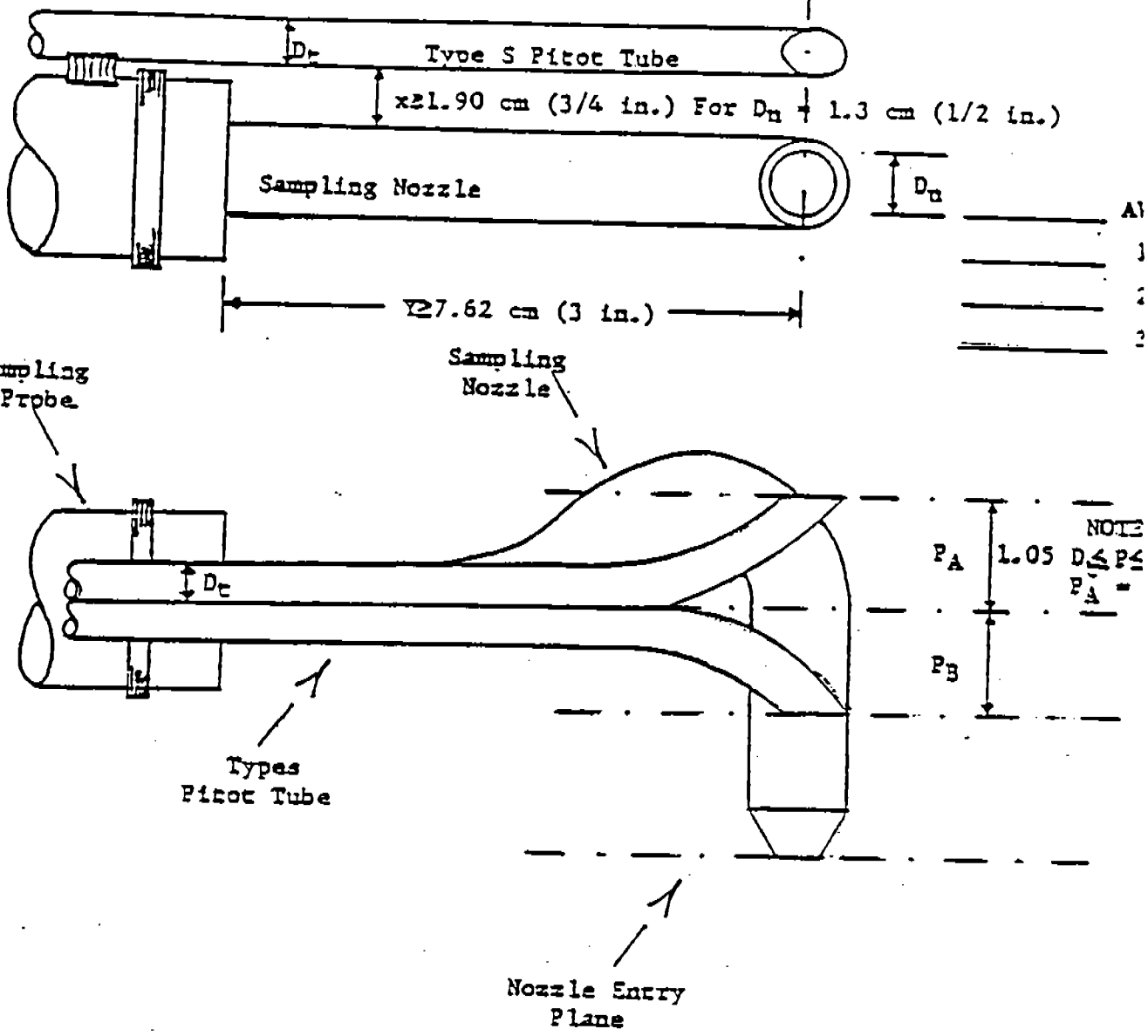
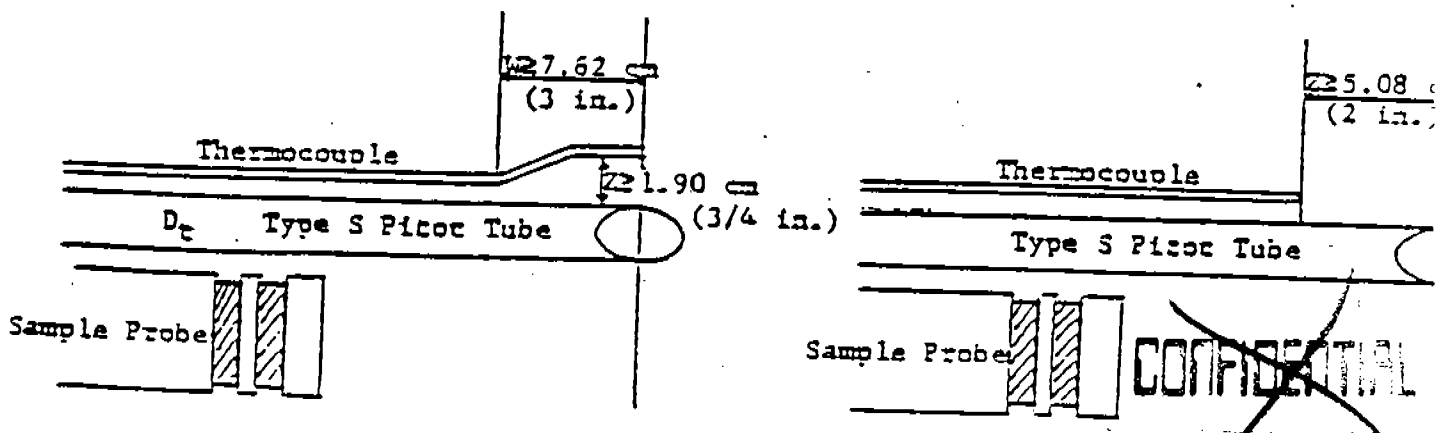
NOZZLE & PITOT TUBE CALIBRATION SHEET

Facility _____

Pitobe ID _____





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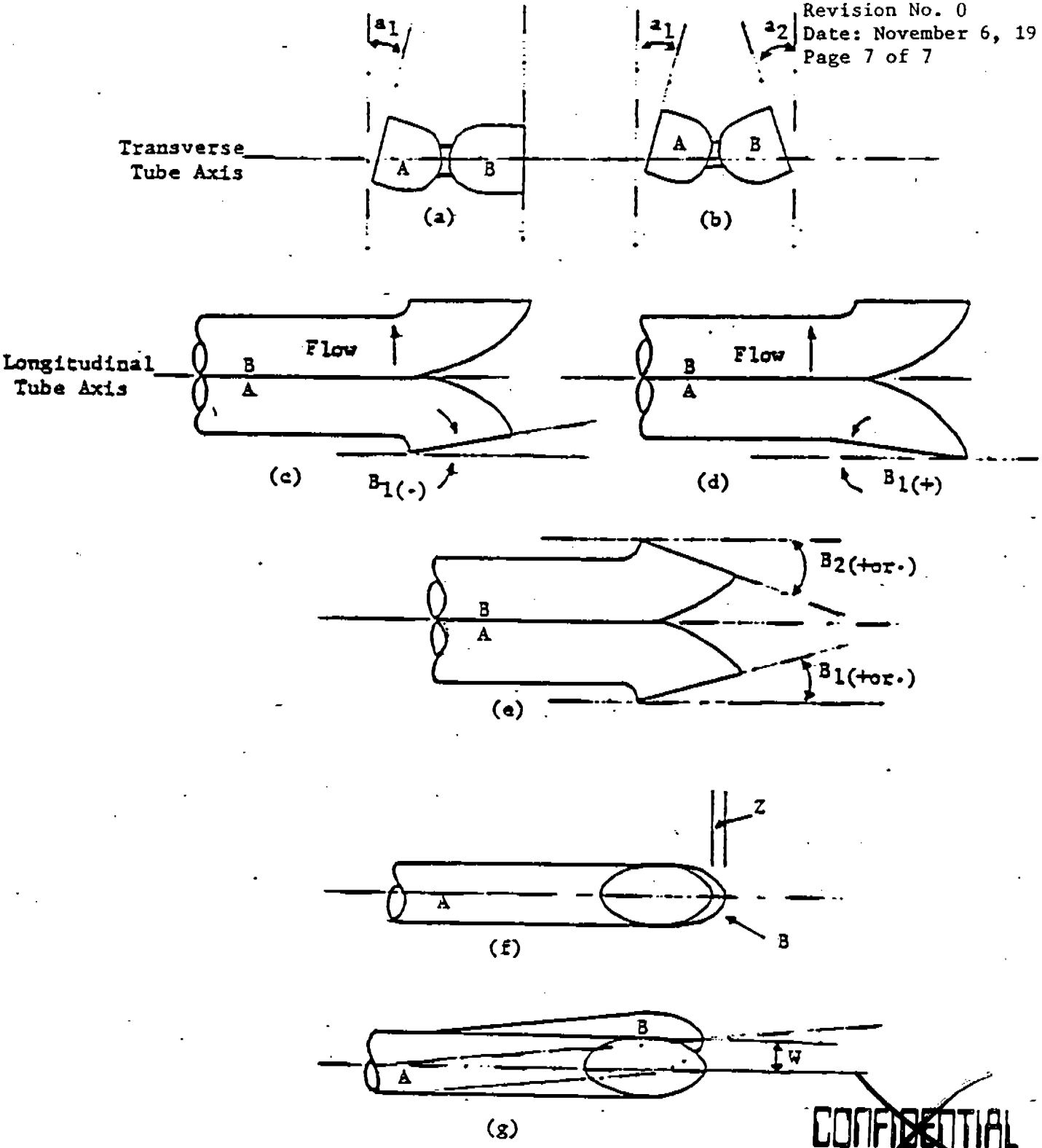

Figure 2-3. Types of face-opening misalignment that can result from Field use or improper construction of Type S pitot tubes. These will not affect the baseline value of Cp(s) so long as α_1 and α_2 10°, β_1 and β_2 5°.z 0.32 cm (1/8 in.) and w 0.08 cm (1/32 in.) PITOT ALIGMENT OK _____

TEMPERATURE MEASURING UNIT CALIBRATION: DATE: _____

BY: _____

METHOD 25A—DETERMINATION OF TOTAL GASEOUS ORGANIC CONCENTRATION USING A FLAME IONIZATION ANALYZER

1. *Applicability and Principle*

1.1 Applicability. This method applies to the measurement of total gaseous organic concentration of vapors consisting primarily of alkanes, alkenes, and/or arenes (aromatic hydrocarbons). The concentration is expressed in terms of propane (or other appropriate organic calibration gas) or in terms of carbon.

1.2 Principle. A gas sample is extracted from the source through a heated sample line, if necessary, and glass fiber filter to a flame ionization analyzer (FIA). Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

2. *Definitions*

2.1 Measurement System. The total equipment required for the determination of the gas concentration. The system consists of the following major subsystems:

2.1.1 Sample Interface. That portion of the system that is used for one or more of the following: sample acquisition, sample transportation, sample conditioning, or protection of the analyzer from the effects of the stack effluent.

2.1.2 Organic Analyzer. That portion of the system that senses organic concentration and generates an output proportional to the gas concentration.

2.2 Span Value. The upper limit of a gas concentration measurement range that is specified for affected source categories in the applicable part of the regulations. The span value is established in the applicable regulation and is usually 1.5 to 2.5 times the applicable emission limit. If no span value is provided, use a span value equivalent to 1.5 to 2.5 times the expected concentration. For convenience, the span value should correspond to 100 percent of the recorder scale.

2.3 Calibration Gas. A known concentration of a gas in an appropriate diluent gas.

2.4 Zero Drift. The difference in the measurement system response to a zero level calibration gas before and after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

2.5 Calibration Drift. The difference in the measurement system response to a mid-level calibration gas before and after a stated period of operation during which no unscheduled maintenance, repair or adjustment took place.

2.6 Response Time. The time interval from a step change in pollutant concentration at the inlet to the emission measurement system to the time at which 95 percent of the corresponding final value is reached as displayed on the recorder.

2.7 Calibration Error. The difference between the gas concentration indicated by the measurement system and the known concentration of the calibration gas.

3. *Apparatus*

A schematic of an acceptable measurement system is shown in Figure 25A-1. The essential components of the measurement system are described below:

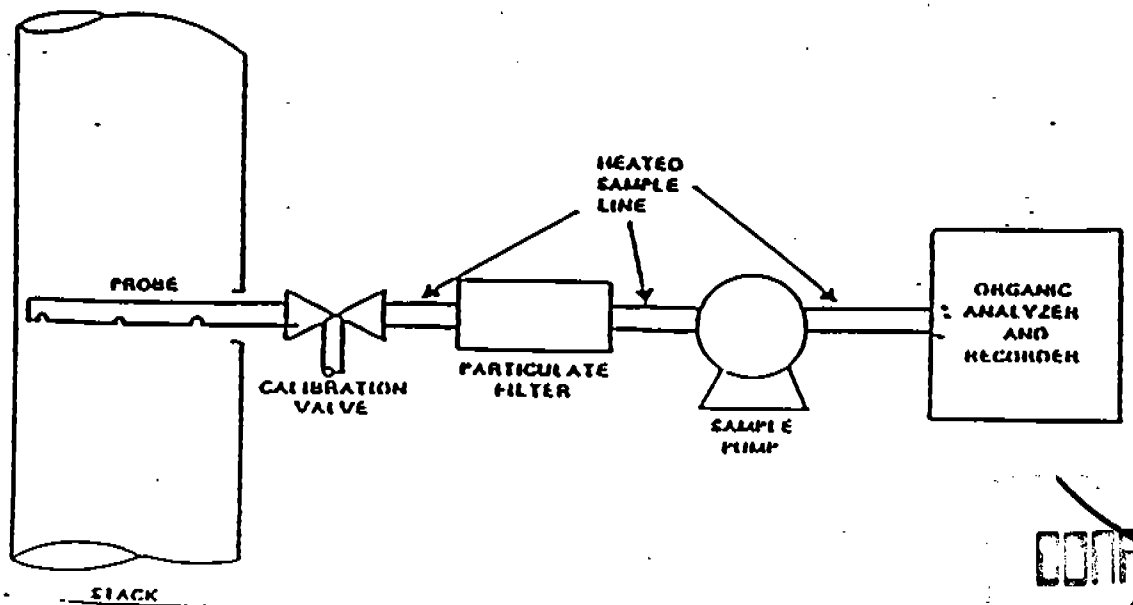

Figure 25A-1. Organic Concentration Measurement System.

3.1 Organic Concentration Analyzer. A flame ionization analyzer (FIA) capable of meeting or exceeding the specifications in this method.

3.2 Sample Probe. Stainless steel, or equivalent, three-hole rake type. Sample holes shall be 4 mm in diameter or smaller and located at 16.7, 50, and 83.3 percent of the equivalent stack diameter. Alternatively, a single opening probe may be used so that a gas sample is collected from the centrally located 10 percent area of the stack cross-section.

3.3 Sample Line. Stainless steel or Teflon* tubing to transport the sample gas to the analyzer. The sample line should be heated, if necessary, to prevent condensation in the line.

3.4 Calibration Valve Assembly. A three-way valve assembly to direct the zero and calibration gases to the analyzers is recommended. Other methods, such as quick-connect lines, to route calibration gas to the analyzers are applicable.

3.5 Particulate Filter. An in-stack or an out-of-stack glass fiber filter is recommended if exhaust gas particulate loading is significant. An out-of-stack filter should be heated to prevent any condensation.

3.6 Recorder. A strip-chart recorder, analog computer, or digital recorder for recording measurement data. The minimum data recording requirement is one measurement value per minute. Note: This method is often applied in highly explosive areas. Caution and care should be exercised in choice of equipment and installation.

4. *Calibration and Other Gases*

Gases used for calibrations, fuel, and combustion air (if required) are contained in compressed gas cylinders. Preparation of calibration gases shall be done according to the procedure in Protocol No. 1, listed in Reference 9.2. Additionally, the manufacturer of the cylinder should provide a recommended shelf life for each calibration gas cylinder over which the concentration does not change more than ±2 percent from the certified value. For calibration gas values not generally available (i.e., organics between 1 and 10 percent by volume), alternative methods for preparing calibration gas mixtures, such as dilution systems, may be used with prior approval of the Administrator.

Calibration gases usually consist of propane in air or nitrogen and are determined in terms of the span value. Organic compounds other than propane can be used following the above guidelines and making the appropriate corrections for response factor.

4.1 Fuel. A 40 percent H_2/60 percent He or 40 percent H_2/60 percent N_2 gas mixture is recommended to avoid an oxygen synergism effect that reportedly occurs when oxygen concentration varies significantly from a mean value.

4.2 Zero Gas. High purity air with less than 0.1 parts per million by volume (ppmv) of organic material (propane or carbon equivalent) or less than 0.1 percent of the span value, whichever is greater.

4.3 Low-level Calibration Gas. An organic calibration gas with a concentration equivalent to 25 to 35 percent of the applicable span value.

4.4 Mid-level Calibration Gas. An organic calibration gas with a concentration equivalent to 45 to 55 percent of the applicable span value.

4.5 High-level Calibration Gas. An organic calibration gas with a concentration equivalent to 80 to 90 percent of the applicable span value.

5. *Measurement System Performance Specifications*

5.1 Zero Drift. Less than ±3 percent of the span value.

5.2 Calibration Drift. Less than ±3 percent of span value.

5.3 Calibration Error. Less than ±5 percent of the calibration gas value.

6. *Pretest Preparations*

6.1 Selection of Sampling Site. The location of the sampling site is generally specified by the applicable regulation or purpose of the test; i.e., exhaust stack, inlet line, etc. The sample port shall be located at least 1.5 meters or 2 equivalent diameters upstream of the gas discharge to the atmosphere.

6.2 Location of Sample Probe. Install the sample probe so that the probe is centrally located in the stack, pipe, or duct and is sealed tightly at the stack port connection.

6.3 Measurement System Preparation. Prior to the emission test, assemble the measurement system following the manufacturer's written instructions in preparing the sample interface and the organic analyzer. Make the system operable.

FIA equipment can be calibrated for almost any range of total organics concentrations. For high concentrations of organics (>1.0 percent by volume as propane) modifications to most commonly available analyzers are necessary. One accepted method of equipment modification is to decrease the size of the sample to the analyzer through the use of a smaller diameter sample capillary. Direct and continuous measurement of organic concentration is a necessary consideration when determining any modification design.

6.4 Calibration Error Test. Immediately prior to the test series, (within 2 hours of the start of the test) introduce zero gas and

*Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

high-level calibration gas at the calibration valve assembly. Adjust the analyzer output to the appropriate levels, if necessary. Calculate the predicted response for the low-level and mid-level gases based on a linear response line between the zero and high-level responses. Then introduce low-level and mid-level calibration gases successively to the measurement system. Record the analyzer responses for low-level and mid-level calibration gases and determine the differences between the measurement system responses and the predicted responses. These differences must be less than 5 percent of the respective calibration gas value. If not, the measurement system is not acceptable and must be replaced or repaired prior to testing. No adjustments to the measurement system shall be conducted after the calibration and before the drift check (Section 7.3). If adjustments are necessary before the completion of the test series, perform the drift checks prior to the required adjustments and repeat the calibration following the adjustments. If multiple electronic ranges are to be used, each additional range must be checked with a mid-level calibration gas to verify the multiplication factor.

6.5 Response Time Test. Introduce zero gas into the measurement system at the calibration valve assembly. When the system output has stabilized, switch quickly to the high-level calibration gas. Record the time from the concentration change to the measurement system response equivalent to 95 percent of the step change. Repeat the test three times and average the results.

7. *Emission Measurement Test Procedure*

7.1 Organic Measurement. Begin sampling at the start of the test period, recording time and any required process information as appropriate. In particular, note on the recording chart periods of process interruption or cyclic operation.

7.2 Drift Determination. Immediately following the completion of the test period and hourly during the test period, reintroduce the zero and mid-level calibration gases, one at a time, to the measurement system at the calibration valve assembly. (Make no adjustments to the measurement system until after both the zero and calibration drift checks are made.) Record the analyzer response. If the drift values exceed the specified limits, invalidate the test results preceding the check and repeat the test following corrections to the measurement system. Alternatively, recalibrate the test measurement system as in Section 6.4 and report the results using both sets of calibration data (i.e., data determined prior to the test period and data determined following the test period).

8. *Organic Concentration Calculations*

Determine the average organic concentration in terms of ppmv as propane or other calibration gas. The average shall be determined by the integration of the output recording over the period specified in the applicable regulation.

If results are required in terms of ppmv as carbon, adjust measured concentrations using Equation 25A-1.

$$C_c = K\,C_{meas} \qquad \text{Eq. 25A-1}$$

Where:

C_c = Organic concentration as carbon, ppmv.

C_{meas} = Organic concentration as measured, ppmv.

K = Carbon equivalent correction factor.

K = 2 for ethane.

K = 3 for propane.

K = 4 for butane.

K = Appropriate response factor for other organic calibration gases.

9. *Bibliography*

9.1 Measurement of Volatile Organic Compounds—Guideline Series. U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA-450/2-78-041. June 1978. p. 46-54.

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9.3 Gasoline Vapor Emission Laboratory Evaluation—Part 2. U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. Research Triangle Park, NC. EMB Report No. 75-GAS-6. August 1975.

FERMENTER EMISSIONS

TEST REPORT

PREPARED FOR

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BALTIMORE, MARYLAND 21224

OCTOBER 26, 1990

GANNETT FLEMING, INC.
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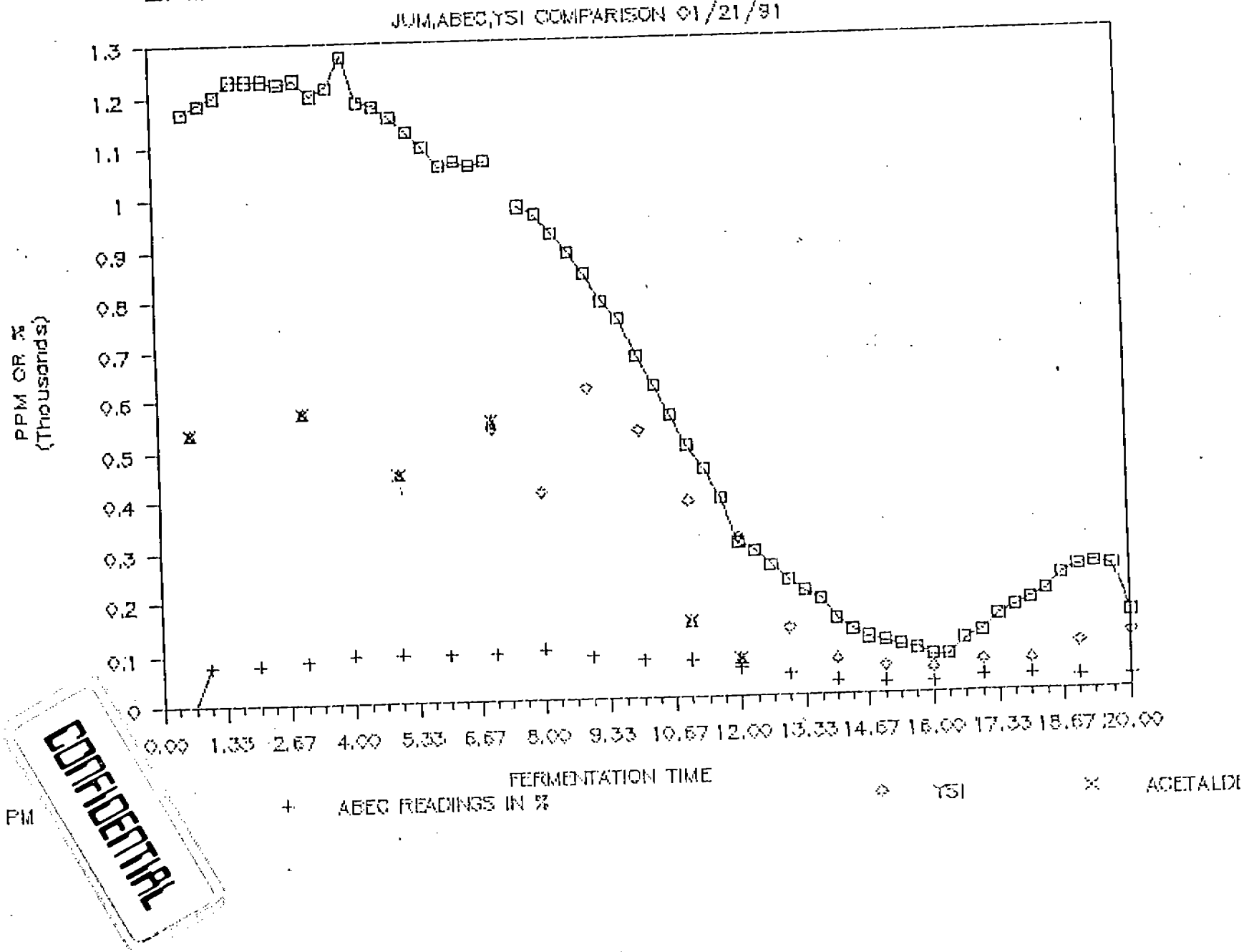
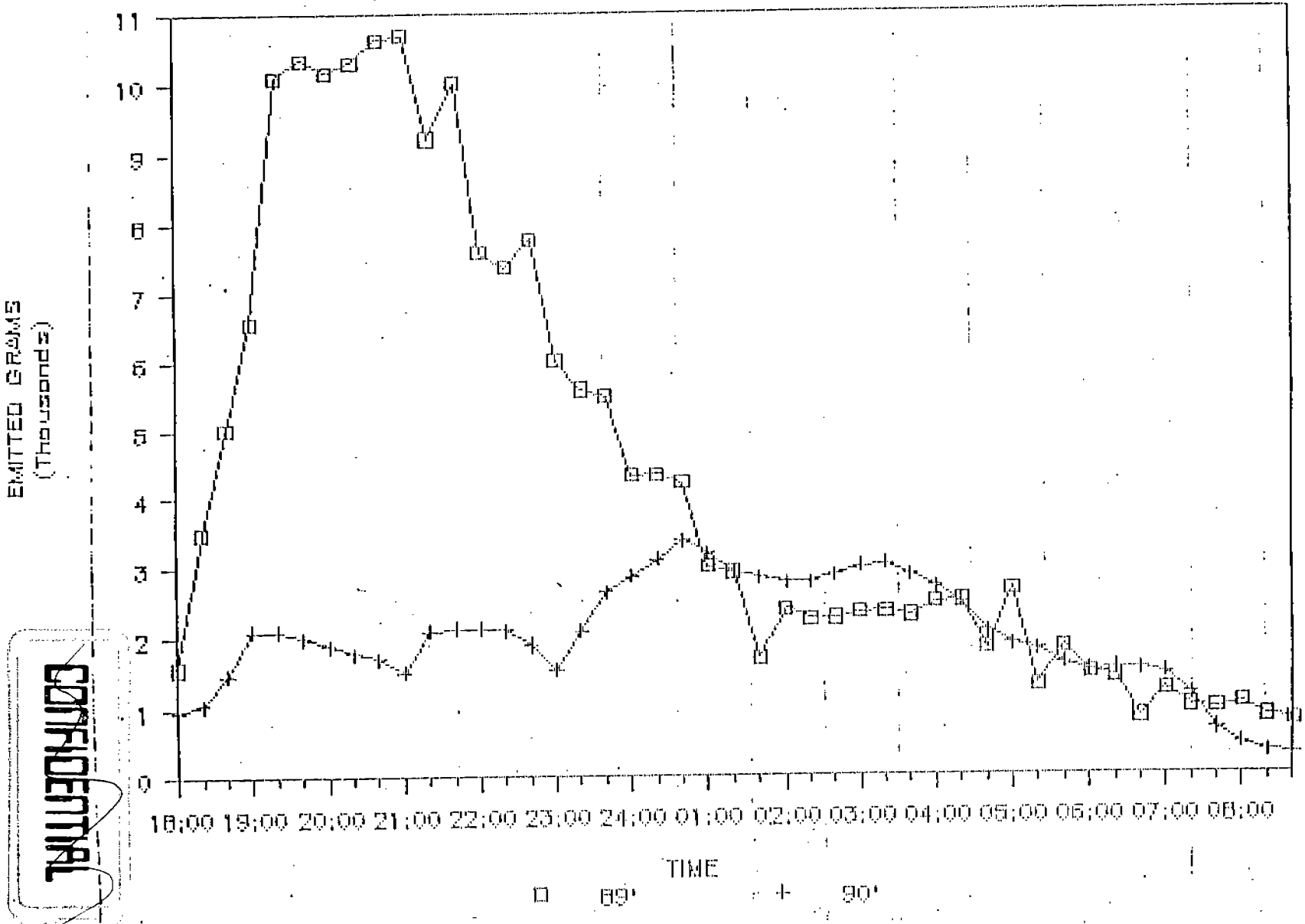
VILLAGE OF CROSS KEYS
BALTIMORE, MARYLAND 21210

BALTIMORE STACK TESTING--1991 CY STOCK



BALTIMORE STACK TESTING

CY-TRADE 89' VS. 90'



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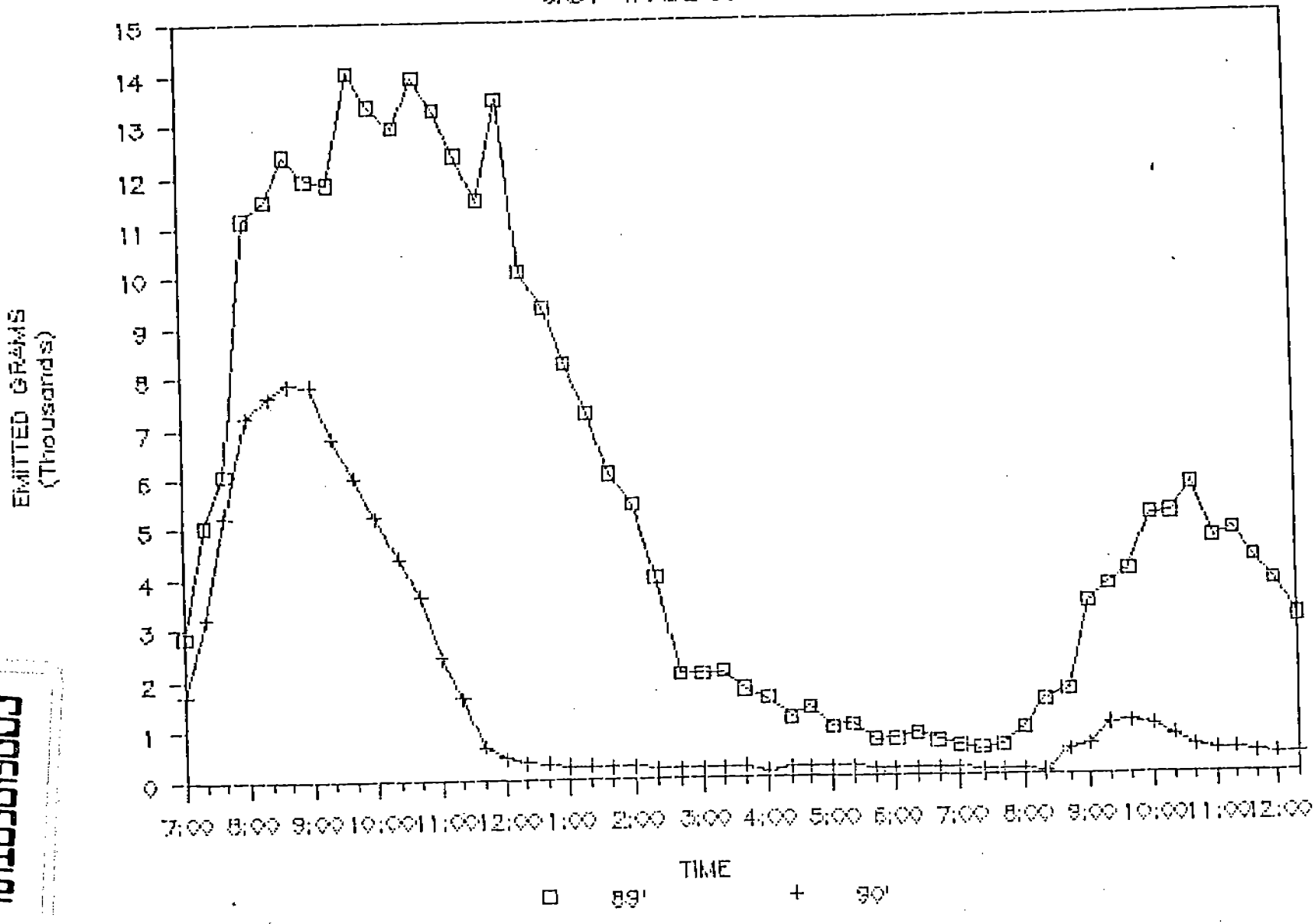
BALTIMORE STACK TESTING

CADY-TRADE 89 VS. 90



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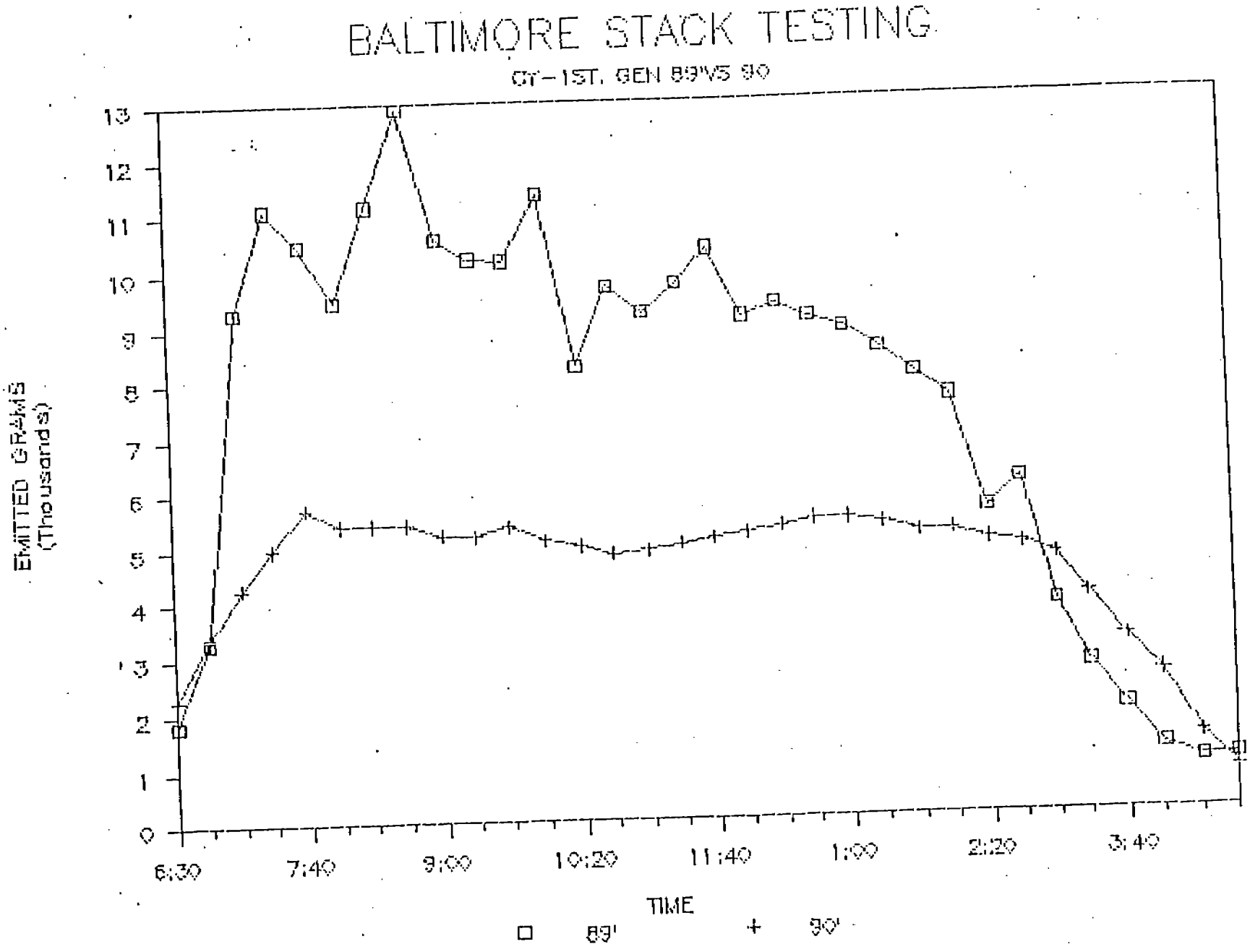
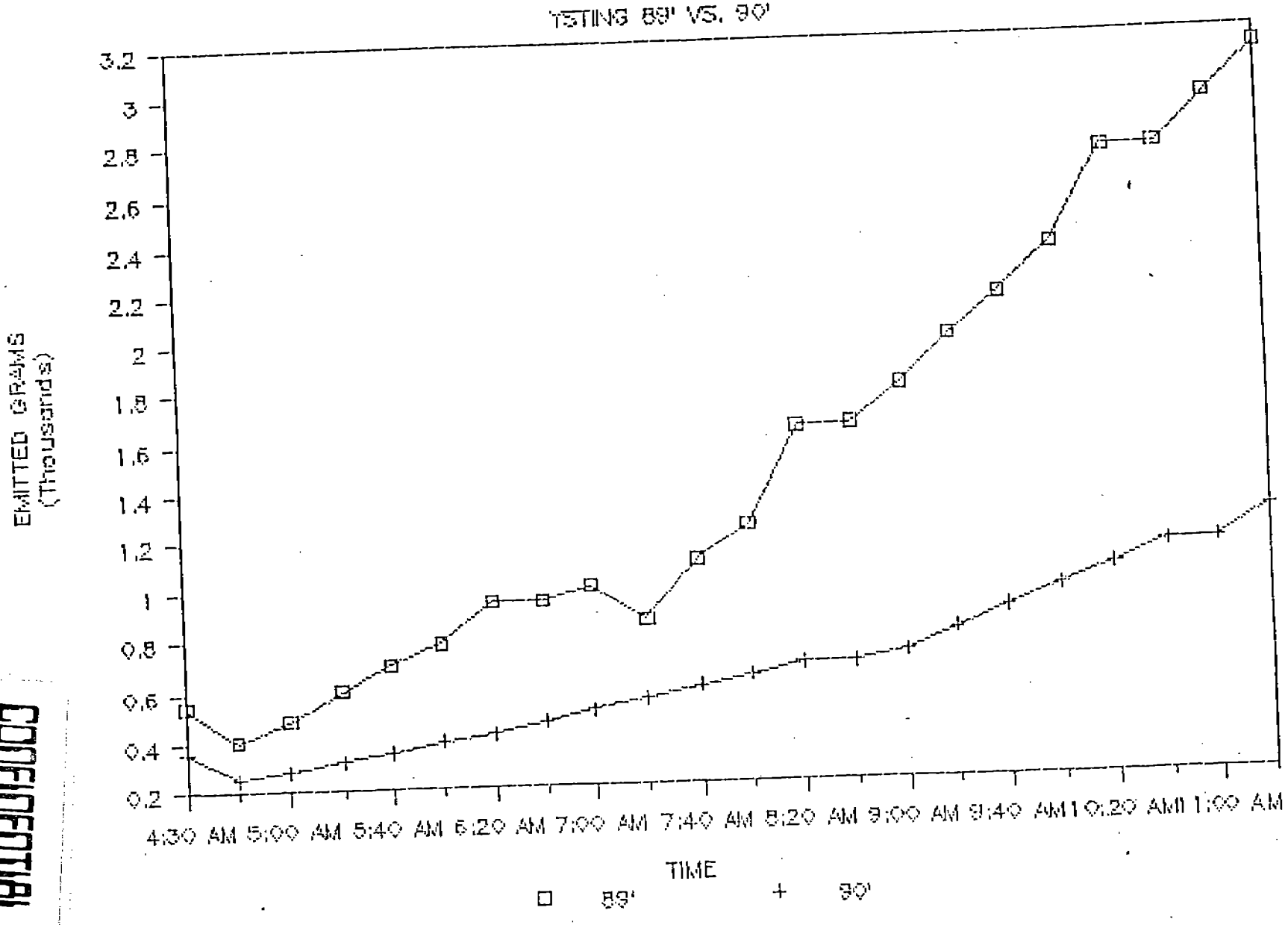
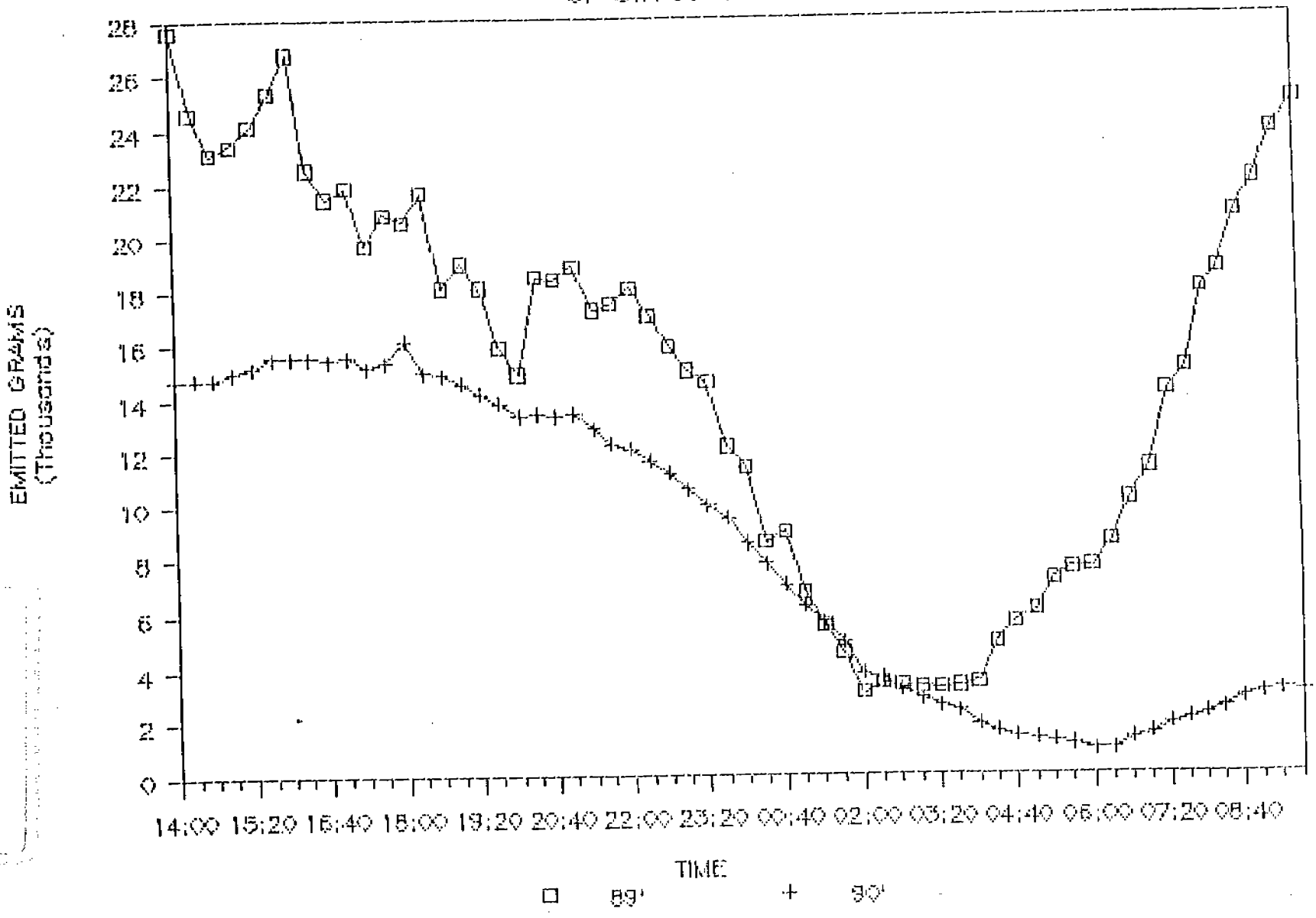


BALTIMORE STACK TESTING



BALTIMORE STACK TESTING

GT-STK 89' VS. 90



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BALTIMORE AIR EMMISION TESTING
CY-TRADE
1989-1990

TIME	1989 CONC. MG/M3	1989 FLOW M3/HR	1989 SAMPLE PERIOD	1989 EMMISION GRAMS	1990 CONC. MG/M3	1990 FLOW M3/HR	1990 SAMPLE PERIOD	1990 EMMISION GRAMS
18:00	235	19980	0.333	1564	140	19980	0.333	931
18:20	525	19980	0.333	3493	157	19980	0.333	1045
18:40	754	19980	0.333	5017	219	19980	0.333	1457
19:00	984	19980	0.333	6547	311	19980	0.333	2069
19:20	1519	19980	0.333	10106	311	19980	0.333	2069
19:40	1557	19980	0.333	10359	298	19980	0.333	1983
20:00	1531	19980	0.333	10186	281	19980	0.333	1870
20:20	1552	19980	0.333	10326	266	19980	0.333	1770
20:40	1599	19980	0.333	10639	255	19980	0.333	1697
21:00	1609	19980	0.333	10705	226	19980	0.333	1504
21:20	1386	19980	0.333	9222	311	19980	0.333	2069
21:40	1506	19980	0.333	10020	317	19980	0.333	2109
22:00	1139	19980	0.333	7578	317	19980	0.333	2109
22:20	1107	19980	0.333	7365	315	19980	0.333	2096
22:40	1168	19980	0.333	7771	283	19980	0.333	1883
23:00	901	19980	0.333	5995	230	19980	0.333	1530
23:20	840	19980	0.333	5589	311	19980	0.333	2069
23:40	826	19980	0.333	5496	396	19980	0.333	2635
24:00	653	19980	0.333	4345	430	19980	0.333	2861
00:20	655	19980	0.333	4358	468	19980	0.333	3114
00:40	635	19980	0.333	4225	509	19980	0.333	3387
01:00	453	19980	0.333	3014	481	19980	0.333	3200
01:20	440	19980	0.333	2927	440	19980	0.333	2927
01:40	255	19980	0.333	1697	428	19980	0.333	2848
02:00	358	19980	0.333	2382	417	19980	0.333	2774
02:20	335	19980	0.333	2229	417	19980	0.333	2774
02:40	337	19980	0.333	2242	434	19980	0.333	2888
03:00	350	19980	0.333	2329	451	19980	0.333	3001
03:20	352	19980	0.333	2342	457	19980	0.333	3041
03:40	343	19980	0.333	2282	434	19980	0.333	2888
04:00	371	19980	0.333	2468	406	19980	0.333	2701
04:20	375	19980	0.333	2495	372	19980	0.333	2475
04:40	275	19980	0.333	1830	309	19980	0.333	2056
05:00	400	19980	0.333	2661	281	19980	0.333	1870
05:20	196	19980	0.333	1304	270	19980	0.333	1796
05:40	276	19980	0.333	1836	242	19980	0.333	1610
06:00	223	19980	0.333	1484	225	19980	0.333	1497
06:20	213	19980	0.333	1417	230	19980	0.333	1530
06:40	126	19980	0.333	838	227	19980	0.333	1510
07:00	184	19980	0.333	1224	219	19980	0.333	1457
07:20	149	19980	0.333	991	175	19980	0.333	1164
07:40	144	19980	0.333	958	99	19980	0.333	659
08:00	155	19980	0.333	1031	68	19980	0.333	452
08:20	126	19980	0.333	838	49	19980	0.333	326
08:40	119	19980	0.333	792	45	19980	0.333	299
SUM	29236			194517	13527			90000

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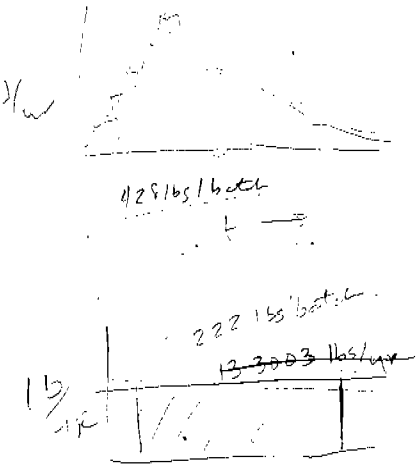
BALTIMORE AIR EMMISION TESTING
CY-TRADE
1989-1990

TIME	1989 CONC. MG/M3	1989 FLOW M3/HR	1989 SAMPLE PERIOD	1989 EMMISION GRAMS	1990 CONC. MG/M3	1990 FLOW M3/HR	1990 SAMPLE PERIOD	1990 EMMISION GRAMS
AVG	650	345		4323	301			2000
MAX	1609	500		10705	509			3387
	TOTAL	POUNDS	EMITTED	428				198



345 mg/M3

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BALTIMORE AIR EMMISION TESTING
CADY-TRADE
1989-1990

TIME	1989 CONC. MG/M3	1989 FLOW M3/HR	1989 SAMPLE PERIOD	1989 EMMISION GRAMS	1990 CONC. MG/M3	1990 FLOW M3/HR	1990 SAMPLE PERIOD	1990 EMMISION GRAMS
7:00	400	21263	0.333	2832	242	21263	0.333	1714
7:20	714	21263	0.333	5056	452	21263	0.333	3200
7:40	860	21263	0.333	6089	736	21263	0.333	5211
8:00	1575	21263	0.333	11152	1019	21263	0.333	7215
8:20	1628	21263	0.333	11527	1075	21263	0.333	7612
8:40	1748	21263	0.333	12377	1109	21263	0.333	7852
9:00	1684	21263	0.333	11924	1104	21263	0.333	7817
9:20	1672	21263	0.333	11839	962	21263	0.333	6812
9:40	1981	21263	0.333	14027	849	21263	0.333	6011
10:00	1886	21263	0.333	13354	736	21263	0.333	5211
10:20	1826	21263	0.333	12929	623	21263	0.333	4411
10:40	1964	21263	0.333	13906	509	21263	0.333	3604
11:00	1876	21263	0.333	13283	340	21263	0.333	2407
11:20	1748	21263	0.333	12377	230	21263	0.333	1629
11:40	1626	21263	0.333	11513	96	21263	0.333	680
12:00	1905	21263	0.333	13489	62	21263	0.333	439
12:20	1423	21263	0.333	10076	49	21263	0.333	347
12:40	1322	21263	0.333	9361	45	21263	0.333	319
1:00	1165	21263	0.333	8249	38	21263	0.333	269
1:20	1026	21263	0.333	7265	40	21263	0.333	283
1:40	855	21263	0.333	6054	34	21263	0.333	241
2:00	767	21263	0.333	5431	34	21263	0.333	241
2:20	560	21263	0.333	3965	28	21263	0.333	198
2:40	291	21263	0.333	2060	28	21263	0.333	198
3:00	291	21263	0.333	2060	28	21263	0.333	198
3:20	296	21263	0.333	2096	28	21263	0.333	198
3:40	245	21263	0.333	1735	32	21263	0.333	227
4:00	220	21263	0.333	1558	19	21263	0.333	135
4:20	167	21263	0.333	1182	28	21263	0.333	198
4:40	194	21263	0.333	1374	28	21263	0.333	198
5:00	139	21263	0.333	984	28	21263	0.333	198
5:20	145	21263	0.333	1027	28	21263	0.333	198
5:40	102	21263	0.333	722	23	21263	0.333	163
6:00	105	21263	0.333	743	23	21263	0.333	163
6:20	118	21263	0.333	836	21	21263	0.333	149
6:40	99	21263	0.333	701	23	21263	0.333	163
7:00	85	21263	0.333	602	23	21263	0.333	163
7:20	75	21263	0.333	531	15	21263	0.333	106
7:40	85	21263	0.333	602	15	21263	0.333	106
8:00	132	21263	0.333	935	15	21263	0.333	106
8:20	208	21263	0.333	1473	11	21263	0.333	78
8:40	237	21263	0.333	1678	72	21263	0.333	510
9:00	475	21263	0.333	3363	85	21263	0.333	602
9:20	529	21263	0.333	3746	142	21263	0.333	1005
9:40	569	21263	0.333	4029	147	21263	0.333	1041
10:00	726	21263	0.333	5141	136	21263	0.333	963
10:20	730	21263	0.333	5169	108	21263	0.333	765

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BALTIMORE AIR EMMISION TESTING
CADY-TRADE
1989-1990

TIME	1989 CONC. MG/M3	1989 FLOW M3/HR	1989 SAMPLE PERIOD	1989 EMMISION GRAMS	1990 CONC. MG/M3	1990 FLOW M3/HR	1990 SAMPLE PERIOD	1990 EMMISION GRAMS
10:40	810	21263	0.333	5735	79	21263	0.333	559
11:00	657	21263	0.333	4652	68	21263	0.333	481
11:20	681	21263	0.333	4822	68	21263	0.333	481
11:40	600	21263	0.333	4248	57	21263	0.333	404
12:00	534	21263	0.333	3781	55	21263	0.333	389
12:20	432	21263	0.333	3059	49	21263	0.333	347
SUM	42188			298715	11894			84216
AVG	796			5636	224			1589
MAX	1981			14027	1109			7852
	TOTAL POUNDS EMITTED			658				185

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BALTIMORE AIR EMMISION TESTING
CY-1ST GEN.
1989-1990

TIME	1989 CONC. MG/M3	1989 FLOW M3/HR	1989 SAMPLE PERIOD	1989 EMMISION GRAMS	1990 CONC. MG/M3	1990 FLOW M3/HR	1990 SAMPLE PERIOD	1990 EMMISION GRAMS
6:30	300	18266	0.333	1825	311	22074	0.333	2286
6:40	535	18266	0.333	3254	453	22074	0.333	3330
7:00	1531	18266	0.333	9312	581	22074	0.333	4271
7:20	1826	18266	0.333	11107	679	22074	0.333	4991
7:40	1724	18266	0.333	10486	779	22074	0.333	5726
8:00	1558	18266	0.333	9477	736	22074	0.333	5410
8:20	1833	18266	0.333	11149	736	22074	0.333	5410
8:40	2120	18266	0.333	12895	736	22074	0.333	5410
9:00	1738	18266	0.333	10572	708	22074	0.333	5204
9:20	1680	18266	0.333	10219	706	22074	0.333	5190
9:40	1672	18266	0.333	10170	728	22074	0.333	5351
10:00	1863	18266	0.333	11332	694	22074	0.333	5101
10:20	1357	18266	0.333	8254	679	22074	0.333	4991
10:40	1593	18266	0.333	9690	657	22074	0.333	4829
11:00	1514	18266	0.333	9209	667	22074	0.333	4903
11:20	1597	18266	0.333	9714	681	22074	0.333	5006
11:40	1700	18266	0.333	10340	694	22074	0.333	5101
12:00	1498	18266	0.333	9112	705	22074	0.333	5182
12:20	1535	18266	0.333	9337	721	22074	0.333	5300
12:40	1494	18266	0.333	9087	736	22074	0.333	5410
1:00	1462	18266	0.333	8893	736	22074	0.333	5410
1:20	1398	18266	0.333	8503	723	22074	0.333	5315
1:40	1320	18266	0.333	8029	700	22074	0.333	5145
2:00	1246	18266	0.333	7579	702	22074	0.333	5160
2:20	913	18266	0.333	5553	679	22074	0.333	4991
2:40	1000	18266	0.333	6083	666	22074	0.333	4896
3:00	626	18266	0.333	3808	638	22074	0.333	4690
3:20	441	18266	0.333	2682	538	22074	0.333	3955
3:40	311	18266	0.333	1892	423	22074	0.333	3109
4:00	195	18266	0.333	1186	338	22074	0.333	2485
4:20	154	18266	0.333	937	187	22074	0.333	1375
4:40	159	18266	0.333	967	100	22074	0.333	735
SUM	39893			242652	19817			145668
AVG	1247			7583	619			4552
MAX	2120			12895	779			5726
TOTAL POUNDS EMITTED				534				321

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BALTIMORE AIR EMMISION TESTING
YSTING
1989-1990

TIME	1989 CONC. MG/M3	1989 FLOW M3/HR	1989 SAMPLE PERIOD	1989 EMMISION GRAMS	1990 CONC. MG/M3	1990 FLOW M3/HR	1990 SAMPLE PERIOD	1990 EMMISION GRAMS
4:30 AM	2421	445	0.500	539	1642	445	0.500	365
4:40 AM	2715	445	0.333	402	1698	445	0.333	252
5:00 AM	3266	445	0.333	484	1896	445	0.333	281
5:20 AM	4057	445	0.333	601	2151	445	0.333	319
5:40 AM	4740	445	0.333	702	2377	445	0.333	352
6:00 AM	5254	445	0.333	779	2660	445	0.333	394
6:20 AM	6383	445	0.333	946	2830	445	0.333	419
6:40 AM	6377	445	0.333	945	3113	445	0.333	461
7:00 AM	6755	445	0.333	1001	3396	445	0.333	503
7:20 AM	5794	445	0.333	859	3679	445	0.333	545
7:40 AM	7430	445	0.333	1101	3962	445	0.333	587
8:00 AM	8336	445	0.333	1235	4245	445	0.333	629
8:20 AM	11017	445	0.333	1633	4528	445	0.333	671
8:40 AM	11049	445	0.333	1637	4528	445	0.333	671
9:00 AM	12095	445	0.333	1792	4811	445	0.333	713
9:20 AM	13435	445	0.333	1991	5377	445	0.333	797
9:40 AM	14596	445	0.333	2163	5943	445	0.333	881
10:00 AM	15928	445	0.333	2360	6509	445	0.333	965
10:20 AM	18420	445	0.333	2730	7075	445	0.333	1048
10:40 AM	18463	445	0.333	2736	7642	445	0.333	1132
11:00 AM	19794	445	0.333	2933	7698	445	0.333	1141
11:20 AM	21125	445	0.333	3130	8491	445	0.333	1258
SUM	219450			32699	96255			14385
AVG	9975			1486	4375			654
MAX	21125			3130	8491			1258

TOTAL POUNDS EMITTED 72 32

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BALTIMORE AIR EMMISION TESTING
CY-STK
1989-1990

TIME	1989 CONC. MG/M3	1989 FLOW M3/HR	1989 SAMPLE PERIOD	1989 EMMISION GRAMS	1990 CONC. MG/M3	1990 FLOW M3/HR	1990 SAMPLE PERIOD	1990 EMMISION GRAMS
14:00	5113	16214	0.333	27606	2208	20160	0.333	14820
14:20	4563	16214	0.333	24637	2208	20160	0.333	14820
14:40	4287	16214	0.333	23147	2208	20160	0.333	14820
15:00	4341	16214	0.333	23438	2236	20160	0.333	15010
15:20	4469	16214	0.333	24129	2264	20160	0.333	15200
15:40	4692	16214	0.333	25333	2321	20160	0.333	15580
16:00	4956	16214	0.333	26759	2321	20160	0.333	15580
16:20	4178	16214	0.333	22558	2321	20160	0.333	15580
16:40	3975	16214	0.333	21462	2307	20160	0.333	15485
17:00	4049	16214	0.333	21862	2321	20160	0.333	15580
17:20	3644	16214	0.333	19675	2264	20160	0.333	15200
17:40	3867	16214	0.333	20879	2292	20160	0.333	15390
18:00	3813	16214	0.333	20587	2406	20160	0.333	16150
18:20	4016	16214	0.333	21683	2236	20160	0.333	15010
18:40	3347	16214	0.333	18071	2222	20160	0.333	14915
19:00	3516	16214	0.333	18984	2179	20160	0.333	14630
19:20	3347	16214	0.333	18071	2123	20160	0.333	14250
19:40	2955	16214	0.333	15955	2066	20160	0.333	13870
20:00	2772	16214	0.333	14967	1995	20160	0.333	13395
20:20	3421	16214	0.333	18471	2009	20160	0.333	13490
20:40	3401	16214	0.333	18363	1995	20160	0.333	13395
21:00	3492	16214	0.333	18854	2009	20160	0.333	13490
21:20	3194	16214	0.333	17245	1925	20160	0.333	12920
21:40	3232	16214	0.333	17450	1840	20160	0.333	12350
22:00	3343	16214	0.333	18050	1811	20160	0.333	12160
22:20	3157	16214	0.333	17045	1741	20160	0.333	11685
22:40	2955	16214	0.333	15955	1670	20160	0.333	11210
23:00	2789	16214	0.333	15059	1585	20160	0.333	10640
23:20	2715	16214	0.333	14659	1486	20160	0.333	9975
23:40	2262	16214	0.333	12213	1415	20160	0.333	9500
24:00	2124	16214	0.333	11468	1274	20160	0.333	8550
00:20	1589	16214	0.333	8579	1160	20160	0.333	7790
00:40	1663	16214	0.333	8979	1047	20160	0.333	7030
01:00	1256	16214	0.333	6781	934	20160	0.333	6270
01:20	1035	16214	0.333	5588	849	20160	0.333	5700
01:40	841	16214	0.333	4541	736	20160	0.333	4940
02:00	568	16214	0.333	3067	566	20160	0.333	3800
02:20	637	16214	0.333	3439	538	20160	0.333	3610
02:40	624	16214	0.333	3369	481	20160	0.333	3230
03:00	615	16214	0.333	3321	425	20160	0.333	2850
03:20	603	16214	0.333	3256	382	20160	0.333	2565
03:40	618	16214	0.333	3337	354	20160	0.333	2375
04:00	649	16214	0.333	3504	283	20160	0.333	1900
04:20	922	16214	0.333	4978	241	20160	0.333	1615
04:40	1051	16214	0.333	5675	212	20160	0.333	1425
05:00	1128	16214	0.333	6090	198	20160	0.333	1330
05:20	1341	16214	0.333	7240	184	20160	0.333	1235

BALTIMORE AIR EMMISION TESTING
CY-STK
1989-1990

TIME	1989 CONC. MG/M3	1989 FLOW M3/HR	1989 SAMPLE PERIOD	1989 EMMISION GRAMS	1990 CONC. MG/M3	1990 FLOW M3/HR	1990 SAMPLE PERIOD	1990 EMMISION GRAMS
05:40	1406	16214	0.333	7591	170	20160	0.333	1140
06:00	1417	16214	0.333	7651	142	20160	0.333	950
06:20	1592	16214	0.333	8596	142	20160	0.333	950
06:40	1888	16214	0.333	10194	198	20160	0.333	1330
07:00	2109	16214	0.333	11387	225	20160	0.333	1520
07:20	2636	16214	0.333	14232	283	20160	0.333	1900
07:40	2795	16214	0.333	15091	311	20160	0.333	2090
08:00	3316	16214	0.333	17904	340	20160	0.333	2280
08:20	3454	16214	0.333	18649	368	20160	0.333	2470
08:40	3853	16214	0.333	20803	425	20160	0.333	2850
09:00	4076	16214	0.333	22007	453	20160	0.333	3040
09:20	4408	16214	0.333	23800	467	20160	0.333	3135
09:40	4604	16214	0.333	24858	453	20160	0.333	3040
SUM	164679			889145	75821			509006
AVG	2745			14819	1254			8483
MAX	5113			27606	2406			16150
	TOTAL POUNDS EMITTED			1958				1121

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BALTIMORE AIR EMMISION TESTING
CY-STK
1989-1990

TIME	1989 CONC. MG/M3	1989 FLOW M3/HR	1989 SAMPLE PERIOD	1989 EMMISION GRAMS	1990 CONC. MG/M3	1990 FLOW M3/HR	1990 SAMPLE PERIOD	1990 EMMISION GRAMS	1991 CONC. MG/M3	1991 FLOW M3/HR	1991 SAMPLE PERIOD	1991 EMMISION GRAMS	1991 JUM(PPM) PROPANE	1991 JUM(PPM) VOC	READINGS (DOUG) 1991 ABEC %	1991 YSI	1991 ACET. PPM	1991 (TUBE) HOURS
14:00	5113	16214	0.333	27606		20376	0.333	0		20160	0.333							0.00
14:20	4563	16214	0.333	24637		20376	0.333	0		20160	0.333							0.33
14:40	4287	16214	0.333	23147		20376	0.333	0	2250	20160	0.333	15105	780	1170			537	0.67
15:00	4341	16214	0.333	23438		20376	0.333	0	2279	20160	0.333	15299	790	1185	76.5			1.00
15:20	4469	16214	0.333	24129		20376	0.333	0	2308	20160	0.333	15492	800	1200				1.33
15:40	4692	16214	0.333	25333		20376	0.333	0	2365	20160	0.333	15879	820	1230				1.67
16:00	4956	16214	0.333	26759		20376	0.333	0	2365	20160	0.333	15879	820	1230	80.5			2.00
16:20	4178	16214	0.333	22558		20376	0.333	0	2365	20160	0.333	15879	820	1230				2.33
16:40	3975	16214	0.333	21462		20376	0.333	0	2351	20160	0.333	15783	815	1222.5				2.67
17:00	4049	16214	0.333	21862		20376	0.333	0	2365	20160	0.333	15879	820	1230	85		575	3.00
17:20	3644	16214	0.333	19675		20376	0.333	0	2308	20160	0.333	15492	800	1200				3.33
17:40	3867	16214	0.333	20879		20376	0.333	0	2337	20160	0.333	15686	810	1215				3.67
18:00	3813	16214	0.333	20587		20376	0.333	0	2452	20160	0.333	16460	850	1275	97.1			4.00
18:20	4016	16214	0.333	21683		20376	0.333	0	2279	20160	0.333	15299	790	1185				4.33
18:40	3347	16214	0.333	18071		20376	0.333	0	2264	20160	0.333	15202	785	1177.5				4.67
19:00	3516	16214	0.333	18984		20376	0.333	0	2221	20160	0.333	14911	770	1155	97.5		450	5.00
19:20	3347	16214	0.333	18071		20376	0.333	0	2163	20160	0.333	14524	750	1125				5.33
19:40	2955	16214	0.333	15955		20376	0.333	0	2106	20160	0.333	14137	730	1095				5.67
20:00	2772	16214	0.333	14967		20376	0.333	0	2034	20160	0.333	13652	705	1057.5	94.1			6.00
20:20	3421	16214	0.333	18471		20376	0.333	0	2048	20160	0.333	13749	710	1065				6.33
20:40	3401	16214	0.333	18363		20376	0.333	0	2034	20160	0.333	13652	705	1057.5				6.67
21:00	3492	16214	0.333	18854		20376	0.333	0	2048	20160	0.333	13749	710	1065	94.3	535	550	7.00
21:20	3194	16214	0.333	17245		20376	0.333	0		20160	0.333							7.33
21:40	3232	16214	0.333	17450		20376	0.333	0	1875	20160	0.333	12587	650	975				7.67
22:00	3343	16214	0.333	18050		20376	0.333	0	1846	20160	0.333	12394	640	960	101.1	408		8.00
22:20	3157	16214	0.333	17045		20376	0.333	0	1774	20160	0.333	11910	615	922.5				8.33
22:40	2955	16214	0.333	15955		20376	0.333	0	1702	20160	0.333	11425	590	885				8.67
23:00	2789	16214	0.333	15059		20376	0.333	0	1615	20160	0.333	10845	560	840	84.5	612		9.00
23:20	2715	16214	0.333	14659		20376	0.333	0	1514	20160	0.333	10167	525	787.5				9.33
23:40	2262	16214	0.333	12213		20376	0.333	0	1442	20160	0.333	9683	500	750				9.67
24:00	2124	16214	0.333	11468		20376	0.333	0	1298	20160	0.333	8714	450	675	77.6	527		10.00
00:20	1589	16214	0.333	8579		20376	0.333	0	1183	20160	0.333	7940	410	615				10.33
00:40	1663	16214	0.333	8979		20376	0.333	0	1067	20160	0.333	7165	370	555				10.67
01:00	1256	16214	0.333	6781		20376	0.333	0	952	20160	0.333	6391	330	495	73.6	386	150	11.00
01:20	1035	16214	0.333	5588		20376	0.333	0	865	20160	0.333	5810	300	450				11.33
01:40	841	16214	0.333	4541		20376	0.333	0	750	20160	0.333	5035	260	390				11.67
02:00	568	16214	0.333	3067		20376	0.333	0	577	20160	0.333	3873	200	300	55.6	311	75	12.00
02:20	637	16214	0.333	3439	1189	20376	0.333	8068	548	20160	0.333	3679	190	285				12.33
02:40	624	16214	0.333	3369	1132	20376	0.333	7681	490	20160	0.333	3292	170	255				12.67
03:00	615	16214	0.333	3321	1147	20376	0.333	7783	433	20160	0.333	2905	150	225	42.9	132		13.00
03:20	603	16214	0.333	3256	1168	20376	0.333	7925	389	20160	0.333	2614	135	202.5				13.33
03:40	618	16214	0.333	3337	1189	20376	0.333	8068	361	20160	0.333	2421	125	187.5				13.67
04:00	649	16214	0.333	3504	1189	20376	0.333	8068	288	20160	0.333	1937	100	150	27.4	71		14.00
04:20	922	16214	0.333	4978	1196	20376	0.333	8115	245	20160	0.333	1646	85	127.5				14.33
04:40	1051	16214	0.333	5675	1204	20376	0.333	8169	216	20160	0.333	1452	75	112.5				14.67
05:00	1128	16214	0.333	6090	1232	20376	0.333	8359	202	20160	0.333	1356	70	105	24.6	56		15.00
05:20	1341	16214	0.333	7240	1251	20376	0.333	8488	188	20160	0.333	1259	65	97.5				15.33

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05:40	1406	16214	0.333	7591	1345	20376	0.333	9126	173	20160	0.333	1162	60	90			15.67
06:00	1417	16214	0.333	7651	1415	20376	0.333	9601	144	20160	0.333	968	50	75	22.1	50	16.00
06:20	1592	16214	0.333	8596	1460	20376	0.333	9906	144	20160	0.333	968	50	75			16.33
06:40	1888	16214	0.333	10194	1551	20376	0.333	10524	202	20160	0.333	1356	70	105			16.67
07:00	2109	16214	0.333	11387	1585	20376	0.333	10755	231	20160	0.333	1549	80	120	33.8	62	17.00
07:20	2636	16214	0.333	14232	1627	20376	0.333	11040	288	20160	0.333	1937	100	150			17.33
07:40	2795	16214	0.333	15091		20376	0.333	0	317	20160	0.333	2130	110	165			17.67
08:00	3316	16214	0.333	17904		20376	0.333	0	346	20160	0.333	2324	120	180	33.9	63	18.00
08:20	3454	16214	0.333	18649		20376	0.333	0	375	20160	0.333	2517	130	195			18.33
08:40	3853	16214	0.333	20803		20376	0.333	0	433	20160	0.333	2905	150	225			18.67
09:00	4076	16214	0.333	22007		20376	0.333	0	462	20160	0.333	3098	160	240	28.8	94	19.00
09:20	4408	16214	0.333	23800		20376	0.333	0	476	20160	0.333	3195	165	247.5			19.33
09:40	4604	16214	0.333	24858		20376	0.333	0	462	20160	0.333	3098	160	240			19.67
10:00									288				100	150	25.2	112	20.00
SUM	164679			889145		1222560	20	141675		1209600	20	475416 = 1047 lb.					
AVG	2745			14819		20376	0	2361		20160	0	8341					
MAX	5113			27606		20376	0	11040		20160	0	16460					

SUM RESULTS			103860	141675
TOTAL	POUNDS	EMITTED	229	312