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

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

COKE OVEN EMISSIONS

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Prepared for the

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FOREWORD

Two firms prepared this report under contract to the U.S. Environmental Protection Agency, therefore it is presented in two sections. Section I was prepared by Clayton Environmental Consultants, Inc., Southfield, Michigan and includes testing results for benzene soluble organics, benzene, and O_2, CO, CO_2, as well as coke oven door emission rates and visible emission data. Section II was prepared by TRW Energy Systems Group, Durham, North Carolina and contains benzo(a)pyrene (B(a)P) sampling data only, and immediately follows Appendix H of the Clayton report.

SECTION I - CLAYTON REPORT

BENZENE SOLUBLE ORGANICS STUDY
COKE OVEN DOOR LEAKS

Project No. 79-CKO-22
Contract No. 68-02-2817
Work Assignment No. 20

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1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) retained Clayton Environmental Consultants, Inc. to determine the benzene soluble organic (BSO) fraction of particulate, and benzene emissions from the inlet and outlet of a Mikropul wet electrostatic precipitator (WESP). In addition, stack visible emission and coke oven door fugitive emission data were obtained. This unit cleans the door leak and pushing emissions from Battery Nos. 1 and 2 at the Armco, Inc. facility in Houston, Texas.

The results of this study will be used in research and development efforts for supporting possible New Source Performance Standards for the iron and steel industry, coke oven door emissions. This study was commissioned as EMB Project No. 79-CKO-22, Contract No. 68-02-2817, Work Assignment 20.

The testing program included the following:

(1) triplicate, simultaneous WESP inlet and outlet samples for benzene soluble organics;

(2) simultaneous integrated bag samples for benzene and Orsat analyses, at the WESP inlet and outlet;

(3) visible emission observations (from the WESP exhaust stack) recorded for the duration of each BSO sample run; and,

(4) visible emission observations of the coke oven doors.

Auxiliary data included exhaust gas temperatures and flowrates as determined from the traverses. Figure 1.1 presents an elevation and plan view of the process/control system as tested.

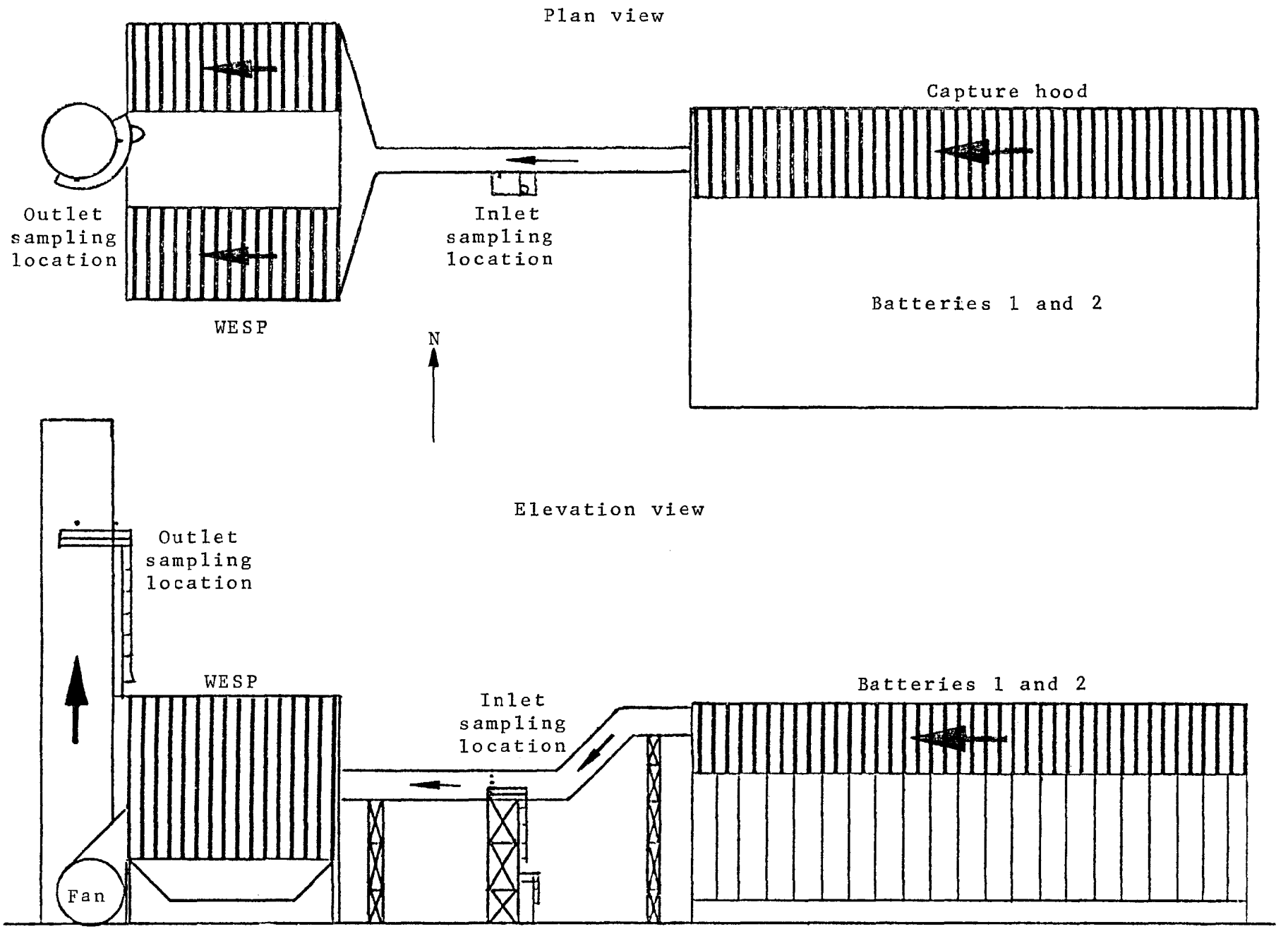

Figure 1.1. Elevation and plan view of process/control system (not to scale).

2.0 PRESENTATION OF RESULTS

BENZENE SOLUBLE ORGANICS

Table 2.1 presents the concentrations and emission rates of benzene soluble organics as determined from both the inlet and outlet of the WESP. Concentrations are presented in grains per dry standard cubic foot (gr/dscf) and milligrams per dry standard cubic meter (mg/dscm). Emission rates are expressed in pounds per hour (lb/hr) and kilograms per hour (kg/hr).

The flowrate data presented in Table 2.1 show a consistent pattern of approximately 14-percent lower flowrates at the WESP outlet than at the inlet, for each of the three runs. The flowrates determined by TRW, which are presented in Section II, Table 2, also tend to corroborate a higher flowrate at the inlet than at the outlet.

Due to the flowrate difference, a review of all pitot tube calibrations was conducted and these calibrations were compared with calibrations made throughout the life history of these pitot tubes. No irregularities were detected. The pitot tubes and sampling lines had all been leak checked in-field, the alignment of the pitot tube with respect to the gas flow was verified,

TABLE 2.1. BENZENE SOLUBLE ORGANIC CONCENTRATIONS AND EMISSION RATES

Sample Location	Sample Number	Date 1979	Stack Gas Parameters		Concentration		Emission Rate	
			Flowrate dscfm	Temp F	gr/dscf	mg/dscm	lb/hr	kg/hr
Inlet	1	10-4	176,000	95.0	0.010	22.8	15.0	6.83
	2	10-5	174,000	105.0	0.017	37.8	24.6	11.2
	3	10-5	172,000	109.0	0.020	45.0	28.9	13.1
	Average		174,000	103.0	0.016	35.2	22.8	10.4
Outlet	1	10-4	153,000	79.6	0.007	16.0	9.18	4.16
	2	10-5	149,000	77.3	0.011	25.4	14.1	6.41
	3	10-5	148,000	66.9	0.011	24.9	13.8	6.27
	Average		150,000	74.6	0.010	22.1	12.4	5.61

and adequate clearance was maintained between the pitot tube openings and the sampling nozzle to eliminate flow disturbances. These various procedures and checks, therefore, substantiate the validity of the data.

The data suggest air exfiltration in the system between the inlet and outlet sampling locations which allows gases to escape the system. During the week of testing, the WESP was continually being serviced, so it is not beyond the realm of possibility that the WESP structure or ductwork was a source of out-leakage.

If the outlet flowrates were as high as the inlet, the emission rates of BSO and benzene would be correspondingly higher and the WESP removal efficiency would be lower.

Inlet

BSO concentrations at the inlet ranged from 0.010 to 0.020 gr/dscf (22.8 to 45.0 mg/dscm) and averaged 0.016 gr/dscf (35.2 mg/dscm). Emission rates ranged from 15.0 to 28.9 lb/hr (6.83 to 13.1 kg/hr), averaging 22.8 lb/hr (10.4 kg/hr).

Outlet

Outlet BSO concentrations ranged from 0.007 to 0.011 gr/dscf (16.0 to 25.4 mg/dscm) and averaged 0.010 gr/dscf (22.1 mg/dscm). Emission rates at the outlet ranged from 9.18 to 14.1 lb/hr (4.16 to 6.41 kg/hr), averaging 12.4 lb/hr (5.61 kg/hr).

BENZENE

Table 2.2 presents the results of the benzene analyses. Concentrations are presented in parts per million (ppm) with emission rates in lb/hr and kg/hr.

Inlet

Benzene concentrations at the inlet ranged from 0.7 to 2.2 ppm and averaged 1.7 ppm. Emission rates ranged from 1.6 to 4.6 lb/hr (0.71 to 2.1 kg/hr) and averaged 3.5 lb/hr (1.6 kg/hr).

Outlet

Concentrations at the outlet ranged from 0.7 to 2.9[a] ppm and averaged 1.9 ppm. Emission rates ranged from 1.4 to 5.3[a] lb/hr (0.63 to 2.4[a] kg/hr) and averaged 3.5 lb/hr (1.6 kg/hr).

EFFICIENCY

Table 2.3 presents the removal efficiency for the wet electrostatic precipitator relative to benzene soluble organics and benzene emissions. Removal efficiency for BSO ranged from 38.8 to 52.2-percent and averaged 44.6-percent. Benzene removal was 12.5-percent during Run 1 and 19.6-percent during Run 3,

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[a]Since the volume obtained for this bag sample was much smaller than those of the other samples, it is suspected that the bag was leaking and therefore, this value may be misleading.

TABLE 2.2 BENZENE CONCENTRATIONS AND EMISSION RATES

Sample Location	Sample Number	Concentration ppm	Emission Rate	
			lb/hr	kg/hr
Inlet	1	0.7	1.6	0.71
	2	2.1	4.4	2.0
	3	2.2	4.6	2.1
	Average	1.7	3.5	1.6
Outlet	1	0.7	1.4	0.63
	2	2.9[a]	5.3[a]	2.4[a]
	3	2.1	3.7	1.7
	Average	1.9	3.5	1.6

[a]This result determined from small air sample, possible leaky bag.

TABLE 2.3 REMOVAL EFFICIENCY OF WESP

Sample Number	Removal Efficiency, Percent	
	Benzene Soluble Organics	Benzene
1	38.8	12.5
2	42.7	NA[1]
3	52.2	19.6
Average	44.6	16.1

[1] Not applicable, as there was more benzene measured at the outlet than at the inlet for this test run.

averaging 16.1-percent. Sample 2 was not applicable for this determination as more benzene was measured at the outlet than at the inlet.

COKE OVEN DOOR EMISSION RATES

Table 2.4 presents a summary of the fugitive emissions observations made during this study. The leaking coke oven door emission rates (expressed as a percent of the total doors) are presented for the entire battery and both the coke side and push side doors for each run for each observer. Also included in this table are the observed total number of leaking doors which were combined over the number of runs conducted at each site for each observer.

The emission rate was calculated as follows. For each run, the total number of leaking oven doors and leaking chuck doors were summed individually for both the push side and coke side. These sums were then divided by the total number of ovens on the battery and then multiplied by 100 to determine the percentage of leaking doors. To obtain the total emission rate for the entire battery, first, the number of leaking doors from all the runs for both the push side and the coke side were summed. Next, the total number of push side and coke side observation runs was multiplied by the number of ovens in the battery. Then the total number of leaking doors was divided by this product.

TABLE 2.4. SUMMARY OF FUGITIVE EMISSIONS OBSERVATIONS

Sample Number	Observer[a]	Total[b] No. of Leaking Doors	Total Emission Rate for Entire Battery	Coke Oven Door Emission Rate, Percent of Total Doors									
				Run Number									
				1		2		3		4		AVG	
				PS	CS	PS	CS	PS	CS	PS	CS	PS	CS
BSO Sample No. 1	1	46	12	9.7	16	11	--	9.7	--	8.1	19	13	18
	2	28	9.0	8.1	--	9.7	15	9.7	--	3.2	--	7.7	NA
	3	28	9.0	6.5	--	6.5	--	11	11	9.7	--	8.4	NA
Average		34	10	8.1	NA	9.1	NA	10	NA	7.0	NA	9.7	NA
BSO Sample No. 2	1	68	22	18	--	25	--	16	31	23	--	20	NA
	2	81	22	16	29	19	--	19	--	16	31	18	30
	3	67	22	18	--	24	32	18	--	16	--	19	NA
Average		72	22	17	NA	23	NA	18	NA	18	NA	19	NA
BSO Sample No. 3	1	51	21	15	--	13	45	9.7	--	c		13	NA
	2	35	14	9.7	--	13	--	6.5	27	c		9.7	NA
	3	51	21	15	42	13	--	13	--	c		14	NA
Average		46	19	13	NA	13	NA	9.7	NA	c		12	NA

[a] The observers are as follows: (1) J. Breger; (2) A. Baecker; (3) D. Lazarevic.

[b] These values are the combined number of leaking doors from all the runs per observer.

[c] Due to darkness, Run 4 was not conducted.

NA - Not applicable.

The coke-side door leak emissions were captured by the shed system and ducted into the WESP. These leaks, therefore, were the emissions quantitatively measured for BSO and benzene.

From Table 2.4, it is evident that the coke side door emission rate ranged from 11 to 19-percent during BSO Sample No. 1, from 29 to 32-percent during Sample No. 2, and from 27 to 45-percent during Sample No. 3. This corresponds to the pattern of emission rates of BSO and benzene at the WESP inlet, which progressively increased from Sample No. 1 to Sample No. 3.

Visible Emission Observations

Visible emissions from the WESP exhaust stack were recorded during each BSO sample run. The readings were summed and averaged over six-minute periods. The summaries of visible emissions may be found in Appendix B-4.

During Sample No. 1 the six-minute averages were 5-percent or less, with one excursion to 10-percent. Averages over Sample No. 2 ranged from 6 to 24-percent. Visible emissions were terminated before the end of BSO Sample No. 3 due to darkness, however, the averages were 20-percent or less, with two excursions to 34 and 40-percent. Generally, therefore, the visible emission observations follow the progressively increasing trend of BSO emission results from Sample No. 1 to Sample No. 3.

3.0 PROCESS DESCRIPTION AND OPERATION

To be supplied by EPA.

4.0 LOCATION OF SAMPLING POINTS

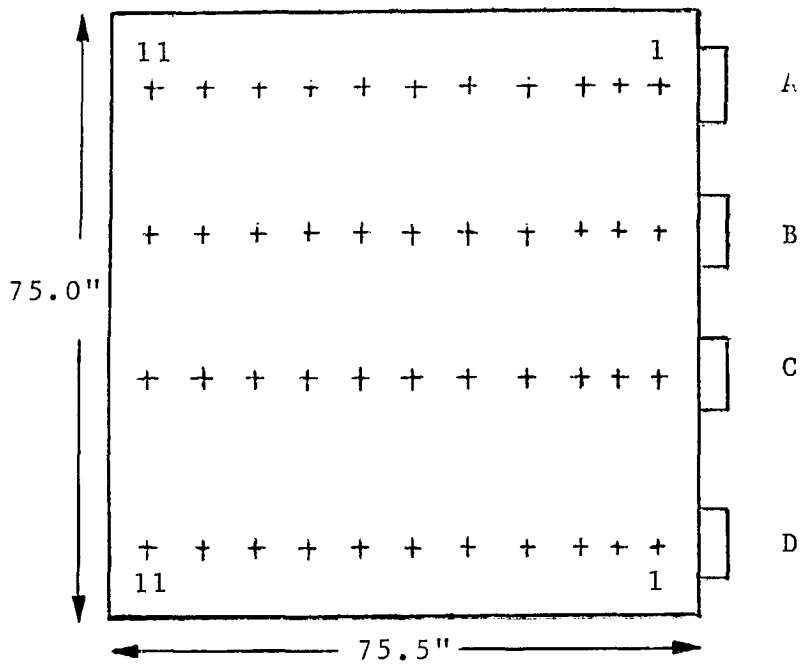
INLET

The WESP inlet sampling location was a 75.5-inch (191.8 cm) by 75.0-inch (190.5 cm) duct, located approximately 17-feet (5.18 meters) downstream of a 45-degree bend in the duct and 28-feet (8.53 meters) upstream of the WESP. This location provided adequate upstream/downstream distances to disturbances. The sampling platform was 37-feet (11.3 meters) above ground level. The duct was accessed through four 3-inch (7.6 cm) ports along the vertical face.

Each traverse consisted of eleven sampling points. Velocity pressures and temperatures were measured at each of the 44 sampling points. Figure 4.1 depicts the inlet sampling location along with the traverse points and their respective distances from the inside duct wall.

OUTLET

The WESP outlet sampling location was a 95.5-inch (242.6 cm) I.D. stack located approximately 56-feet (17.1 meters) downstream of the nearest disturbance (fans) and 15-feet (4.57 meters) upstream from the top of the stack. This provided adequate upstream/downstream distances to disturbances. The sampling platform was 80-feet (24.4 meters) above ground level. The stack



Point	Distance (Inches)
1	3.4
2	10.3
3	17.2
4	24.0
5	30.9
6	37.7
7	44.6
8	51.5
9	58.3
10	65.2
11	72.1

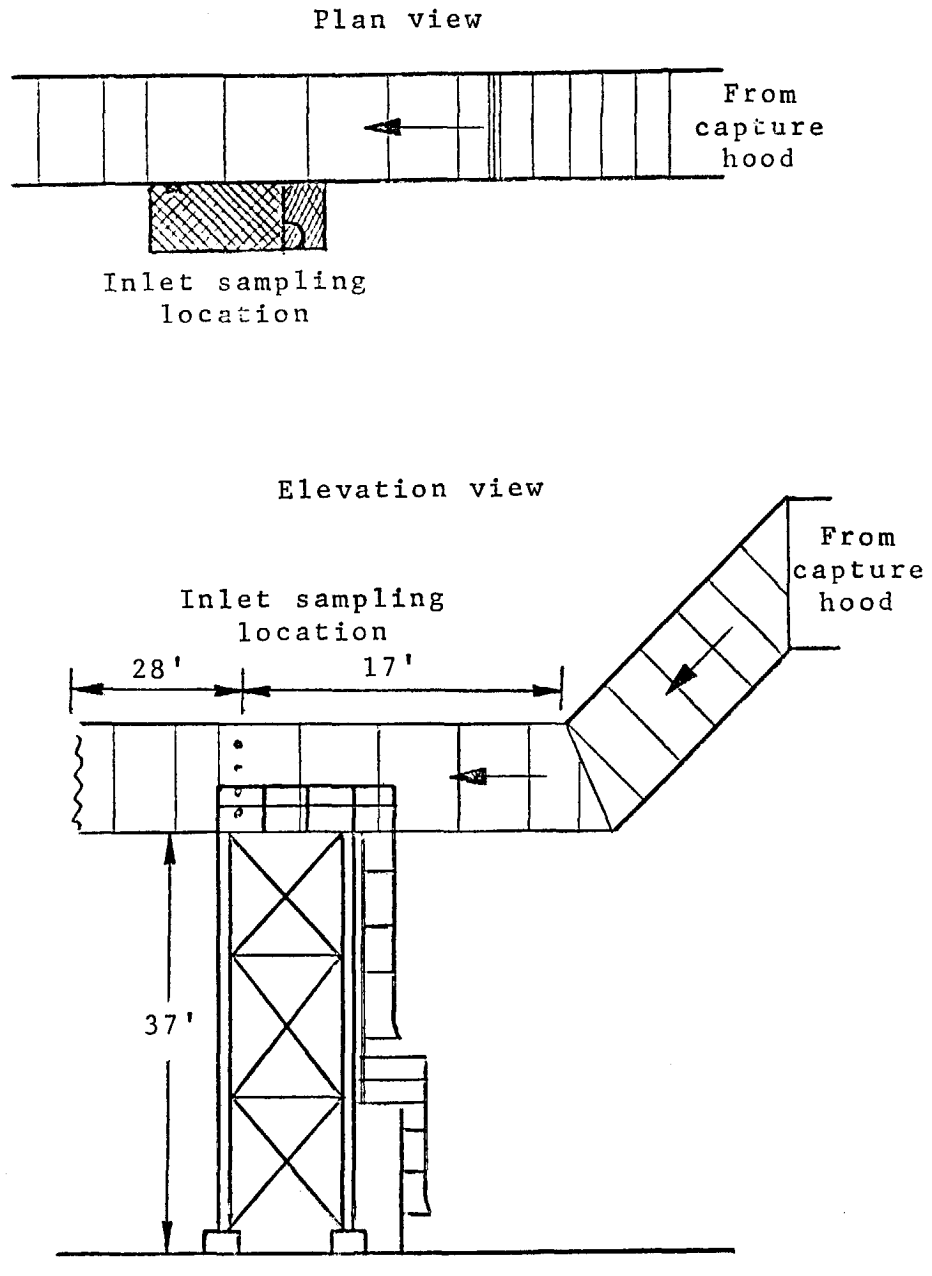


Figure 4.1. Inlet stack cross-section and sampling location (not to scale).

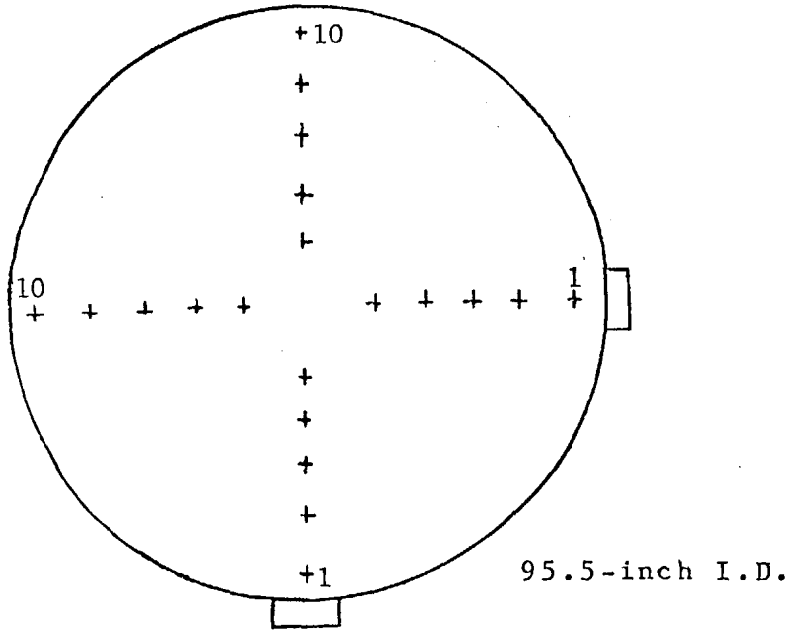
was accessed through two 3-inch (7.6 cm) ports located at a 90-degree separation about the stack circumference.

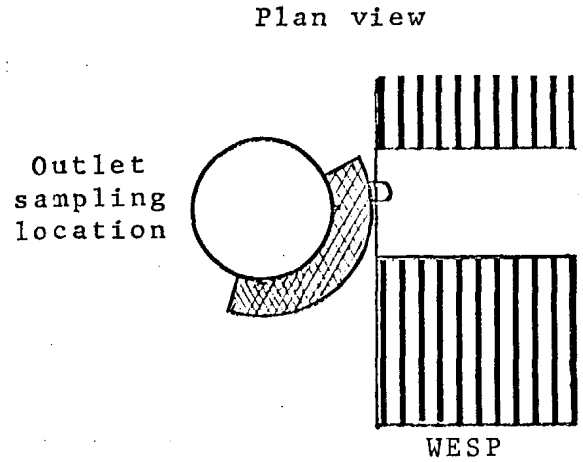
Each traverse consisted of ten sampling points. Velocity pressures and temperatures were measured at each of 20 sampling points. Figure 4.2 is a diagram of the outlet sampling location with each of the traverse points and their respective distances from the inside stack wall.

OBSERVER LOCATION FOR FUGITIVE EMISSIONS OBSERVATIONS

Figure 4.3 presents a plan view of coke oven Battery Nos. 1 and 2. Battery orientation is presented, along with the designation of coke side and push side, and oven door numbers.

For safety reasons, observations were made from outside the pusher machine and quench car tracks, placing observers 15 to 35-feet away from the battery. On the coke side, observers sometimes stood in the quench car tracks to obtain a better view of the oven doors. This resulted in an extremely dangerous situation since the movement of the quench car had to be watched constantly. All observations were made from ground level with the guidance of an Armco, Inc. representative.





Point	Distance (Inches)
1	2.5
2	7.8
3	13.9
4	21.6
5	32.7
6	62.8
7	73.9
8	81.6
9	87.7
10	93.0

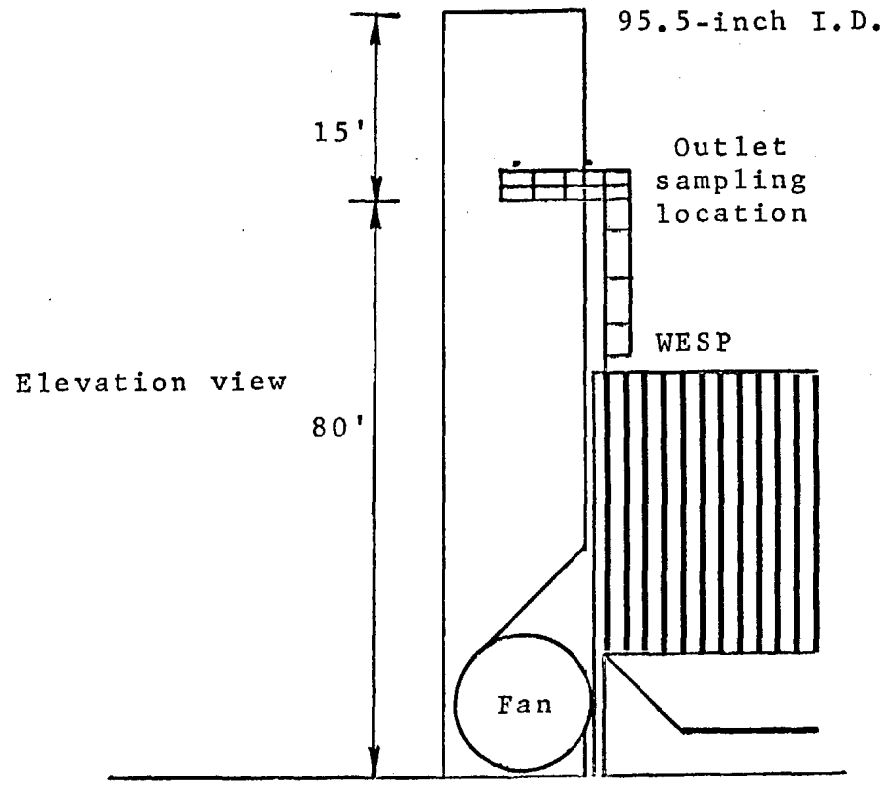


Figure 4.2. Outlet stack cross-section and sampling location (not to scale).

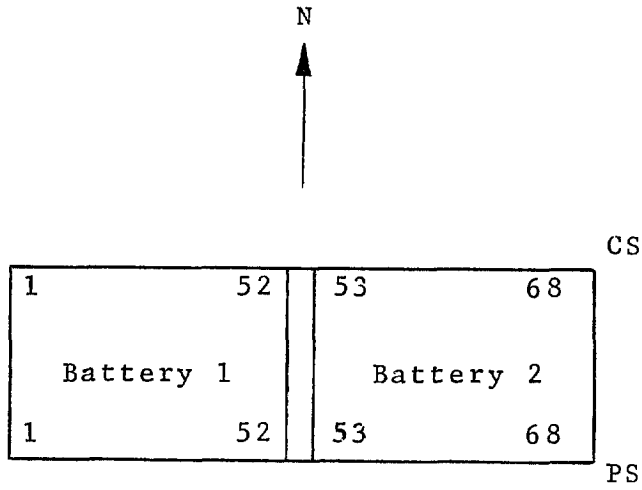


Figure 4.3. Plan view of battery orientation.

5.0 SAMPLING AND ANALYTICAL PROCEDURES

BENZENE SOLUBLE ORGANICS

Sampling was conducted in accordance with EPA Reference Methods 1 - 4, as outlined in the Standards of Performance for New Stationary Sources (Federal Register, 40CFR60, December 23, 1971, as amended through August 18, 1977) and the EPA draft method Benzene Soluble Organics July 3, 1978.

Triplicate samples were extracted isokinetically and simultaneously from the inlet and outlet of the Mikropul wet electrostatic precipitator. At the inlet, 44 points were sampled for three minutes each, while at the outlet, 20 points were sampled for seven minutes per point.

Prior to sampling, each duct was divided into equal areas and exhaust gas velocities and temperatures were measured at their centers. Velocity pressures were obtained using a calibrated S-Type Pitot tube and an inclined 0 to 10-inch water gauge manometer. Temperatures were measured with an iron-constantan (Type J) thermocouple attached to a calibrated pyrometer. Preliminary moisture determinations were made at both locations each using a Method 4 sampling train. An exhaust gas grab sample was obtained from the inlet and analyzed by the Orsat method for gas composition.

Exhaust gas flowrates and the nozzle sizes required to maintain isokinetic sampling rates were then calculated from these preliminary determinations.

Each BSO sampling train consisted of a sharp, tapered, stainless steel nozzle; a heated Teflon® probe and flexline at the inlet, a heated glass probe at the outlet; an empty modified Greenburg-Smith impinger; an unheated 110-mm Type A glass-fiber filter in a glass filter holder with a thermocouple positioned at the outlet; one modified and one standard Greenburg-Smith impinger each containing 150-ml of distilled water; two modified Greenburg-Smith impingers, the first empty, the second containing 200-300 grams of silica gel with a thermocouple positioned to monitor the temperature at the impinger outlet; an umbilical cord; a leak-free vane axial-vacuum pump with a vacuum gauge; a calibrated dry gas meter equipped with bimetallic inlet and outlet thermometers; and a 0 to 10-inch water gauge manometer connected to a calibrated orifice-type flowmeter. The impingers were immersed in an ice bath to maintain the impinger temperature at ±70F.

While conducting each sample run, the temperatures of the filter holder and the last impinger were monitored and maintained below 104F (40C) and 70F (20C), respectively. The probes were connected to the rest of the sampling train with ball and socket joints, stainless

steel at the inlet and glass at the outlet. Teflon® tape was used on all connection fittings up to the filter holder inlet to eliminate the possibility of contaminating the sample with stopcock grease. Stopcock grease was used on all remaining glassware components. A schematic of the sampling train is depicted in Figure 5.1.

Each sampling train was checked for leakage before and after each sample run, in accordance with the requirement that the initial leak rate shall not exceed 0.02 cubic feet per minute (cfm) at 15-inches of mercury vacuum. The final leak rate was checked at or above the greatest vacuum which occurred during the run. At the inlet, the probe assembly was moved to each sampling point, where the velocity pressure and temperature of the exhaust gas was measured and recorded. At the outlet, the sampling train glassware was connected directly to the probe and the assembly moved to each point.

At each individual sampling point, an isokinetic sampling rate was calculated and the sampling flowrate was adjusted accordingly, using an orifice-type meter which indicated instantaneous flowrates. Isokinetic sampling rates were maintained within 10-percent of true isokinecity for any velocity pressure measured. An insulating asbestos mitten and duct tape

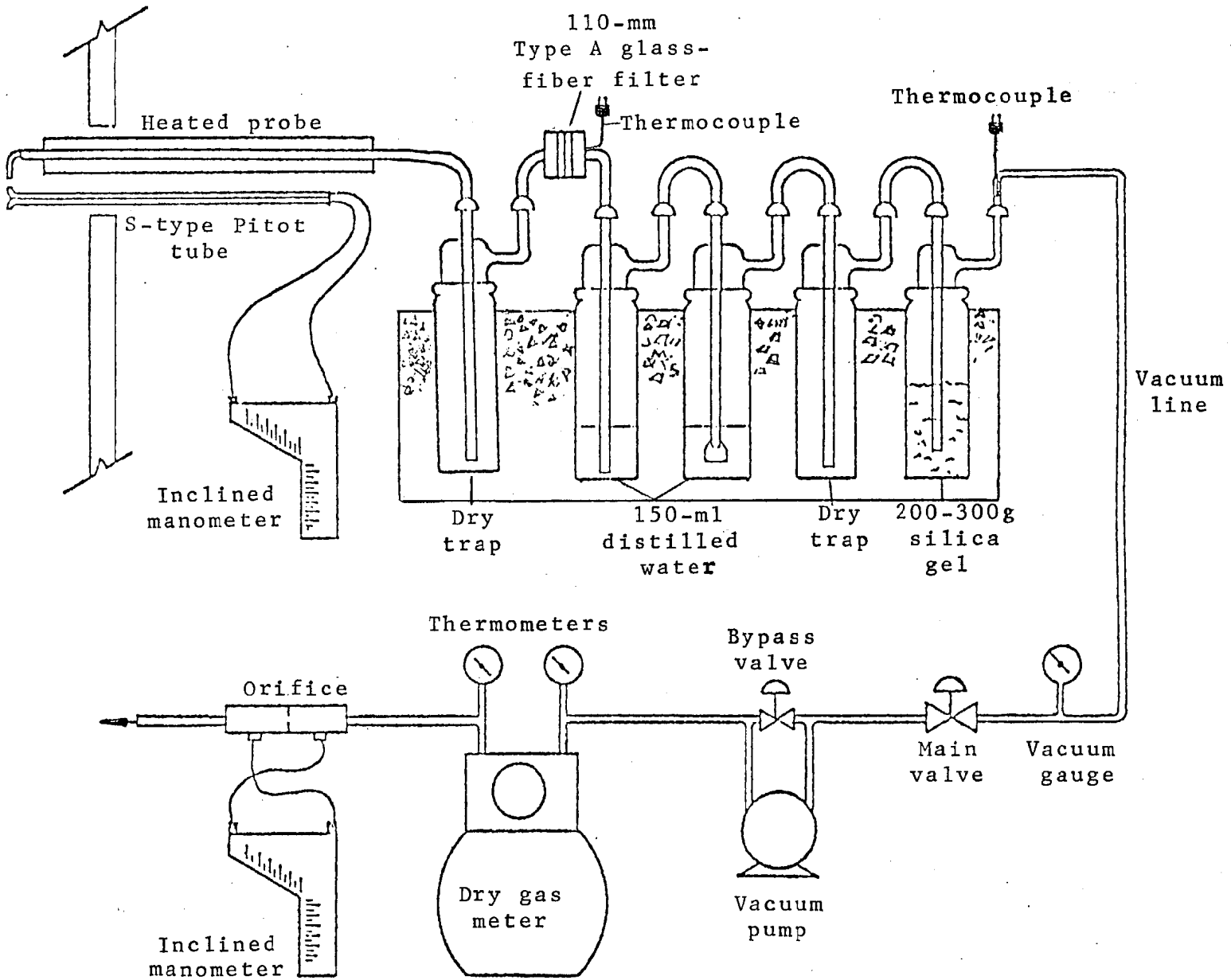


Figure 5.1. Benzene soluble organics sampling train.

were positioned around the probe assembly in each sampling port to maintain a relatively positive seal.

The testing program was designed to measure non-pushing emissions only. Therefore, sampling ceased during the pushing cycle. Pushes were monitored by a Clayton Environmental Consultants, Inc. observer and direct communications were maintained between the observer and the sampling teams. For the purpose of this study, push duration was considered to be from the time the coke was sighted emerging from the oven until the shed had been relatively cleared of pushing emissions (after the quench car had exited the shed area).

Following the final leak check, the sampling trains were moved to a relatively dust-free area for sample transfer. Any condensate collected before the filter was measured and collected in a glass sample bottle. The probe, probe extension (inlet only), initial condensate trap, and front-half of the filter holder were rinsed and brushed, initially with acetone and secondly, with benzene. The rinsings were collected in separate glass sample bottles with Teflon® lined caps. The volumes of the impingers were measured and

increases recorded as condensate. The silica gel was weighed and the gain recorded as condensate. The impinger solutions were not saved beyond volume determinations. The filter was transferred to its original Petri dish and sealed. All bottles were sealed with tape and liquid levels marked.

Thus, at the end of each sample run, the following fractions were available for BSO analysis:

(1) condensate, when collected, before the filter;

(2) acetone rinsings of the probe, probe extension (inlet only), initial condensate trap, and front-half of the filter holder;

(3) benzene rinsings of the probe, probe extension (inlet only), initial condensate trap, and front-half of the filter holder; and,

(4) 110-mm glass-fiber filter.

In the laboratory, each bottle was checked for leakage and volumes measured. Fraction 1 was then extracted in a separatory funnel three times with 50-ml of benzene. The extract was then filtered through a Whatman® 40 filter into a tared 250-ml beaker. The filtrate was then dried at room temperature to a residue. Fraction 2 was dried at room temperature in a tared 250-ml beaker. The residue was then extracted with 50-ml of benzene and set in an ultrasonic bath for one

hour. The extract was then filtered through a Whatman® 40-filter into a tared 250-ml beaker. The filtrate was then dried at room temperature to a constant weight. Fraction 3 was dried at room temperature in tared beakers and the residue weighed until constant. Fraction 4 was extracted with benzene in a Soxhlet extractor for six hours. The extract was then filtered through a Whatman® 40 filter into a tared beaker. The filtrate was then dried at room temperature to residue. All weighings were performed on analytical balances with sensitivities of 0.1 milligram. A summary of weights by fraction appears in Appendix C.

INTEGRATED BAG SAMPLING (BENZENE AND ORSAT)

An integrated bag sample was withdrawn from the WESP inlet and outlet ducts simultaneously with each BSO sampling run utilizing the train described by EPA Method 110 and depicted in Figure 5.2. Sampling was conducted during steady operation of the battery, not during push times. An evacuated 96-liter Saran® bag, especially treated to reduce permeability, was placed inside an insulated steel drum. The drum was then gradually evacuated, thereby filling the Saran® bag. A rotameter was placed in-line to control the actual sample flowrates, as shown in Figure 5.2.

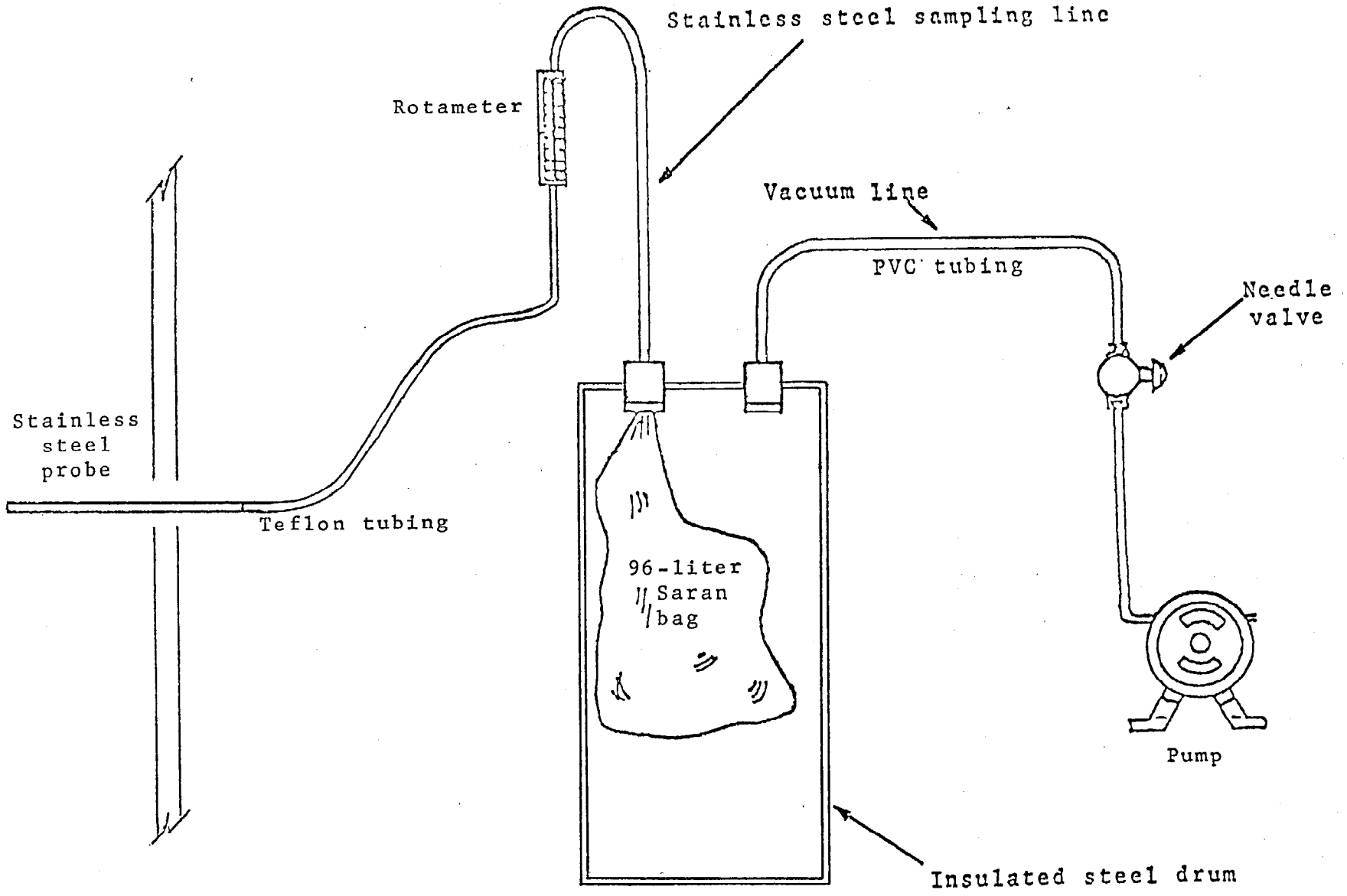


Figure 5.2. Integrated bag sampling train.

Upon filling, the bag was removed and transferred to a laboratory for immediate gas chromatographic (GC) analysis for benzene content and Orsat analysis for gaseous composition.

Benzene concentrations were determined in accordance with EPA Method 110, "Determination of Benzene from Stationary Sources", delineated in Appendix E-2. Gas chromatographic field analyses were performed utilizing an Analytical Instrument Development (AID) Model 511, portable gas chromatograph with a flame ionization detector and a 6' x 1/8" stainless steel column packed with 1.75-percent Bentone and 5-percent SP1200 on 100/120 mesh Supelcoport.

The following operation conditions were maintained for all analyses: 85C oven, 105C detector, 99C gas sampling loop with 1-ml capacity, and 15 ml/min zero nitrogen carrier gas. Prior to sample analysis, the EPA required that the analyst accurately identify the concentration of two audit cylinder standards (one low concentration standard in the range of 5 to 20 ppm benzene, and one high concentration cylinder in the range of 100 to 300 ppm benzene). Each measured concentration agreed to within $\pm$10% of the actual concentration as required. The Field Audit Report can be found in Appendix H. Samples were then analyzed and peak areas were measured using a compensating planimeter. The sample chromatograms had to apparent peaks, which were completely resolved.

Following the GC analyses, each integrated bag sample was analyzed by the Orsat method for carbon dioxide, oxygen, and carbon monoxide concentrations, as specified in EPA Method 3. These results were used to calculate the molecular weight of the process gas.

FUGITIVE EMISSIONS

Visible emission observations were performed in accordance with EPA Draft Method 109 (and Addendum to Method 109), Determination of Visible Emissions from Coke Oven Batteries, Part C. These observations were conducted simultaneously with each BSO sample. Several modifications to the method were made due to difficulties encountered during the testing program.

Draft Method 109 requires one observer, however, three observers were used for this study. All three observers were to traverse together either the coke or push side, then move to the opposite side of the battery to inspect the remaining doors and complete the run. Due to insufficient lighting, only one observer traversed the coke side per run. All three observers traversed the push side of the battery. Two of the observers started their traverse simultaneously from opposite ends of the battery. The third observer started the traverse from either end, not less than one minute nor more than two minutes

after the first two observers began traversing. A run consists of traversing both the coke and push side of a battery. Four runs were conducted during BSO Sample Nos. 1 and 2 each. Due to darkness, only three runs were conducted during BSO Sample No. 3.

The coke side was covered by a shed which captured door leak and pushing emissions. This shed allowed very little entry of natural light and several of the electric lights, located within the shed, were inoperable. Therefore, the darkness made reading of the coke doors extremely difficult. Since there was no feasible way of obtaining proper lighting, the EPA Technical Manager decided that observers would use a high powered lantern light to aide in viewing the top of the doors. Those doors located at the outermost ends of the battery were easiest to view since more light entered these areas. The light intensity from the lantern was such that the beam had to be moved around the jamb area of each oven door (from top to bottom) to view the entire door. Since there was only one lantern and observers were not allowed to traverse the battery in a group, only one observer viewed the coke side per run. Therefore, each observer read the coke side every third run.

Jamb, buckstay, and lintel leaks were documented by the observers, in addition to oven door and chuck door leaks from the push side. Distinguishing between these various types of leaks for the coke side was impossible due to the lighting problem. The observers, when entering the shed from bright sunlight, had to wait several minutes before starting a traverse to allow for eye adjustment.

Several other problems were encountered during this study which made observations of the coke oven battery doors extremely difficult. Obstructions, such as push cars, door cars, quench cars, and other equipment located on the battery, resulted in frequent delays. Some interruptions were caused by plant personnel taking breaks. The workers would leave the equipment in front of the oven doors, making observations in those areas impossible.

Using a lantern light created several problems. Fine dust particles, always present in the battery area, were accentuated by the light beam. It was difficult at times to determine if the oven door was actually leaking through this intensified haze.

The wind also created some problems. Dust, which had settled in the battery area, along with smoke from

oven doors, would be carried sometimes across the entire battery, obscuring the vision of the remaining oven doors.

Observers had to view approximately 15 oven doors at an angle ranging from 0 to 45-degrees. The bin, where the quenched coke is dumped, was located in front of these doors. No one was allowed in front of this bin due to lack of clearance from the quench car. Determining which doors were leaking and the type of leak was very difficult, if not impossible at times. This was especially true when oven doors were leaking heavily, filling the entire area with smoke.

At the request of the Technical Manager, Battery Nos. 1 and 2 were observed as one, since only one push car/quench car unit serviced both batteries.

Opacity Readings

Addendum to Draft Method 109 requires observers to determine the opacity of the emissions at the lintel area. Since exhaust hoods were located in this area on the push side, opacity readings were not recorded. The aforementioned problems encountered on the coke side prevented any reading of opacities, especially since the lintel area was the darkest area of the battery.

VISIBLE EMISSIONS

Visible emissions from the WESP exhaust stack were recorded for the duration of each BSO sample run. The observations were performed in accordance with EPA Method 9 by a qualified visible emissions observer. A summary of the visible emission data is presented in Appendix B-4.

APPENDIX A

PROJECT PARTICIPANTS

PROJECT PARTICIPANTS

Clayton Environmental Consultants, Inc.

Timothy V. Mattson	Group Leader, Emission Measurement
August H. Baecker	Laboratory Technician
Bruce G. Bird	Source Testing Specialist
John J. Breger	Environmental Technician
William E. Ewing	Industrial Hygiene Technician
John C. Holm	Laboratory Technician
Randy M. Knutson	Source Testing Specialist
Dusanka Lazarevic	Environmental Data Specialist
Donna L. Opthoff	Environmental Data Specialist
J. Douglas Opthoff	Environmental Chemist
Timothy J. Palmer	Environmental Control Specialist

Armco Steel

William Chadick

Research Triangle Institute

Marvin Branscome

Environmental Protection Agency

Daniel G. Bivins

Lee Beck

King Yu

APPENDIX B

FIELD DATA SHEETS

B-1. Benzene Soluble Organic Test Data Sheets
B-2. Sampling Summary Data
B-3. Visible Emission Data Sheets
B-4. Summary of Visible Emissions
B-5. Fugitive Emission Observation Data Sheets

APPENDIX B-1.

BENZENE SOLUBLE ORGANIC TEST DATA SHEETS

SAMPLING TRAIN DATA

Company: ARMCO STEEL - HOUSTON
Source Designation: INLET - ESD
Date: 10-4
Test Number: P-1
Field Person: AMK, DJO
Filter Number: A-220-06
Barometric Pressure ("Hg): 29.81
Stack Static Pressure ("H_2O): -4.5
Stack Dimensions: 75.5 X 75
Plume Appearance:
Ambient Temperature (°F): 75
Record all Data Every 3 Minutes

Filter Heater Setting:
Probe Heater Setting:
Nozzle Number: ____, Dia. (in.):
Pitot Tube No. ____, Corr. Factor:
Meter Box No. ____, Corr. Factor:
Meter Isokinetic Factor:
Assumed Moisture (%):
Condensate Volume (ml):
Silica Gel Weight Gain (g):
Leak Rate ____ CFM at ____ "Hg

Page 3(4)

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O)	Stack Temp (°F)	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp (°F) Inlet	Dry Gas Meter: Temp (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
3 -1	0	15:57	0.35	90	488.113	104	102	0.50	65	65	—
-2	3	16:04	1.7	85	89.6	104	102	2.44	65	60	1
-3	6	:07	2.6	90	92.1	104	102	3.70	65	55	2
-4	9	:10	2.6	100	95.1	100	100	3.61			2
-5	12	:21	2.6	95		102	100	3.65	65	55	2
-6	15	16:24	2.8	90		106	100	3.98			
-7	18	16:27	2.3	95	04.8	110	100	3.25	65	55	2
-8	21	:36	2.3	90	07.6	106	100	3.27			
-9	24	:39	2.3	95	10.5	108	100	3.25	65	55	2
-10	27	17:07	2.3	95	13.2	96	96	3.2	60	55	2
11	30	17:10	2.3	95	16.6	98	98	3.2	55	50	2
	33				519.217						
AVERAGE (TOTAL)					( )	3376	3196	89.94			

SAMPLING TRAIN DATA

Company: ARMCO STEEL - Houston
Source Designation: Inlet
Date: 10-4-79
Test Number: P-1
Field Person: RMK DJO
Filter Number: A-220-06
Barometric Pressure ("Hg): ~~29.65~~ 29.8
Stack Static Pressure ("H_2O): -4.5
Stack Dimensions: 75.5 x 75
Plume Appearance:
Ambient Temperature (°F): 75
Record all Data Every 3 Minutes

Filter Heater Setting:
Probe Heater Setting:
Nozzle Number: ____, Dia. (in.): 0.182
Pitot Tube No. 18, Corr. Factor: 0.8
Meter Box No. 2, Corr. Factor: 1.00
Meter Isokinetic Factor: 1683
Assumed Moisture (%): 3
Condensate Volume (ml):
Silica Gel Weight Gain (g): 14.8
Leak Rate <0.01 CFM at 5 "Hg

Page 4(4)

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O) 5	Stack Temp (°F) 4	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp (°F) Inlet	Dry Gas Meter: Temp (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
D (4)-1	0	17:21	1.2	100	519.217	96	96	1.66			
-2	3	17:24	1.8	100	21.3	98	96	2.49	60	50	2
-3	6	:27	2.0	90	24.2	100	96	2.82	55	45	2
-4	9	:30	2.5	95		104	98	3.51	60	50	2
-5	12	:33	2.5	95	29.6	106	98	3.52	60	50	2
-6	15	:36	2.3	90	32.6	110	100	3.28	60	55	2
-7	18	:39	2.3	95	35.8	110	100	3.25	60	55	2
-8	21	:41	2.3	95	38.6	112	100	3.26	60	55	2
-9	24	:44	2.1	90	41.6	112	100	3.00	60	55	2
push -10	27	:47 :50-:53	2.0	90	44.4	112	100	2.86	60	55	2
-11	30	:54	2.0	90	47.3	114	102	2.87	60	55	2
	33	17:57			550.049						
	(132)										
					119.061						
AVERAGE (TOTAL)				95.0	(118.824)	103.4	97.3	2.78			

Clayton Environmental Consultants, Inc.

DRY MOLECULAR WEIGHT DETERMINATION (M_d)

Plant: Armco Steel
Date: 10/4/79
Sampling Time (24-hour Clock): P-1
Sampling Location:: Inlet

Sample Type (bag, integrated, continuous)
Analytical Method: ORSAT
Ambient Temperature: Rm
Operator: RLB

Comments:

Gas \ Run	1 Actual Reading	1 Net	2 Actual Reading	2 Net	3 Actual Reading	3 Net	Average Net Volume	Multiplier	Molecular Weight Of Stack Gas (dry basis) M_d, lb/lb-mole
CO_2	0	0	0	0	0	0	0	44/100	
O_2 (Net is actual O_2 reading minus actual CO_2 reading)	19.6		19.6		19.4		19.5	32/100	6.24
CO (net is actual CO reading minus actual O_2 reading)	19.7	0.1	19.7	0.1	19.4	<0.1	<0.1	28/100	
N_2 (Net is 100 minus actual CO reading)							80.5	28/100	22.54
								Total	28.78 = M_d

WET MOLECULAR WEIGHT DETERMINATION (M_s)

B_{wo} = Proportion by volume of water vapor in the gas stream

M_s = Molecular weight of stack gas (wet basis), lb/lb-mole = $M_d(1-B_{wo}) + 18(B_{wo})$

M_s = ( )(1-) + 18( ) =

$G_m = \frac{M_d}{28.96} = \frac{\quad}{28.96} =$, $G_s = \frac{M_s}{28.96} = \frac{\quad}{28.96} =$, $\frac{G_m}{G_s} = \frac{\quad}{\quad} =$

Page 1 of 4 $\frac{1}{25}$ x60

SAMPLING TRAIN DATA

$m = 1.43 \frac{T_m}{T_s} H$

Company: Amco Steel EPA Task 20
Source Designation: WESP Inlet
Date: 10-5-79
Test Number: BSO-2 pg 1
Field Person: RMK, DJO
Filter Number: A-221-11
Barometric Pressure ("Hg): 29.72
Stack Static Pressure ("H_2O): -4.5
Stack Dimensions: 75.5" x 75"
Plume Appearance:
Ambient Temperature (°F):
Record all Data Every 3 Minutes

Filter Heater Setting:
Probe Heater Setting:
Nozzle Number: 3/16, Dia. (in.):
Pitot Tube No. 18, Corr. Factor: 0.83
Meter Box No. 2, Corr. Factor: 1.002
Meter Isokinetic Factor:
Assumed Moisture (%): 1.1
Condensate Volume (ml): -3
Silica Gel Weight Gain (g): 33.5
Leak Rate <0.01 CFM at 15 "Hg
final

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O) 5	Stack Temp (°F) 4	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp (°F) Inlet 1	Dry Gas Meter: Temp (°F) Outlet 2	Orifice Pressure Differential ("H_2O)	Filter Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
A-1	0	9:49	1.1	100	551.133	70	72	1.49	60	60	3
-2	3	:52 (:52-:55)	1.9	95	53.1	76	76	2.62	60	60	5
-3	6	9:58	2.3	100	55.5	84	80	3.18			6
-4	9	10:01	2.0	105	58.4	90	80	2.76	60	60	6
-5	12	10:04	1.8	100	61.2	96	92	2.55	65	65	5
-6	15	10:07	1.7	100	63.7	100	84	2.40	60	65	5
-7	18	10:10	1.5	100	66.2	104	88	2.13	65	70	4
-8	21	10:13 (:14-:17)	1.6	100	68.6	104	90	2.28	65	65	4
-9	24	10:22	1.9	100	71.0	100	90	2.69	60	65	5
-10	27	10:25 (:27-:31)	2.0	100	73.7	104	92	2.85	60	65	6
-11	30	:32 (:35-:40)	1.8	100	76.4	98	92	2.55	60	65	5
	33	10:41			578.910						
AVERAGE (TOTAL)					( )	1026		27.5			

Push
Push

Clayton Environmental Consultants, Inc.

SAMPLING TRAIN DATA

$m = 1.39 \left(\frac{\Delta m}{T_s}\right)(H)$

Company: Armco Steel EPA Task 20

Source Designation: Inlet to ESP

Date: 10-[illegible]-79

Test Number: [illegible] P-1

Field Person: RMK

Filter Number: A-220-06

Barometric Pressure ("Hg): 29.81

Stack Static Pressure ("H_2O): -4.5

Stack Dimensions: 75.5 x 75

Plume Appearance:

Ambient Temperature (°F): 70

Record all Data Every _____ Minutes

Filter Heater Setting:

Probe Heater Setting:

Nozzle Number: 3/16, Dia. (in.): 0.1875

Pitot Tube No. 18, Corr. Factor: 0.833

Meter Box No. 2, Corr. Factor: 1.002

Meter Isokinetic Factor: 1683

Assumed Moisture (%): 3

Condensate Volume (ml): 296 ml - 300

Silica Gel Weight Gain (g): 14.8

Leak Rate 0.015 CFM at 15 "Hg

Page 1(4)

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O) 5	Stack Temp (°F) 4	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp (°F) 1 Inlet	Dry Gas Meter: Temp (°F) 2 Outlet	Orifice Pressure Differential ("H_2O)	Filter Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
2.32 A-1	0	14:19	1.7	100	431.462	90	90	2.32	60	70	—
-2	3		1.7	100		90	90	2.32	50	70	—
3-[illegible]	6	14:26	2.0	100		90	90	2.73	50	70	—
[illegible]	7:41	14:26 - 14:30		~~100~~	437.911	~~98~~	~~96~~				—
4-[illegible]	9	[illegible]	2.0	105		92	90	2.71	50	65	
5-[illegible]	12	~~14:38~~	1.8	110		96	90	2.43			
6	15	14:38 14:42	1.7	100		100	90	2.34	50	65	—
1.81 7-[illegible]	18	14:43	1.3	95	446.9	100	92	1.81	55	65	—
8	21	14:48-52	1.5	100		100	92	2.07			—
9	24	[illegible]	1.4	100	51.6	98	92	1.93	55	65	—
10	27		1.8	100	53.8	100	94	2.49			—
11	30		1.7	95		104	98	2.39	50	60	—
	33	≈15:05			458.742						
				95.0			100.4	2.78			
AVERAGE (TOTAL)					( )	1060	1008	25.54			

Clayton Environmental Consultants, Inc.

SAMPLING TRAIN DATA

Company: AMOCO STEEL - HOUSTON
Source Designation: INLET ESP
Date: 10-4-79
Test Number: P-1
Field Person: RMK
Filter Number:
Barometric Pressure ("Hg): 29.81
Stack Static Pressure ("H_2O): -4.5
Stack Dimensions: 75.5 x 75.0
Plume Appearance:
Ambient Temperature (°F):
Record all Data Every _____ Minutes

Filter Heater Setting:
Probe Heater Setting:
Nozzle Number: ____, Dia. (in.):
Pitot Tube No. ____, Corr. Factor:
Meter Box No. ____, Corr. Factor:
Meter Isokinetic Factor:
Assumed Moisture (%):
Condensate Volume (ml):
Silica Gel Weight Gain (g):
Leak Rate _____ CFM at _____ "Hg

Page 2 (4)

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O)	Stack Temp (°F)	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp (°F) Inlet	Dry Gas Meter: Temp (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter ~~Box~~ Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
B-1	0	15:12	0.28	100	458.742	98	96	0.39			—
-2	3	15:15	2.0	90		96	96	2.81	65	60	—
-3	6	15:18	1.8	95	62.7	100	96	2.52	55	60	—
-4	9	:21	2.3	85	65.3	104	98	3.29	60	55	—
-5	12	:24	2.1	95		108	98	2.96	60	55	—
-6	15	:27	2.1	95	71.1	110	100	2.97	60	55	—
-7	18	:30	2.1	95		110	100	2.97	60	55	
-8	21	:33	2.2	90		112	100	3.15			—
-9	24	:36	2.1	95	79.8	112	100	2.98			—
-10	27	:39	2.3	95	82.6	114	102	3.30	65	60	—
11	30	:41	2.1	90		114	102	3.01	65	60	—
	33				488.115						
AVERAGE (TOTAL)					( )	2238	2096	55.89			

Clayton Environmental Consultants, Inc.

SAMPLING TRAIN DATA

COMPANY: ARMCO STEEL - HOUSTON
SOURCE DESIGNATION: ~~US EPA~~ WESO INLET
REGULATING AUTHORITY: U.S. EPA
DATE: 10-5-79
TEST NUMBER: BSO-2
Field Person(s): RMK DJO
Filter Number: A-221-11
Barometric Pressure ("Hg): 29.72
Stack Static Pressure ("H_2O): -4.5
Stack Dimensions: 75.5X75
Ambient Temperature (°F): 70
Record all Data Every 3 Minutes

Nozzle(Dia-in): ___ ___ ___ (Avg): ___
Pitot Tube No. 18, Corr. Factor: ___
Meter Box No. 2, Corr. Factor: ___
Meter Isokinetic Factor: ___
Assumed Moisture (%): 1.1
Condensate Volume(ml): ___
Silica Gel Weight Gain(g): ___
Actual Moisture (%): ___
Leak Rate: Initial: <0.01 CFM at ___ "Hg; Final: ___ CFM at ___ "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O) 5	Stack Temp (°F) 4	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp. (°F) 1 Inlet	Dry Gas Meter: Temp. (°F) 2 Outlet	Orifice Pressure Differential ("H_2O)	Filter Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
B-1	0	10:55	0.25	100	578.970	94	94	0.35			
-2	3	10:58	1.50	100	80.0	94	94	2.12	75	70	4
-3	6	11:01	2.3	105	82.3	100	96	3.25	75	65	6
-4	9	11:04	2.3	110	85.3	105	98	3.24			6
-5	12	11:07	2.2	110	88.2	110	98	3.11	70	65	6
-6	15	11:10	2.1	105	91.2	114	98	2.97	75	70	6
-7	18	11:13	2.0	105	94.0	116	100	2.85	70	65	5
-8	21	11:16	2.2	105	96.8	118	102	3.15	70	60	6
-9	24	11:19	2.3	105	99.6	120	102	3.29	70	60	6
-10	27	11:22	2.3	105	602.5	120	104	3.30	70	60	6
-11	30	11:25	2.3	105	605.5	122	115	3.34	70	60	6
	33	11:28			608.555						
AVERAGE (TOTAL)					( )	2234	2039	58.47			

Page 3 of 4

SAMPLING TRAIN DATA

COMPANY: ARMCO STEEL - HOUSTON
SOURCE DESIGNATION: WESP INLET
REGULATING AUTHORITY: U.S. EPA
DATE: 10-5-79
TEST NUMBER: BSO-2
Field Person(s): RMK, DJO
Filter Number: A-221-11
Barometric Pressure ("Hg): 29.72
Stack Static Pressure ("H_2O): -4.5
Stack Dimensions: 75.5X75
Ambient Temperature (°F): 75°
Record all Data Every 3 Minutes

Nozzle(Dia-in): ___ ___ ___ (Avg): ___
Pitot Tube No. 18, Corr. Factor: ___
Meter Box No. 2, Corr. Factor: ___
Meter Isokinetic Factor: ___
Assumed Moisture (%): 1.1
Condensate Volume(ml): ___
Silica Gel Weight Gain(g): ___
Actual Moisture (%): ___
Leak Rate: Initial: <0.01 CFM at 15 "Hg; Final: ___ CFM at ___ "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O)	Stack Temp (°F)	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp. (°F) Inlet	Dry Gas Meter: Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter ~~Box~~ Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
C-1	0	11:37	0.40	100	608.555	110	102	0.58			
-2	3	11:40 11:41-45	1.5	100	609.9	110	106	2.18	80	65	4
-3	6	:47	2.4	110	12.2	108	104	3.41	75	60	6
-4	9	:50	2.4	110	15.2	112	104	3.42	75	60	7
-5	12	:53	2.3	110	18.2	116	104	3.29	75	60	7
-6	15	:56	2.4	110	21.2	118	106	3.44	75	65	7
-7	18	:59	2.3	110	24.2	120	106	3.31	~~[illegible]~~		
-8	21	12:00 12:04-5	2.3	110	27.4	122	108	3.32	75	60	6
-9	24	:09	2.4	110	30.2	116	104	3.43	75	55	7
-10	27	:12	2.4	110	33.3	118	106	3.44	70	60	7
-11	30	:15	2.3	110	36.4	120	108	3.31			
	33	:18			639.371						
AVERAGE (TOTAL)					( )	3509	3197	91.6			

SAMPLING TRAIN DATA

COMPANY: ARMCO - HOUSTON
SOURCE DESIGNATION: WESP INLET
REGULATING AUTHORITY: U.S. EPA
DATE: 10-5-79
TEST NUMBER: ISO-2
Field Person(s): RMK DJO
Filter Number: A-221-11
Barometric Pressure ("Hg): 29.72
Stack Static Pressure ("H_2O): -4.5
Stack Dimensions: 75.5 x 75
Ambient Temperature (°F): 75
Record all Data Every 3 Minutes

Nozzle (Dia-in): ___ ___ ___ (Avg): ___
Pitot Tube No. ___, Corr. Factor: ___
Meter Box No. ___, Corr. Factor: ___
Meter Isokinetic Factor: ___
Assumed Moisture (%): ___
Condensate Volume (ml): ___
Silica Gel Weight Gain (g): ___
Actual Moisture (%): ___
Leak Rate } Initial: ___ CFM at ___ "Hg
Leak Rate } Final: ___ CFM at ___ "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O) 5	Stack Temp (°F) 4	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp. (°F) Inlet 1	Dry Gas Meter: Temp. (°F) Outlet 2	Orifice Pressure Differential ("H2O)	Filter [redacted] Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
D-1	0	12:23	1.2	100	639.371	110	102	1.73			3
-2	3	12:26	1.8	100	41.5	112	106	2.62	75	60	5
-3	6	12:29	2.1	105	44.4	114	106	3.03	70	60	6
-4	9	:32 :34-:35	2.3	110	47.0	118	106	3.30	75	60	6
-5	12	:42 :42-:46	2.4	110	49.7	114	106	3.43	75	65	7
-6	15	:49	2.4	110	52.9	110	102	3.41	70	55	7
-7	18	:52 :53-:58	2.3	110	55.9	114	106	3.29	70	60	7
-8	21	13:01 :02-:07	2.3	110	58.9	112	104	3.28	70	55	7
-9	24	:10	2.2	115	61.9	110	102	3.10	65	55	6
-10	27	:13 :13-:18	2.1	115	64.7	112	104	2.97	70	60	6
-11	30	:24 :24-:29	2.0	105	67.5	108	102	2.86	70	60	
	33				670.412						
AVERAGE (TOTAL)				105.3	(119.518	107.8	98.7	2.83			

DRY MOLECULAR WEIGHT DETERMINATION (M_d)

Plant: Armco Steel
Date:
Sampling Time (24-hour Clock):
Sampling Location::

Sample Type (bag, integrated, continuous)
Analytical Method:
Ambient Temperature:
Operator:

Comments:

Gas \ Run	1		2		3		Average Net Volume	Multiplier	Molecular Weight Of Stack Gas (dry basis) M_d, lb/lb-mole
	Actual Reading	Net	Actual Reading	Net	Actual Reading	Net			
CO_2	0		0		0		0	44/100	
O_2 (Net is actual O_2 reading minus actual CO_2 reading)	19.4		19.4		19.2		19.3	32/100	
CO (net is actual CO reading minus actual O_2 reading)	0		0		0		0	28/100	
N_2 (Net is 100 minus actual CO reading)							80.7	28/100	
								Total	= M_d

WET MOLECULAR WEIGHT DETERMINATION (M_s)

B_{wo} = Proportion by volume of water vapor in the gas stream

M_s = Molecular weight of stack gas (wet basis), lb/lb-mole = $M_d(1-B_{wo}) + 18(B_{wo})$

M_s = ( )(1-) + 18( ) =

$G_m = \frac{M_d}{28.96} = \frac{\quad}{28.96} =$, $G_s = \frac{M_s}{28.96} = \frac{\quad}{28.96} =$, $\frac{G_m}{G_s} = \frac{\quad}{\quad} =$

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SAMPLING TRAIN DATA

COMPANY: ARMCO - Houston
SOURCE DESIGNATION: WESP Inlet
REGULATING AUTHORITY: U.S. EPA
DATE: 10-5-79
TEST NUMBER: BSO-3
Field Person(s): RMK, DJO
Filter Number: A-221-17
Barometric Pressure ("Hg): 29.72
Stack Static Pressure ("H_2O): -4.5
Stack Dimensions: 75.5 x 75
Ambient Temperature (°F): 75
Record all Data Every 3 Minutes

Nozzle (Dia-in): 3/16 (Avg):
Pitot Tube No. 18, Corr. Factor: 0.833
Meter Box No. 2, Corr. Factor: 1.002
Meter Isokinetic Factor:
Assumed Moisture (%): 1.1
Condensate Volume (ml):
Silica Gel Weight Gain (g):
Actual Moisture (%):
Leak Rate: Initial: 0.018 CFM at 15 "Hg; Final: CFM at "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O) 5	Stack Temp (°F) 4	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp. (°F) 1 Inlet	Dry Gas Meter: Temp. (°F) 2 Outlet	Orifice Pressure Differential ("H2O)	Filter Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
A-1	0	16:53	0.95	110	673.005	90	90	1.31	70	70	—
-2	3	17:00	1.90	110	674.8	86	86	2.60	65	60	1
-3	6	17:03	2.0	110	77.4	88	88	2.75	60	50	2
-4	9	17:06	2.0	110	80.2	92	88	2.76	60	50	2
-5	12	:15	2.0	110	82.8	96	90	2.76	60	55	2
-6	15	:18	1.8	115		98	90	2.48			2
-7	18	:21	1.7	110	88.1	100	90	2.36	60	60	2
-8	21	:24	1.6	110	90.6	102	92	2.24	65	60	2
-9	24	:32	1.8	115	93.1	100	92	2.49	60	60	2
-10	27	:35	1.8	115	95.7	102	94	2.50			
-11	30	:41	1.8	110	98.4	98	94	2.51	60	60	2
	33	:44			700.855						
AVERAGE (TOTAL)					( )	1052	997	20.76			

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SAMPLING TRAIN DATA

COMPANY: ARMCO - HOUSTON
SOURCE DESIGNATION: ~~[illegible]~~ WESP INLET
REGULATING AUTHORITY: US. EPA
DATE: 10-5-79
TEST NUMBER: BSO-3
Field Person(s): RMK, DJO
Filter Number: A-221-17
Barometric Pressure ("Hg): 29.72
Stack Static Pressure ("H_2O): -4.5
Stack Dimensions:
Ambient Temperature (°F): 70°
Record all Data Every 3 Minutes

Nozzle (Dia-in): ___ ___ ___ (Avg): .1875
Pitot Tube No. 18, Corr. Factor:
Meter Box No. 2, Corr. Factor:
Meter Isokinetic Factor:
Assumed Moisture (%): 1.1
Condensate Volume (ml):
Silica Gel Weight Gain (g):
Actual Moisture (%):
Leak Rate: Initial: ___ CFM at ___ "Hg; Final: ___ CFM at ___ "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O)	Stack Temp (°F)	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter Temp. (°F): Inlet	Dry Gas Meter Temp. (°F): Outlet	Orifice Pressure Differential ("H_2O)	Filter [redacted] Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
B-1	0	17:52	0.28	110	701.855	95	92	0.39			
-2	3	17:55 :57-:01	1.6	110	02.1	96	95	2.23	65	65	1
-3	6	18:03	2.2	110	04.6	96	96	3.07	60	60	1
-4	9	18:06	2.2	110	07.4	100	96	3.08	60	55	2
-5	12	:09 :10-:13	2.2	110	10.3	104	96	3.10	65	55	2
-6	15	:15 :17-:23	2.1	115	13.2	105	98	2.93	60	65	2
-7	18	:24	2.2	115	16.0	100	88	3.03	60	55	2
-8	21	:27 :28-:32	2.2	115	18.9	102	96	3.06	60	50	2
-9	24	:33	2.3	115	21.6	100	96	3.20	60	50	2
-10	27	:36 :38-:44	2.2	110	24.6	102	98	3.09			
-11	30	:45	2.1	110	27.5	100	96	2.94	55	50	2
	33				730.251						
AVERAGE (TOTAL)					( )	2152	2041	56.85			

1.43 $\frac{Tm}{Ts}$ Δ

SAMPLING TRAIN DATA

COMPANY: ARMCO - HOUSTON
SOURCE DESIGNATION: WESP INLET
REGULATING AUTHORITY: US EPA
DATE: 10-5-79
TEST NUMBER: BSO-3
Field Person(s): RMK DJO
Filter Number: A-221-17
Barometric Pressure ("Hg):
Stack Static Pressure ("H_2O): -4.5
Stack Dimensions: 75.5 X 75
Ambient Temperature (°F): 70
Record all Data Every 3 Minutes

Nozzle (Dia-in): ___ ___ ___ (Avg): ___
Pitot Tube No. 18, Corr. Factor: ___
Meter Box No. 2, Corr. Factor: ___
Meter Isokinetic Factor: ___
Assumed Moisture (%): ___
Condensate Volume (ml): ___
Silica Gel Weight Gain (g): ___
Actual Moisture (%): ___
Leak Rate: Initial: ___ CFM at ___ "Hg; Final: ___ CFM at ___ "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O)	Stack Temp (°F)	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp. (°F) Inlet	Dry Gas Meter: Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
C-1	0	18:56	0.25	100	730.371	94	94	0.35			
C-2	3	:59	1.7	100	31.4	94	94	2.40	60	50	2
C-3	6	19:02	2.4	100	34.0	98	96	3.41			
C-4	9	:05	2.3	100	36.9	102	96	3.28	55	50	2
-5	12	:08	2.3	~~100~~ 100	40.0	~~100~~ 106	~~96~~ 96	3.29			2
-6	15	:11	2.3	100	42.9	108	96	3.30	55	55	2
-7	18	:14	2.3	100	45.9	108	96	3.30			
-8	21	:17 :18	~~2.3~~	~~100~~	49.2	~~108~~ 108	~~96~~ 96	~~3.30~~			
outlet down	21:40		2.3	107	749.502	94.7	90.7	3.21			
	21:40	20:00	~~2.3~~	~~110~~	49.5	88	88	~~3.16~~	55	60	2
-9	24	20:03	2.3	110	51.7	88	88	3.16			
-10	27	:06	2.4	110	54.6	90	90	3.31	55	55	2
-11	30	:09	2.2	105	57.6	92	90	3.07			
	33	:12			760.438						
AVERAGE (TOTAL)					( )	22' 3326	3060 3161	88.93			

SAMPLING TRAIN DATA

COMPANY: ARMCO - HOUSTON
SOURCE DESIGNATION: WESP INLET
REGULATING AUTHORITY: U.S. EPA
DATE: 10-5-79
TEST NUMBER: BX0 - 3
Field Person(s): RMK - DJ
Filter Number:
Barometric Pressure ("Hg):
Stack Static Pressure ("H_2O): -4.5
Stack Dimensions: 75.5X75
Ambient Temperature (°F): 65
Record all Data Every 3 Minutes

Nozzle(Dia-in): ___ ___ ___ (Avg): ___
Pitot Tube No. ___, Corr.Factor: ___
Meter Box No. ___, Corr.Factor: ___
Meter Isokinetic Factor:
Assumed Moisture (%):
Condensate Volume(ml): 9
Silica Gel Weight Gain(g): 32.3
Actual Moisture (%):
Leak Rate } Initial: 0.018 CFM at 15 "Hg
Final: <0.010 CFM at 6 "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O) 5.	Stack Temp (°F) 4	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp. (°F) 1 Inlet	Dry Gas Meter: Temp. (°F) 2 Outlet	Orifice Pressure Differential ("H2O)	Filter Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
0+1	0	20:27	1.3	100	760.526	86	86	1.81	55	55	1
-2	3	:30	1.9	100	62.7	88	88	2.66			
-3	6	:33	2.1	105	65.3	92	88	2.92			
-4	9	:36 :40-:45	2.3	105		96	88	3.21	55	55	2
-5	12	:46	2.4	105	71.1	90	88	3.33			
-6	15	:49 :52-:56	2.3	105	74.1	96	90	3.22	55	55	2
-7	18	:57	2.3	110	77.0	92	90	3.18			
-8	21	21:00 :03-:08	2.3	110	79.8	96	90	3.19	55	55	2
-9	24	:10	2.2	105	82.7	94	90	3.07			
-10	27	:13	2.1	105	85.5	96	90	2.94	55	55	2
-11	30	:20 :16-:20	2.0	100	88.3	98	90	2.76			
	33	21:23			790.963						
AVERAGE (TOTAL)				107.9	(116.984)	96.5	91.9	2.76			

DRY MOLECULAR WEIGHT DETERMINATION (M_d)

Plant: Armco Steel
Date:
Sampling Time (24-hour Clock):
Sampling Location::

Sample Type (bag, integrated, continuous)
Analytical Method:
Ambient Temperature:
Operator:

Comments:

Gas \ Run	1		2		3		Average Net Volume	Multiplier	Molecular Weight Of Stack Gas (dry basis) M_d, lb/lb-mole
	Actual Reading	Net	Actual Reading	Net	Actual Reading	Net			
CO_2	0		0		0		0	44/100	
O_2 (Net is actual O_2 reading minus actual CO_2 reading)	19.6		19.4		19.6		19.5	32/100	
CO (net is actual CO reading minus actual O_2 reading)	0		0		0			28/100	
N_2 (Net is 100 minus actual CO reading)							80.5	28/100	
								Total	$= M_d$

WET MOLECULAR WEIGHT DETERMINATION (M_s)

B_{wo} = Proportion by volume of water vapor in the gas stream

M_s = Molecular weight of stack gas (wet basis), lb/lb-mole = $M_d(1-B_{wo}) + 18(B_{wo})$

M_s = ( )(1-) + 18( ) =

$G_m = \frac{M_d}{28.96} = \frac{\quad}{28.96} =$, $G_s = \frac{M_s}{28.96} = \frac{\quad}{28.96} =$, $\frac{G_m}{G_s} = \frac{\quad}{\quad} =$

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SAMPLING TRAIN DATA

$1.22 \frac{T_m}{T_s}$ #

COMPANY: Armco Steel
SOURCE DESIGNATION: [illegible]
REGULATING AUTHORITY:
DATE: 10/4/79
TEST NUMBER: P-1
Field Person(s): [illegible]
Filter Number: A-220-07
Barometric Pressure ("Hg): 25.8
Stack Static Pressure ("H_2O): [illegible]
Stack Dimensions: 95.5"
Ambient Temperature (°F): [illegible]
Record all Data Every 7 Minutes

Nozzle (Dia-in): ___ ___ ___ (Avg): 7/16
Pitot Tube No. 40, Corr. Factor: .836
Meter Box No. 2[illegible], Corr. Factor: 0.994
Meter Isokinetic Factor: 1564
Assumed Moisture (%): 4.3%
Condensate Volume (ml):
Silica Gel Weight Gain (g):
Actual Moisture (%):
Leak Rate } Initial: 4.01 CFM at 15 "Hg
Final: ___ CFM at ___ "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O)	Stack Temp (°F)	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp. (°F) Inlet	Dry Gas Meter: Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
5	0	14:00	.45	79	309.1[illegible]	84	84	.55	67		
2	7	[illegible]	.60	79		86	86	[illegible]	76		
3	14	14:[illegible]	.52	75	316.5	90	88	1.02	74		
4	[illegible]	[illegible]	.88	79		92	90	1.13			
5	28	14:49	1.0	77	325.4	94	92	1.26		67	0
6	35	15:06	.98	77	330.0	98	92	1.24	72		
7	42	15:13	.99	77	334.5	100	94	1.25	71		
8	49	15:20	1.1	78	339.1	100	94	1.39	72	66	
9	56	15:27	1.1	79	343.9	100	94	1.39			
10	63	15:34	.95	79	348.8	100	96	1.20			
	70				353.319						
				79.6			95.3*	1.15*			
AVERAGE (TOTAL)					( )						

* Down

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1.22 $\frac{T_m}{T_s}$ H

SAMPLING TRAIN DATA

COMPANY: Armco
SOURCE DESIGNATION: Outlet
REGULATING AUTHORITY:
DATE: 10/6/79
TEST NUMBER: P-1
Field Person(s): [illegible]
Filter Number: A-220-07
Barometric Pressure ("Hg): 29.9
Stack Static Pressure ("H_2O):
Stack Dimensions:
Ambient Temperature (°F):
Record all Data Every _____ Minutes

Nozzle (Dia-in): ___ ___ ___ (Avg): ___
Pitot Tube No. ___, Corr. Factor: ___
Meter Box No. ___, Corr. Factor: ___
Meter Isokinetic Factor:
Assumed Moisture (%):
Condensate Volume (ml): 324 ml + 4 ml
Silica Gel Weight Gain (g): 16.5 g
Actual Moisture (%):
Leak Rate: Initial: ___ CFM at ___ "Hg; Final: ___ CFM at ___ "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O)	Stack Temp (°F)	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter Temp. (°F): Inlet	Dry Gas Meter Temp. (°F): Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
E 1	0	16:24	.57	79	353.521	86	86	.71	80		
2	7	17:08	.78	80		90	90	.97	83		
3	14	17:15	1.0	81	361.4	96	92	1.25	85	66	
4	21	17:28	1.1	82	366.6	102	94	1.35	86		
5	28	17:35	1.1	83	371.1	104	98	1.39		65	
6	35	17:42	1.0	84	375.9	104	98	1.26	88	64	
7	42	17:49	1.1	84	380.7	104	98	1.38			
8	49	18:00	1.0	85	385.8	104	100	1.26	88		
9	56	18:07	.97	80	390.4	106	100	1.23	86	62	
10	63	18:14	.81	80	395.1	104	100	1.03	85	63	
					399.434						
					89.579						
AVERAGE (TOTAL)				79.6	(89.579)	97.3	95.3	1.15			

DRY MOLECULAR WEIGHT DETERMINATION (M_d)

Plant: ARMCO Steel
Date: 10/4/79
Sampling Time (24-hour Clock): P-1
Sampling Location:: outlet

Sample Type (~~bag~~, integrated, continuous)
Analytical Method: ORSAT
Ambient Temperature: RM
Operator: BCB

Comments:

Gas \ Run	1 Actual Reading	1 Net	2 Actual Reading	2 Net	3 Actual Reading	3 Net	Average Net Volume	Multiplier	Molecular Weight Of Stack Gas (dry basis) M_d, lb/lb-mole
CO_2	0	0	0	0	0	0	0	44/100	
O_2 (Net is actual O_2 reading minus actual CO_2 reading)	19.6	19.6	19.2	19.2	19.6	19.6	19.5	32/100	6.24
CO (net is actual CO reading minus actual O_2 reading)	0	0	0	0	0	0		28/100	
N_2 (Net is 100 minus actual CO reading)							80.5	28/100	
								Total	28.78 = M_d

WET MOLECULAR WEIGHT DETERMINATION (M_s)

B_{wo} = Proportion by volume of water vapor in the gas stream

M_s = Molecular weight of stack gas (wet basis), lb/lb-mole = $M_d(1-B_{wo}) + 18(B_{wo})$

M_s = ( )(1-) + 18( ) =

$G_m = \frac{M_d}{28.96} = \frac{\quad}{28.96} =$, $G_s = \frac{M_s}{28.96} = \frac{\quad}{28.96} =$, $\frac{G_m}{G_s} = \frac{\quad}{\quad} =$

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$1.28 \frac{m}{T_s} H$

SAMPLING TRAIN DATA

COMPANY: Armco Steel
SOURCE DESIGNATION: outlet
REGULATING AUTHORITY: U.S. EPA.
DATE: 10/5/79
TEST NUMBER: P-2
Field Person(s):
Filter Number:
Barometric Pressure ("Hg): 29.72
Stack Static Pressure ("H_2O): -.35
Stack Dimensions: 95.5
Ambient Temperature (°F): 65
Record all Data Every 7 Minutes

Nozzle (Dia-in): ___ ___ ___ (Avg): .1875
Pitot Tube No. 40, Corr. Factor: .836
Meter Box No. Rec 3, Corr. Factor: 0.994
Meter Isokinetic Factor: 1564
Assumed Moisture (%): 1.6%
Condensate Volume (ml):
Silica Gel Weight Gain (g):
Actual Moisture (%):
Leak Rate: Initial: 0.006 CFM at 15 "Hg; Final: ___ CFM at ___ "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O)	Stack Temp (°F)	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp. (°F) Inlet	Dry Gas Meter: Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
1	0	9:49	.57	73	400.118	72	72	.73	71		0
2	7	10:01	.78	72	403.70	78	76	1.0	78	64	
3	14	10:08	.96	75	407.7	80	76	1.24			
4	21	10:15	1.1	75	412.2	84	78	1.42	83	61	
5	28	10:26	.99	78	416.95	86	86	1.28			
6	35	10:42	.97	76	421.5	84	82	1.26	79		
7	42	10:54	.92	74	426.0	86	82	1.20			
8	49	11:03	.92	72	430.4	88	84	1.21	78	67	
9	56	11:10	.94	76	435.0	88	84	1.23	80		
10	63	11:17	.74	80	439.4	88	84	.96			
	70				443.370						
AVERAGE (TOTAL)					( )						

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SAMPLING TRAIN DATA

COMPANY: Armco Steel
SOURCE DESIGNATION: outlet
REGULATING AUTHORITY: _____
DATE: 10/5/79
TEST NUMBER: P-2
Field Person(s): _____
Filter Number: _____
Barometric Pressure ("Hg): 29.72
Stack Static Pressure ("H_2O): _____
Stack Dimensions: _____
Ambient Temperature (°F): _____
Record all Data Every _____ Minutes

Nozzle (Dia-in): ___ ___ ___ (Avg): ___
Pitot Tube No. ___, Corr. Factor: ___
Meter Box No. ___, Corr. Factor: ___
Meter Isokinetic Factor: ___
Assumed Moisture (%): ___
Condensate Volume (ml): ~~15~~ ~~22~~ 30
Silica Gel Weight Gain (g): 16.5
Actual Moisture (%): ___
Leak Rate } Initial: 2.01 CFM at 15 "Hg
Leak Rate } Final: 0 CFM at 15 "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O)	Stack Temp (°F)	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp. (°F) Inlet	Dry Gas Meter: Temp. (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
1	0	11:48	.37	85	443.579	82	82	.47	84		
2	7	11:55	.65	83	446.5	84	82	.83	82		
3	14	12:02	.76	80	449.	88	82	.98	80		
4	21	12:13	.85	76	454.1	88	84	1.11	76		
5	28	12:20	.95	74	458.3	92	86	1.25	71	69	
6	35	12:34	1.1	76	462.8	94	88	1.45			
7	42	12:52	.95	80	467.6	100	92	1.25	82		
8	49	13:10	.98	79	472.2	94	92	1.29	83		
9	56	13:22	.95	80	476.8	100	94	1.25			
10	63	13:34	.78	81	481.20	100	98	1.03	81		
	70				485.282						
AVERAGE (TOTAL)				77.3	34.445	87.8	84.8	1.12			

DRY MOLECULAR WEIGHT DETERMINATION (M_d)

Plant: Amoco
Date: 10/5/[illegible]
Sampling Time (24-hour Clock): [illegible]
Sampling Location:: outlet

Sample Type (bag, integrated, continuous) _____
Analytical Method: _____
Ambient Temperature: _____
Operator: _____

Comments:

Gas \ Run	1		2		3		Average Net Volume	Multiplier	Molecular Weight Of Stack Gas (dry basis) M_d, lb/lb-mole
	Actual Reading	Net	Actual Reading	Net	Actual Reading	Net			
CO_2	0		0		0		0	44/100	
O_2 (Net is actual O_2 reading minus actual CO_2 reading)	19.6		19.6		19.6		19.6	32/100	
CO (net is actual CO reading minus actual O_2 reading)	0		0		0		0	28/100	
N_2 (Net is 100 minus actual CO reading)							80.4	28/100	
								Total	= M_d

WET MOLECULAR WEIGHT DETERMINATION (M_s)

B_{wo} = Proportion by volume of water vapor in the gas stream

M_s = Molecular weight of stack gas (wet basis), lb/lb-mole = $M_d(1-B_{wo}) + 18(B_{wo})$

M_s = ( )(1-) + 18( ) =

$G_m = \frac{M_d}{28.96} = \frac{\quad}{28.96} =$, $G_s = \frac{M_s}{28.96} = \frac{\quad}{28.96} =$, $\frac{G_m}{G_s} = \frac{\quad}{\quad} =$

Clayton Environmental Consultants, Inc.

SAMPLING TRAIN DATA

Company: Aemco Steel
Source Designation: outlet
Date: 10/5/79
Test Number: P-3
Field Person: BCB TJP
Filter Number: A-221-12
Barometric Pressure ("Hg): 24.72
Stack Static Pressure ("H_2O): -.35
Stack Dimensions: 95.5
Plume Appearance:
Ambient Temperature (°F):
Record all Data Every 7 Minutes

Filter Heater Setting:
Probe Heater Setting:
Nozzle Number: ____, Dia. (in.): .1875
Pitot Tube No. 40, Corr. Factor: .836
Meter Box No. 263, Corr. Factor: 0.99
Meter Isokinetic Factor: 1.564
Assumed Moisture (%): 1.6%
Condensate Volume (ml):
Silica Gel Weight Gain (g):
Leak Rate 2.01 CFM at 15 "Hg

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O)	Stack Temp (°F)	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp (°F) Inlet	Dry Gas Meter: Temp (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter ~~Box~~ Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
S 1	0	16:53	[illegible]	73	486.382	84	84	.51	73		0
2	7	17:05	.84	73	489.4	88	88	.84	79		
3	14	17:13	[illegible]	67	493.0	90	94	.97	79		
4	21	[illegible]	.80	75	497.0	98	92	1.06			
5	28	17:31	.84	74	501.1	94	92	1.11	8[illegible]		
6	35	17:42	.88	73	505.4	96	92	1.17			
7	42	17:54	.88	73	509.8	94	94	1.17	80	64	
8	49	18:05	.92	71	514.1	96	94	1.23	80		
9	56	18:12	.89	74	518.7	100	94	1.19			
10	63	18:24	.96	71	523.1	100	94	1.01			
	70				527.058						
AVERAGE (TOTAL)					( )						

7:01 × 23 1 22 × 35 1 40 × 46 1 51 × 57 × 18:17 1 22 × 32

Clayton Environmental Consultants, Inc.

SAMPLING TRAIN DATA

Company: Armco Steel
Source Designation: Outlet
Date: 10/5/79
Test Number: P.3
Field Person: BRB TJP
Filter Number: 221-25
Barometric Pressure ("Hg):
Stack Static Pressure ("H_2O):
Stack Dimensions:
Potentiometer No.
Ambient Temperature (°F):
Record all Data Every _____ Minutes

Filter Heater Setting:
Probe Heater Setting:
Nozzle Number: ____, Dia. (in.):
Pitot Tube No. ____, Corr. Factor:
Meter Box No. ____, Corr. Factor:
Meter Isokinetic Factor:
Assumed Moisture (%):
Condensate Volume (ml): 22
Silica Gel Weight Gain (g): 19
Leak Rate .02 CFM at 15 "H

Traverse Point No.	Time: Sampling (min)	Time: Clock	Velocity Pressure ("H_2O)	Stack Temp (°F)	Dry Gas Meter: Volume (ft^3)	Dry Gas Meter: Temp (°F) Inlet	Dry Gas Meter: Temp (°F) Outlet	Orifice Pressure Differential ("H_2O)	Filter Box Temp (°F)	Last Imp. Gas Temp (°F)	Sampling Train Static Pressure ("Hg)
E1	0	19:24	.56	64	527.259	82	82	.74	79		
2	7	19:45	.76	67	—	86	82	1.01	79	62	
3	14	19:56	.94	[illegible]	534.5	86	84	1.26			
4	21	20:03	.9[illegible]	67	537.3	86	84	1.30		62	
5	28	20:1[illegible]	.99	63	548.[illegible]	89	84	1.32	78		
6	35	20:25	.89	[illegible]	542.4	90	84	1.19			
7	42	20:32	.92	[illegible]	552.7	88	84	1.23	77	62	
8	49	20:39	.98	[illegible]	557.2	88	86	1.32	76		
9	56	20:5[illegible]	.98	56	561.7	88	86	1.32	75		
10	63	21:01	[illegible]	51	566.3	84	84	1.3[illegible]			
	70				571.001						
AVERAGE (TOTAL)				66.9	(83.911)	90.3	87.9	1.12			

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DRY MOLECULAR WEIGHT DETERMINATION (M_d)

Plant: [illegible]
Date: [illegible]
Sampling Time (24-hour Clock): [illegible]
Sampling Location:: Outlet

Sample Type (bag, integrated, continuous) _____
Analytical Method: _____
Ambient Temperature: _____
Operator: _____

Comments:

Gas \ Run	1		2		3		Average Net Volume	Multiplier	Molecular Weight Of Stack Gas (dry basis) M_d, lb/lb-mole
	Actual Reading	Net	Actual Reading	Net	Actual Reading	Net			
CO_2	0		0		0		0	44/100	
O_2 (Net is actual O_2 reading minus actual CO_2 reading)	19.8		19.8		19.8		19.8	32/100	
CO (net is actual CO reading minus actual O_2 reading)	0		0		0			28/100	
N_2 (Net is 100 minus actual CO reading)							80.2	28/100	
								Total	= M_d

WET MOLECULAR WEIGHT DETERMINATION (M_s)

B_{wo} = Proportion by volume of water vapor in the gas stream

M_s = Molecular weight of stack gas (wet basis), lb/lb-mole = $M_d(1-B_{wo}) + 18(B_{wo})$

M_s = ( )(1-) + 18( ) =

$G_m = \frac{M_d}{28.96} = \frac{\quad}{28.96} =$, $G_s = \frac{M_s}{28.96} = \frac{\quad}{28.96} =$, $\frac{G_m}{G_s} = \frac{\quad}{\quad} =$

Clayton Environmental Consultants, Inc.

APPENDIX B-2.

SAMPLING SUMMARY DATA

SAMPLING SUMMARY SHEET

Plant Armco Steel, Houston, Texas Location Inlet

Sampled Source Wet Electrostatic Precipitator

Run	Date	N_p	P_m	P_b	V_m	T_m	$V_{m_{std}}$	V_w	$V_{w_{gas}}$	%M	M_d
1	10-4-79	44	2.78	29.81	118.824	100.4	112.3	10.8	0.509	0.451	0.995
2	10-5-79	44	2.83	29.72	119.518	103.3	112.1	30.5	1.44	1.27	0.987
3	10-5-79	44	2.76	29.72	116.984	94.2	111.5	41.3	1.95	1.72	0.983

Run	MW_d	MW	P_{st}	P_s	C_p	$\sqrt{\Delta P_s X (T_s+460)}^{c}$	V_s	T_s	T_t	D_n	%I
1	28.78	28.73	-0.33	29.48	0.833	32.74	4799	95.0	132	0.1875	98.4
2	28.77	28.64	-0.33	29.39	0.833	33.15	4874	105.3	132	0.1875	99.6
3	28.78	28.60	-0.33	29.39	0.833	33.07	4866	107.9	132	0.1875	100.2

$$V_{m_{std}} = \frac{17.65 \times V_m \left(P_b + \frac{P_m}{13.6}\right)}{(T_m + 460)}$$

$$V_{w_{gas}} = 0.0471 \times V_w$$

$$MW_d = (\%CO_2 \times \tfrac{44}{100}) + (\%O_2 \times \tfrac{32}{100}) + (\%CO + \%N_2) \times \tfrac{28}{100}$$

$$MW = MW_d \times M_d + 18\,(1 - M_d)$$

$$P_s = P_b \pm P_{st}$$

$$V_s = 5120.8 \times Cp \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{1{,}032 \times (T_s + 460) \times V_{m_{std}}}{V_s \times T_t \times P_s \times M_d \times (D_n)^2}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}}$$

$$M_d = \frac{100 - \%M}{100}$$

N_p Total No. of Sampling Points

P_m Average Orifice Pressure Drop, in. H_2O

P_b Barometric Pressure, in. Hg. Absolute

V_m Volume of Dry Gas at Meter Conditions, DCF

T_m Average Meter Temperature, °F

$V_{m_{std}}$ Volume of Dry Gas at STP, DSCF[a]

V_w Total H_2O Collected in Impingers and Silica Gel, ml

$V_{w_{gas}}$ Volume of Water Vapor Collected at STP, SCF[b]

%M % Moisture by Volume

M_d Mole Fraction of Dry Gas

$\%CO_2$ Volume % Dry

$\%O_2$ Volume % Dry

%CO Volume % Dry

$\%N_2$ Volume % Dry

MW_d Molecular Weight of Stack Gas, Dry Basis

MW Molecular Weight of Stack Gas, Wet Basis

P_{st} Static Pressure of Stack Gas, in. Hg

P_s Stack Gas Pressure, in. Hg Absolute

C_p Pitot Tube Coefficient

V_s Stack Gas Velocity at Stack Conditions, fps.

T_s Average Stack Temperature °F

T_t Net Time of Test, Min.

D_n Sampling Nozzle Diameter, i

%I Percent Isokinetic

[a] Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b] Standard conditions at 68°F, 29.92 in. Hg.

[c] $\sqrt{\Delta P_s \times (T_s + 460)}$ is determined by averaging the square root of the product of the velocity head (ΔP_s) and the absolute

SAMPLING SUMMARY SHEET

Plant Armco Steel, Houston, Texas Location Outlet

Sampled Source Wet Electrostatic Precipitator

Run	Date	N_p	P_m	P_b	V_m	T_m	$V_{m_{std}}$	V_w	$V_{w_{gas}}$	%M	M_d
1	10-4-79	20	1.15	29.81	89.579	95.3	85.12	44.5	2.096	2.40	0.976
2	10-5-79	20	1.12	29.72	84.445	86.0	81.35	46.5	2.190	2.62	0.974
3	10-5-79	20	1.12	29.72	83.911	89.1	80.38	41.0	1.931	2.35	0.977

Run	MW_d	MW	P_{st}	P_s	C_p	$\sqrt{\Delta P_s X (T_s+460)}$ [c]	V_s	T_s	T_t	D_n	%I
1	28.78	28.52	-0.026	29.78	0.836	22.09	3245	79.6	140	0.1875	102.1
2	28.78	28.50	-0.026	29.69	0.836	21.38	3146	77.3	140	0.1875	100.7
3	28.79	28.54	-0.026	29.69	0.836	20.87	3069	66.9	140	0.1875	99.8

$$V_{m_{std}} = \frac{17.65 \times V_m \left(P_b + \frac{P_m}{13.6}\right)}{(T_m + 460)}$$

$$\% M = \frac{100 \times V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}}$$

$$V_{w_{gas}} = 0.0471 \times V_w$$

$$M_d = \frac{100 - \% M}{100}$$

$$MW_d = (\% CO_2 \times \tfrac{44}{100}) + (\% O_2 \times \tfrac{32}{100}) + (\% CO + \% N_2) \times \tfrac{28}{100}$$

$$MW = MW_d \times M_d + 18 (1 - M_d)$$

$$P_s = P_b \pm P_{st}$$

$$V_s = 5120.8 \times Cp \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\% I = \frac{1{,}032 \times (T_s + 460) \times V_{m_{std}}}{\ldots}$$

N_p Total No. of Sampling Points

P_m Average Orifice Pressure Drop, in. H_2O

P_b Barometric Pressure, in. Hg. Absolute

V_m Volume of Dry Gas at Meter Conditions, DCF

T_m Average Meter Temperature, °F

$V_{m_{std}}$ Volume of Dry Gas at STP, DSCF[a]

V_w Total H_2O Collected in Impingers and Silica Gel, ml

$V_{w_{gas}}$ Volume of Water Vapor Collected at STP, SCF[b]

% M Moisture by Volume

M_d Mole Fraction of Dry Gas

% CO_2 Volume % Dry

% O_2 Volume % Dry

% CO Volume % Dry

% N_2 Volume % Dry

MW_d Molecular Weight of Stack Gas, Dry Basis

MW Molecular Weight of Stack Gas, Wet Basis

P_{st} Static Pressure of Stack Gas, in. Hg

P_s Stack Gas Pressure, in. Hg Absolute

C_p Pitot Tube Coefficient

V_s Stack Gas Velocity at St Conditions, fpm.

T_s Average Stack Temperatur °F

T_t Net Time of Test, Min.

D_n Sampling Nozzle Diameter

% I Percent Isokinetic

[a] Dry standard cubic feet at 68°F, 29.92 in. Hg.

[b] Standard conditions at 68°F, 29.92 in. Hg.

[c] $\sqrt{\ldots \times (\ldots + 460)}$ is determined by averaging the square root of the

TABLE B-2.1. STACK GAS CONDITIONS

Sampling Location	Sample Number	1979 Date	Temperature		Flowrate			
			F	C	dscfm	acfm	$\frac{dsm^3}{min}$	$\frac{am^3}{min}$
Inlet	1	10-4	95.0	35.0	176,000	189,000	4980	5340
	2	10-5	105	40.6	174,000	192,000	4920	5430
	3	10-5	108	42.2	172,000	191,000	4860	5420
Average			103	39.3	174,000	191,000	4920	5400
Outlet	1	10-4	79.6	26.4	153,000	161,000	4340	4570
	2	10-5	77.3	25.2	149,000	156,000	4210	4430
	3	10-5	66.9	19.4	148,000	153,000	4200	4320
Average			74.6	23.7	150,000	157,000	4250	4440

TABLE B-2.2 EXHAUST GAS COMPOSITION

Sampling Location	Sample Number	Exhaust Gas Composition (Percent Dry Basis)				Moisture, Percent
		Carbon Dioxide	Oxygen	Carbon Monoxide	Nitrogen and Inerts	
Inlet	1	<0.1	19.5	0.1	80.4	0.451
	2	<0.1	19.3	<0.1	80.7	1.27
	3	<0.1	19.5	<0.1	80.5	1.71
Average		<0.1	19.4	0.1	80.5	1.14
Outlet	1	<0.1	19.5	<0.1	80.5	2.40
	2	<0.1	19.6	<0.1	80.4	2.62
	3	<0.1	19.8	<0.1	80.2	2.35
Average		<0.1	19.6	<0.1	80.4	2.46

APPENDIX B-3.

VISIBLE EMISSION DATA SHEETS

SUMMARY
RECORD OF VISIBLE EMISSIONS

1328

Type of Plant Coke Battery Date 10-4-79

Company Name Armco Steel Hours of Observation

Plant Address Houston Texas Observer Opthoff.

Type of Discharge STACK OTHER WESP

Discharge Location Outlet to WESP

Height of Point of Discharge

Run 1

0925

Observer's Location:

Distance to Discharge Point

Height of Observation Point ground

Direction from Discharge Point

Background Description Sky

Weather: Clear Overcast Partly Cloudy Other Color

Wind Direction Wind Velocity 5-10 mi/hr

Plume Description:

Detached: Yes No

Color: Black White Other

Plume Dispersion Behavior: Looping Coning Fanning

Lofting Fumigating Other

Estimated Distance Plume Visible

Summary of Observations:

Opacity	Aggregate Time @ Opacity		Opacity	Aggregate Time @ Opacity
0	min.	sec.	55	
5			60	
10			65	
15			70	
20			75	
25			80	
30			85	
35			90	
40			95	
45			100	
50				

RECORD OF VISIBLE EMISSIONS

Company Name: Armco Steel
Date: 10-4-79
Plant Address: Houston Texas
Observer: Opthoff
Stack Location: Outlet ESP
Observer's Location: 100 yds W
Weather Conditions: Blue 5-10 SW

	HR	MIN	00	15	30	45	COMMENTS		
1332		00	0	5	5	10		Run 1	
		01	10	5	5	0			
		02	0	0	0	0			
		03	0	5	0	0			
		04	0	0	0	0			
37		05	0	0	0	0		45	1.9
38		06	0	0	0	0	push start		
		07	0	0	0	0			
		08	5	5	0	0			
		09	0	0	0	0			
		10	0	0	5	0			
43		11	5	0	0	0		20	0.8
44		12	0	5	5	5			
		13	0	0	0	0			
		14	5	0	5	0			
		15	0	0	0	0			
		16	0	5	0	0			
49		17	5	5	0	5		45	1.9
50		18	5	0	0	0			
		19	0	0	0	0			
		20	0	0	0	0			
		21	0	0	0	0			
		22	0	0	0	0			
55		23	0	5	0	0		10	0.4
56		24	0	0	0	0		44	201
		25	0	0	0	0		3	6
		26	0	0	0	0		132	120
		27	0	0	0	0		120	
		28	0	0	0	0		18	
1401		29	0	0	0	0		0	0

RECORD OF VISIBLE EMISSIONS

Company Name: Armco

Date: 10-4-79

Plant Address:

Observer: Optloff

Stack Location:

Observer's Location:

Weather Conditions:

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS	
1402	30	0	0	0	0		
	31	0	5	0	0	Run 1	
	32	5	5	5	5		
	33	10	5	5	5		
	34	5	5	5	5		
07	35	5	5	0	0		
08	36	0	0	0	0	80	3.3
	37	0	0	0	0		
	38	0	0	0	0		
	39	0	0	0	0		
	40	0	0	0	0		
13	41	0	0	0	0		
14	42	5	5	5	5	0	0
	43	5	0	5	5		
	44	5	5	5	5		
	45	0	0	5	5		
	46	0	0	5	5		
19	47	0	0	0	0		
20	48	5	0	0	0	75	3.1
	49	0	0	0	0		
	50	0	0	0	0		
	51	0	0	0	0		
	52	0	0	0	0		
25	53	0	0	0	0		
26	54	0	0	0	0	5	0.2
	55	5	5	5	0		
	56	0	0	0	0		
	57	0	0	0	0		
	58	0	0	0	0		
1431	59	0	0	0	0	15	0.6

RECORD OF VISIBLE EMISSIONS

Company Name: Amoco
Date: 10-4-79
Plant Address:
Observer: Opthoff
Stack Location:
Observer's Location: "
Weather Conditions:

	TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS		
1432		00	0	0	0	0	P-1 page 3		
		01	0	0	0	0			
		02	0	0	0	0			
		03	0	0	0	0			
		04	0	0	0	0			
37		05	0	0	5	0	start push	5	0.2
38		06	0	0	0	0			
		07	5	10	10	10			
		08	5	5	0	0			
		09	0	0	0	0			
		10	0	0	0	5			
43		11	5	5	5	5		70	2.9
44		12	5	5	0	0			
		13	0	0	0	0			
		14	0	0	0	0			
		15	0	0	0	5	start push		
		16	5	5	0	5			
49		17	5	5	5	5		50	2.1
50		18	0	5	5	5			
		19	0	5	5	5			
		20	5	5	5	0			
		21	0	0	0	0			
		22	0	0	0	0			
55		23	0	0	0	0		45	1.9
56		24	0	0	0	0			
		25	0	0	0	0			
		26	0	0	0	0			
		27	0	0	0	0			
		28	0	0	0	0			
1501		29	0	0	0	0		0	0

RECORD OF VISIBLE EMISSIONS

Company Name: Amoco

Date: 10-4-79

Plant Address:

Observer: Opelhoff

Stack Location:

Observer's Location:

Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	
1502	30	0	0	0	0		
	31	0	0	0	0	Run 1	
	32	0	0	0	0		
	33	0	0	0	0		
	34	0	0	0	0		
07	35	0	0	0	0		
08	36	0	0	0	0	0	0
	37	0	0	0	0		
	38	0	0	0	0		
	39	0	0	0	0		
	40	0	0	0	0		
13	41	5	5	0	0		
14	42	0	0	0	0	10	0.4
	43	0	0	0	0		
	44	0	0	0	0		
	45	0	0	0	0		
	46	0	0	0	0		
19	47	0	0	0	0	moved in 50' closer to the	
20	48	0	0	5	5	stack 0	0
	49	5	5	5	5		
	50	5	0	0	0		
	51	0	0	0	0		
	52	0	0	5	5		
25	53	5	5	5	5	65	2.7
26	54	5	5	5	5		
	55	5	5	0	0		
	56	0	5	0	0		
	57	5	5	5	5		
	58	0	5	5	5		
31	59	5	5	5	0	85	3.5

RECORD OF VISIBLE EMISSIONS

Company Name: Arco
Date: 10-4-79
Plant Address:
Observer: Opthof
Stack Location:
Observer's Location:
Weather Conditions:

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
1532	00	0	0	0	5	Run-1
	01	5	5	5	5	
	02	5	5	0	0	a few puffs clouds are moving in now reducing the sharpness of the background
	03	0	0	0	0	
	04	0	0	0	0	
37	05	0	0	0	0	35 1.5
38	06	5	0	0	0	
	07	0	5	5	5	
	08	5	5	5	5	
	09	5	5	5	5	
	10	5	0	0	0	
43	11	0	0	5	5	pot change 75 3.1
44	12	5	5	5	5	
	13	5	5	5	5	
	14	5	5	5	5	
	15	5	0	0	0	
	16	5	5	5	5	
49	17	5	5	5	5	105 4.4
50	18	5	5	5	5	
	19	5	5	5	5	
	20	5	5	5	5	
	21	5	5	5	5	
	22	5	5	5	5	
55	23	5	5	5	5	120 5.0
56	24	5	5	5	5	
	25	5	5	5	5	
	26	5	0	0	0	
	27	0	20	30	30	
	28	30	25	25	15	
1601	29	5	5	0	0	230 9.6

RECORD OF VISIBLE EMISSIONS

Company Name: Armco

Date: 10-4-79

Plant Address:

Observer: Opthoff

Stack Location:

Observer's Location:

Weather Conditions:

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS	
1602	30	0	0	0	0		
	31	0	0	0	0	Run-1	
	32	5	0	0	0		
	33	0	5	5	5		
	34	5	5	5	5		
1607	35	5	5	5	5		
1608	36	0	0	0	5	60	2.5
	37	5	5	5	0		
	38	5	5	5	5		
	39	5	5	5	0		
	40	0	0	0	10	push	
1613	41	10	5	5	5		
1614	42	0	0	0	5	90	3.8
	43	0	0	0	5		
	44	5	5	5	5		
	45	0	0	0	0		
	46	0	0	5	0		
19	47	5	5	0	0		
20	48	0	0	0	0	45	1.9
	49	0	0	0	0		
	50	0	5	5	5		
	51	0	0	0	0		
	52	0	0	0	0		
25	53	0	0	5	5		
26	54	5	5	5	5	25	1.0
	55	5	5	5	5		
	56	0	0	5	0	purging	
	57	5	5	0	0		
	58	5	5	5	5		
31	59	5	5	5	5	95	4.0

RECORD OF VISIBLE EMISSIONS

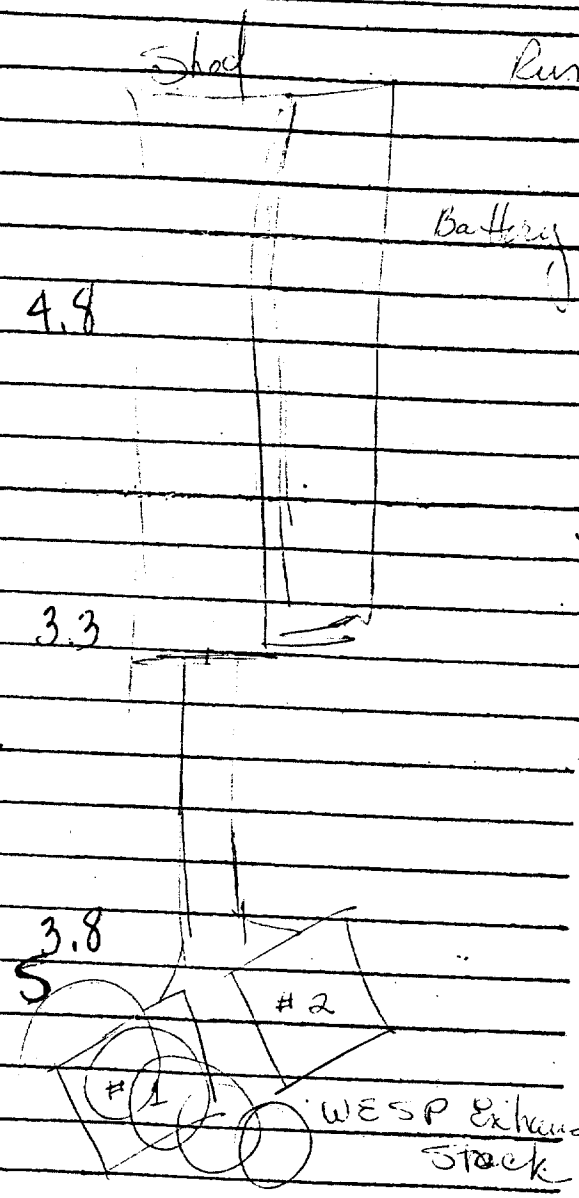
Company Name: Armco
Date: 10-4-79
Plant Address:
Observer: Opthoff
Stack Location:
Observer's Location:
Weather Conditions:

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
1632	30	5	5	5	5	Run - 1
	31	5	5	5	0	
	32	0	0	0	0	
	33	0	0	5	0	
	34	0	0	0	5	
37	35	5	0	5	5	60 2.5
38	36	5	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	5	pushing
43	41	5	10	10	5	40 1.7
44	42	5	5	5	5	
	43	5	5	5	5	
	44	5	5	5	5	test stopped. Dan Bivens waved to me to stop 10 stopped
	45					
	46					
~~47~~	47					1644 – 1646 60 5.0
1705 ~~50~~	48	5	5	5	5	Restart
	49	5	5	5	5	
	50	5	5	5	5	
	51	5	5	5	5	
	52	0	5	5	5	115 4.8
1710 ~~53~~	53	5	5	5	5	sky growing darker due to
1711 ~~54~~	54	5	5	5	5	lowering sun
	55	5	5	5	5	
	56	5	5	5	5	
	57	5	5	5	5	
	58	5	5	5	5	
1711 ~~59~~	59	5	5	5	5	120 5.0

RECORD OF VISIBLE EMISSIONS

Company Name: Amoco
Date: 10-4-79
Plant Address:
Observer: Opthoff
Stack Location:
Observer's Location:
Weather Conditions:

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
1717	00	5	5	5	5	
	01	5	5	5	0	
	02	5	5	5	5	
	03	5	5	5	5	
	04	5	5	5	5	
22	05	5	5	5	5	115 4.8
23	06	5	5	5	5	
	07	5	5	5	5	
	08	5	0	0	0	
	09	0	0	0	5	
	10	0	5	5	0	
28	11	5	5	5	5	80 3.3
29	12	0	5	5	0	
	13	5	0	0	0	
	14	5	5	5	5	
	15	5	5	5	5	
	16	5	5	5	5	
34	17	5	5	5	0	90 3.8
35	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
40	23	0	0	0	0	0 0
41	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
1746	29	0	0	0	0	0 0



Day

* 1500

Location
Observer *

RECORD OF VISIBLE EMISSIONS

Company Name: Amoco
Date: 10-4-79
Plant Address:
Observer: Optkoff
Stack Location:
Observer's Location: 00
Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	
1747	30	0	0	0	0		Run 1
	31	0	0	0	0		
	32	0	0	0	0	smoking	
	33	0	0	0	5		
	34	5	5	5	5		
1752	35	5	0	0	0	30	1.3
1753	36	0	0	0	0		
	37	0	0	0	0		
	38	0	0	0	0		
	39	0	0	0	0		
	40	0	0	0	0		
1758	41	0	0	0	0	0	0
1759	42	0	0	0	0		
1800	43	0	0	0	0		
	44	0	0	0	5		
	45	5	5	5	5		
	46	5	5	5	5		
04	47	5	5	5	5	65	2.7
05	48	5	5	5	5		
	49	5	5	5	5		
	50	5	5	5	5		
	51	5	5	0	5		
	52	5	5	5	5		
10	53	5	5	5	5	115	4.8
11	54	5	5	5	5		
	55	5	0	0	0		
	56	0	0	0	0		
	57	0	0	0	0		
	58	0	0	0	0		
16	59	0	0	0	0	25	1.0

RECORD OF VISIBLE EMISSIONS

Company Name: Armco

Date: 10-4-79

Plant Address:

Observer: Optkoff

Stack Location:

Observer's Location:

Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	
1817	00	0	0	0	0		
	01	0	0	0	0	Run-1	
	02	0	0	0	5		
	03	5	0	0	0		
	04	0	0	0	0		
23	05	0	0	0	0	10	0.4
24	06	0	0	0	0		
	07	0	0	0	0		
	08	0	0	0	0		
	09	0	5	5	5		
	10	5	5	5	5		
18 29	11	5	5	5	5	55	23
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						
	26						
	27						
	28						
	29						

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant ~~[illegible]~~ Date 10-5-79

Company Name Armco Hours of Observation

Plant Address Observer Opthoff

Type of Discharge STACK OTHER

Discharge Location Run 2

Height of Point of Discharge 0925

Observer's Location:

Distance to Discharge Point /

Height of Observation Point

Direction from Discharge Point

Background Description

Weather: Clear Overcast Partly Cloudy Other Color

Wind Direction Wind Velocity mi/hr

Plume Description:

Detached: Yes No

Color: Black White Other

Plume Dispersion Behavior: Looping Coning Fanning

Lofting Fumigating Other

Estimated Distance Plume Visible

Summary of Observations:

Opacity	Aggregate Time @ Opacity	Opacity	Aggregate Time @ Opacity
0	min. sec.	55	
5		60	
10		65	
15		70	
20		75	
25		80	
30		85	
35		90	
40		95	
45		100	
50			

RECORD OF VISIBLE EMISSIONS

Company Name Armco

Date 10-5-79

Plant Address

Observer Opthoff

Stack Location

Observer's Location

Weather Conditions

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
0928	30	10	10	10	10	Run-2
	31	10	10	10	10	
	32	10	10	5	5	
	33	10	10	10	10	
	34	5	5	5	5	
	35	5	5	5	5	
	36	5	5	10	10	Start
	37					moved to see a better location
0934	38	10	10	10	10	but returned to original
	39	10	10	10	10	
	40	10	10	10	10	
	41	10	10	5	5	
0938	42	5	5	10	5	
39	43	5	5	5	5	195 8
40	44	5	5	10	10	
	45	10	10	10	5	
	46	5	5	5	5	
	47	5	5	5	10	
	48	5	5	5	5	
45	49	5	5	5	5	150 6
46	50	5	10	10	5	
	51	5	5	5	5	
	52	5	5	5	5	
	53	10	10	10	10	
	54	10	10	10	10	
51	55	10	10	10	10	190 8 ~~7.9~~
52	56	10	10	10	10	
	57	10	10	10	10	
	58	10	10	10	10	
	59	10	10	10	10	

RECORD OF VISIBLE EMISSIONS

Company Name: Armco

Date: 10-5-79

Plant Address:

Observer: Opthoff

Stack Location:

Observer's Location:

Weather Conditions:

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS	
	00	5	5	10	10		
57	01	5	5	5	5	Run-2	
58	02	10	5	5	5	210	9
	03	10	5	5	10		
1000	04	10	10	10	5		
	05	10	10	5	10		
	06	10	10	5	5		
03	07	5	5	10	10	185	8
04	08	10	5	5	5		
	09	5	5	5	5		
	10	5	5	10	10		
	11	10	10	10	10		
	12	10	10	10	10		
09	13	10	10	10	10	195	8
10	14	10	10	10	10		
	15	10	10	15	10		
	16	10	10	10	10		
	17	10	10	10	10		
	18	10	10	10	5	push	
15	19	5	5	10	10	230	10
16	20	10	10	10	10		
	21	10	10	10	10		
	22	10	10	10	10		
	23	10	10	10	10		
	24	5	5	5	5		
21	25	5	10	10	10	215	9
22	26	5	5	10	5		
	27	5	10	10	10		
	28	10	10	10	10		
1025	29	10	5	5	5		

RECORD OF VISIBLE EMISSIONS

Company Name: Armco
Date: 10-5-79
Plant Address:
Observer: Opthoff
Stack Location:
Observer's Location:
Weather Conditions:

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS Run-2
1026	30	5	5	10	10	The opacities are darker
27	31	10	15	20	25	225 9 today. This is probably
28	32	20	15	15	15	due to a darker sky
	33	15	10	15	15	as it is earlier in the
	34	10	10	10	10	day. Also I am a
	35	10	10	10	10	bit closer to the stack
	36	10	10	10	15	today
33	37	10	10	10	10	285 12
34	38	10	10	10	10	
	39	10	10	5	5	
	40	10	10	10	10	
	41	10	10	10	10	
	42	10	10	10	10	
39	43	10	10	10	5	225 9
40	44	5	5	10	5	
	45	5	10	10	10	
	46	10	10	15	10	
	47	10	10	10	15	
	48	10	10	20	15	
45	49	15	15	15	15	265 11
46	50	10	15	15	15	
	51	15	15	15	10	
	52	10	15	10	10	
	53	10	10	10	10	
	54	10	10	10	10	
51	55	10	10	10	10	275 11
52	56	10	10	10	10	
	57	10	10	15	15	
	58	15	15	10	10	
55	59	10	10	10	10	

RECORD OF VISIBLE EMISSIONS

Company Name: Armco

Date: 10-5-79

Plant Address:

Observer: Opthoff

Stack Location:

Observer's Location:

Weather Conditions:

Run-2

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	
1056	00	10	10	10	10		
57	01	10	15	15	15	275	11
1058	02	10	10	10	10		
	03	10	10	10	15		
1100	04	15	10	10	10		
	05	10	15	10	15		
	06	10	10	10	10		
03	07	10	10	10	10	260	11
04	08	10	10	15	10		
	09	10	10	10	10		
	10	10	10	10	10		
	11	15	15	10	10		
	12	10	10	10	10		
09	13	10	10	10	10	255	11
10	14	10	15	15	15		
	15	15	10	10	15		
	16	15	10	10	10		
	17	15	15	15	15		
	18	10	10	10	10		
15	19	10	10	10	10	290	12
16	20	10	10	10	10		
	21	10	10	10	10		
	22	10	10	10	5		
	23	5	5	5	5		
	24	10	5	10	10		
21	25	10	10	10	15	215	9
22	26	10	10	10	15		
	27	10	10	10	10		
	28	10	10	10	5		
25	29	5	10	10	5		

RECORD OF VISIBLE EMISSIONS

Company Name: Armco

Date: 10-5-79

Plant Address:

Observer: Optkoff

Stack Location:

Observer's Location:

Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	Run-7
1126	30	10	10	10	10		
27	31	10	10	10	10	230	10
28	32	10	10	10	10		
	33	10	10	10	10		
30	34	10	10	10	10		
	35	10	10	10	10		
	36	10	10	10	10		
33	37	10	10	10	5	235	10
34	38	5	10	10	10		
	39	10	10	5	10		
	40	10	10	10	10		
	41	5	10	10	10		
	42	10	10	10	10		
39	43	10	10	10	10	225	9
40	44	10	10	10	10		
	45	15	20	25	25		
	46	25	25	25	25		
	47	25	25	25	25		
	48	20	20	15	15		
45	49	20	20	20	20	475	20
46	50	20	20	20	15		
	51	10	15	20	20		
	52	20	20	15	15		
	53	10	10	10	10		
	54	10	15	20	25		
51	55	25	25	25	25	420	18
52	56	25	20	20	20		
	57	20	20	20	20		
	58	20	20	25	25		
55	59	25	25	25	25		

RECORD OF VISIBLE EMISSIONS

Company Name: Armco

Date: 10-5-79

Plant Address:

Observer: Opthoff

Stack Location:

Observer's Location:

Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	Run-2
1156	00	20	25	25	25		
57	01	25	25	25	25	550	23
58	02	25	25	25	25		
	03	25	25	25	25		
1202	04	25	25	25	30		
	05	30	30	25	25		
	06	20	20	20	20		
03	07	20	20	20	20	575	24
04	08	20	20	20	20		
	09	20	20	25	25		
	10	25	25	25	25		
	11	25	20	20	20		
	12	20	20	20	25		
09	13	20	20	20	20	520	22
10	14	25	25	25	25		
	15	25	20	20	20		
	16	20	20	20	20		
	17	20	20	20	20		
	18	20	20	20	20		
15	19	20	20	20	20	505	21
16	20	20	15	15	15		
	21	15	20	15	15		
	22	20	15	20	20		
	23	20	20	15	15		
	24	15	15	15	15		
21	25	15	15	15	15	395	16
22	26	20	20	20	15		
	27	15	15	15	10		
	28	10	10	15	15		
25	29	15	15	15	15		

RECORD OF VISIBLE EMISSIONS

Company Name: Armco

Date: 10-5-79

Plant Address:

Observer: Opthoff

Stack Location:

Observer's Location:

Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	Run-2
26	30	15	15	15	15		
27	31	10	15	15	15	355	15
28	32	15	15	15	15		
	33	10	15	15	15		
1230	34	15	15	10	15		
	35	15	15	15	15		
	36	15	15	15	15		
33	37	15	15	15	15	350	15
34	38	15	15	15	10		
	39	10	10	15	20		
	40	15	15	15	15		
	41	15	15	15	15		
	42	10	15	15	10		
39	43	15	10	15	15	335	14
40	44	15	15	15	15		
	45	10	10	10	10		
	46	10	10	15	15		
	47	15	15	15	15		
	48	15	10	15	10		
45	49	10	15	15	10	310	13
46	50	10	10	10	10		
	51	10	10	10	10		
	52	10	10	10	10		
	53	10	10	10	10		
	54	10	10	10	10		
51	55	10	10	10	10	240	10
52	56	10	10	10	10		
	57	10	10	10	15		
	58	25	25	25	25		
55	59	25	25	25	20		

continued

RECORD OF VISIBLE EMISSIONS

Company Name: Armco

Date: 10-5-79

Plant Address:

Observer: Opthoff

Stack Location:

Observer's Location:

Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	Run-2
56	00	20	15	20	20		
57	01	20	15	15	15	420	18
58	02	10	10	10	10		
	03	10	10	10	15		
1300	04	10	10	10	10		
	05	10	10	10	10		
	06	5	10	15	15		
03	07	15	15	15	15	270	11
04	08	15	10	10	15		
	09	15	15	15	15		
	10	15	15	10	10		
	11	15	15	15	20		
	12	25	25	25	25		
09	13	25	25	25	25	425	18
10	14	25	25	25	25		
	15	25	25	25	25		
	16	25	20	20	20		
	17	20	25	25	20		
	18	20	20	20	20		
15	19	20	20	25	25	545	23
16	20	25	25	30	25		
	21	20	20	20	20		
	22	20	25	20	25		
	23	20	20	15	20		
	24	25	25	20	25		
21	25	20	25	25	20	535	22
	26	15	20	20	20		
	27	20	20	20	25		
	28	20	30	30	25		
25	29	25	20	20	20		

RECORD OF VISIBLE EMISSIONS

Company Name: Amco

Date: 10-5-79

Plant Address:

Observer: Opthoff

Stack Location:

Observer's Location:

Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	Run-2
26	30	20	20	20	20		
27	31	20	20	15	15	500	21
28	32	15	15	15	15		
	33	10	15	15	15		
1330	34	20	20	15	15		
	35	15	15	15	15		
	36	10	15	10	10		
83	37	10	10	10	10	330	14
84	38	10	10	10	15		
	39	10	15	15	15		
	40	15	20	20	20		
	41	20	20	20	20		
	42	20	25	25	20		
39	43	20	25	25	20	435	18
40	44	20	20	15	20		
	45	20	20	20	20		
	46	20	20	20	15		
	47	20	20	20	20		
	48	20	20	20	20		
45	49	20	20	20	15	465	19
46	50	20	15	20	15		
	51	15	10	10	10		
	52	15	20	20	20		
	53	15	15	20	20		
	54	20	20	20	20		
51	55	20	20	20	20	420	18
52	56	20	20	20	20		
	57	20	20	20	20		
	58	20	15	20	20		
55	59	15	15	15	15		

RECORD OF VISIBLE EMISSIONS

Company Name: Amoco

Date: 10-5/79

Plant Address:

Observer: Opthoff

Stack Location:

Observer's Location:

Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS Run 2	
56	00	10	15	10	15		
57	01	15	15	10	15	400	17
58	02	15	15	10	15		
	03	15	15	10	15		
1400	04	15	15	15	15	170	14
	05						
	06						
	07						
	08						
	09						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
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	23						
	24						
	25						
	26						
	27						
	28						
	29						

RECORD OF VISIBLE EMISSIONS

Company Name: Amco

Date: 10-5-79

Plant Address:

Observer: Opthoff

Stack Location:

Observer's Location:

Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	
1648	00	15	15	15	15	BSO-3	Run 3
	01	15	15	15	15		
	02	20	15	10	10		
	03	10	15	15	15		
	04	15	15	15	10		
48	05	10	15	15	10	335	14
49	06	10	15	15	15		
	07	15	15	15	15		
	08	10	15	15	15		
	09	15	15	20	20		
	10	10	15	15	15		
54	11	15	15	15	15	355	15
55	12	15	15	15	15		
	13	15	15	15	10		
	14	10	15	25	30		
	15	25	25	25	20		
	16	20	15	15	15		
1700	17	10	10	10	10	395	16
1701	18	10	15	10	15		
	19	20	20	15	15		
	20	15	15	15	15		
	21	15	15	15	15		
	22	15	15	20	20		
06	23	15	15	15	15	370	15
07	24	15	15	15	10		
	25	10	10	10	10		
	26	10	10	10	10		
	27	10	10	80	85		
	28	85	90	85	75		
1712	29	60	45	35	25	820	34

RECORD OF VISIBLE EMISSIONS

Company Name Armco

Date 10-5-79

Plant Address

Observer Opthoff

Stack Location

Observer's Location

Weather Conditions

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS	Run-3
1713	30	25	20	20	25	page 2	
	31	25	25	25	25		
	32	25	30	30	25		
	33	30	25	25	25	~~5:15 PM~~	
	34	30	30	25	20		
18	35	15	20	20	15	580	24
19	36	15	10	10	10		
	37	15	15	15	15		
	38	10	15	15	15		
	39	15	15	15	15		
	40	15	15	15	15		
24	41	15	15	15	15	340	14
25	42	15	20	20	20		
	43	20	20	20	20		
	44	20	25	25	20		
	45	20	15	20	20		
	46	20	20	15	15		
30	47	15	15	15	15	450	19
31	48	20	20	15	15	~~St Louis~~	
	49	15	10	10	10		
	50	15	10	10	10		
	51	15	10	15	10		
	52	10	10	10	10		
36	53	10	20	20	15	315	13
37	54	15	15	15	15		
	55	10	10	15	20		
	56	15	15	15	10		
	57	10	15	10	10		
	58	10	10	10	15		
1742	59	15	15	10	15	315	13

RECORD OF VISIBLE EMISSIONS

Company Name: Amoco

Date: 10-5-79

Plant Address:

Observer: Opthoff

Stack Location:

Observer's Location:

Weather Conditions:

	HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS	Run-3
1743		00	20	15	15	15	page 3	
		01	15	15	15	15		
		02	10	15	10	10		
		03	10	5	5	10		
		04	10	15	15	10		
48		05	10	15	15	15	305	13
49		06	15	15	15	20		
		07	20	20	20	20		
		08	20	20	20	20		
		09	20	20	20	20		
		10	25	20	20	25		
54		11	25	25	20	20	485	20
55		12	20	20	15	15		
		13	20	20	15	15		
		14	15	85	90	85		
		15	80	75	70	70		
		16	55	45	35	30		
1800		17	25	20	20	20	960	40
1801		18	15	20	20	20		
		19	20	20	20	20		
		20	20	25	25	25		
		21	20	20	20	20		
		22	20	15	15	20		
06		23	20	25	20	20	485	20
07		24	20	10	15	15		
		25	10	10	5	5		
		26	10	5	5	5		
		27	5	5	10	10		
		28	10	5	10	10		
1912		29	5	10	5	10	210	9

RECORD OF VISIBLE EMISSIONS

Company Name: Amco
Date: 10-5-79
Plant Address:
Observer: Opthoff
Stack Location:
Observer's Location:
Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	Run-3
1813	30	10	5	5	10	page 4	
	31	10	5	5	10		
	32	10	10	10	5		
	33	5	10	5	5		
	34	5	10	10	10		
18	35	10	5	5	5	180	8
19	36	10	15	15	15		
	37	15	15	20	15		
	38	20	20	15	15		
	39	15	10	10	10		
	40	15	15	10	5		
24	41	10	10	15	15	330	14
25	42	15	15	10	10		
	43	10	10	10	10		
	44	5	10	10	10		
	45	10	10	10	15		
	46	20	20	15	15		
30	47	15	15	15	15	300	13
31	48	10	10	15	15		
	49	15	10	10	15		
	50	10	10	10	10		
	51	10	10	10	10		
	52	10	10	10	10	260	11
36	53	10	10	10	10	port change at outlet	
37	54	10	10	10	10		
	55	5	5	5	10		
	56	10	15	10	10		
	57	10	10	10	10		
	58	5	10	5	5		
1842	59	10	10	10	10	215	9

RECORD OF VISIBLE EMISSIONS

Company Name: Amco

Date: 10-5-79

Plant Address:

Observer: Opthoff

Stack Location:

Observer's Location:

Weather Conditions:

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS	Run 3
1843	00	10	10	10	10		
	01	10	10	10	5	page 5	
	02	10	5	5	10		
	03	10	10	10	10	6:45 ≈	
	04	10	5	5	5		
48	05	10	5	5	5	195	8
49	06	5	10	10	10		
	07	10	15	10	10		
	08	10	10	10	10		
	09	10	10	10	10		
	10	5	10	10	10		
54	11	10	10	10	10	235	10
55	12	10	10	10	10		
	13	10	5	10	10		
	14	5	5	10	10		
	15	10	10	10	10		
	16	10	10	10	10		
1900	17	10	10	10	10	225	9
1901	18	10	10	10	10		
	19	10	10	10	10		
	20	10	10	10	10		
	21	10	10	10	10		
	22	10	10	10	10		
06	23	10	10	10	10	240	10
07	24	10	10	10	10		
	25	5	5	5	5		
	26	5	5	5	5		
	27	5	5	5	5		
	28	5	5	5	5		
1912	29	5	5	5	5	140	6

APPENDIX B-4.

SUMMARY OF VISIBLE EMISSIONS

SUMMARY OF VISIBLE EMISSIONS

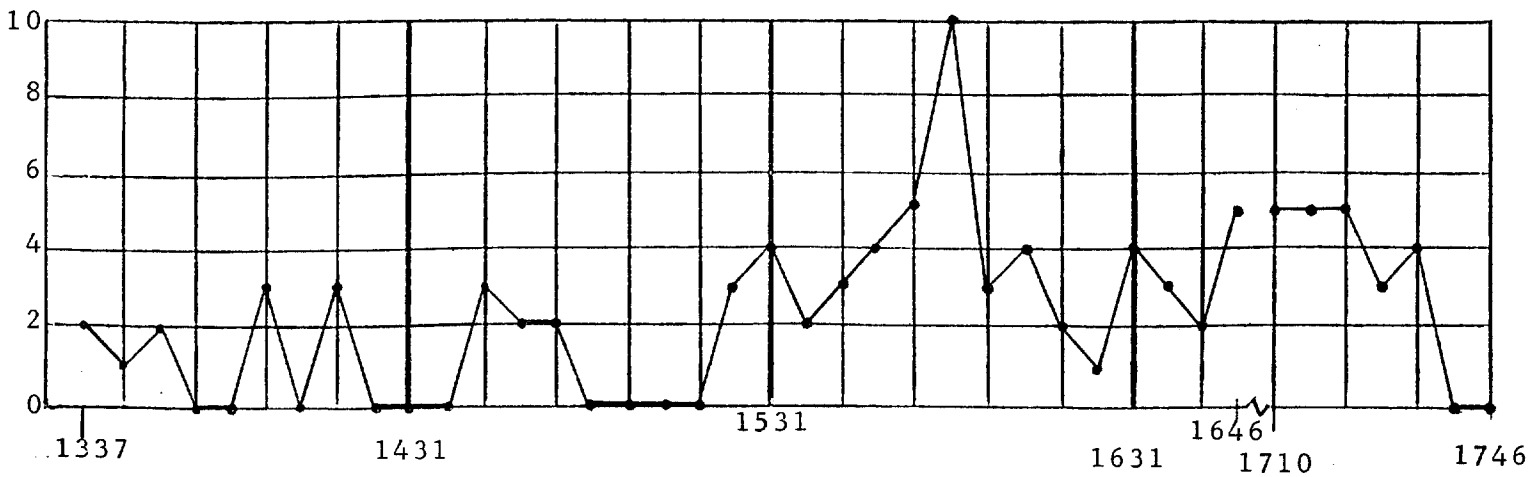
Run 1

Date: 10-4-79
Type of Discharge: WESP
Height of Point of Discharge: 120 ft
Wind Direction: S
Color of Plume: white
Observer No.: Opthoff
Type of Plant: Coke Battery/Armco Steel
Location of Discharge: Outlet of WESP
Description of Sky: Clear/partly cloudy
Wind Velocity: 5-10 mi/hr
Detached Plume: No
Duration of Observation: 4 hr. 39 min.
Distance from Observer to Discharge Point: 200 ft.
Direction of Observer from Discharge Point: SSW
Height of Observation Point: Ground
Description of Background: Sky

SUMMARY OF AVERAGE OPACITY

Set Number	Time		Opacity		Set Number	Time		Opacity	
	Start	End	Sum	Average		Start	End	Sum	Average
1	1332	1337	45	2	21	1532	1537	35	2
2	1338	1343	20	1	22	1538	1543	75	3
3	1344	1349	45	2	23	1544	1549	105	4
4	1350	1355	10	0	24	1550	1555	120	5
5	1356	1401	0	0	25	1556	1601	230	10
6	1402	1407	80	3	26	1602	1607	60	3
7	1408	1413	0	0	27	1608	1613	90	4
8	1414	1419	75	3	28	1614	1619	45	2
9	1420	1425	5	0	29	1620	1625	25	1
10	1426	1431	15	1	30	1626	1631	95	4
11	1432	1437	5	0	31	1632	1637	60	3
12	1438	1443	70	3	32	1638	1643	40	2
13	1444	1449	50	2	33	1644	1646	60	5
14	1450	1455	45	2	34	1705	1710	115	5
15	1456	1501	0	0	35	1711	1716	120	5
16	1502	1507	0	0	36	1717	1722	115	5
17	1508	1513	10	0	37	1723	1728	80	3
18	1514	1519	0	0	38	1729	1734	90	4
19	1520	1525	65	3	39	1735	1740	0	0
20	1526	1531	85	4	40	1741	1746	0	0

Sketch Showing How Opacity Varied With Time:



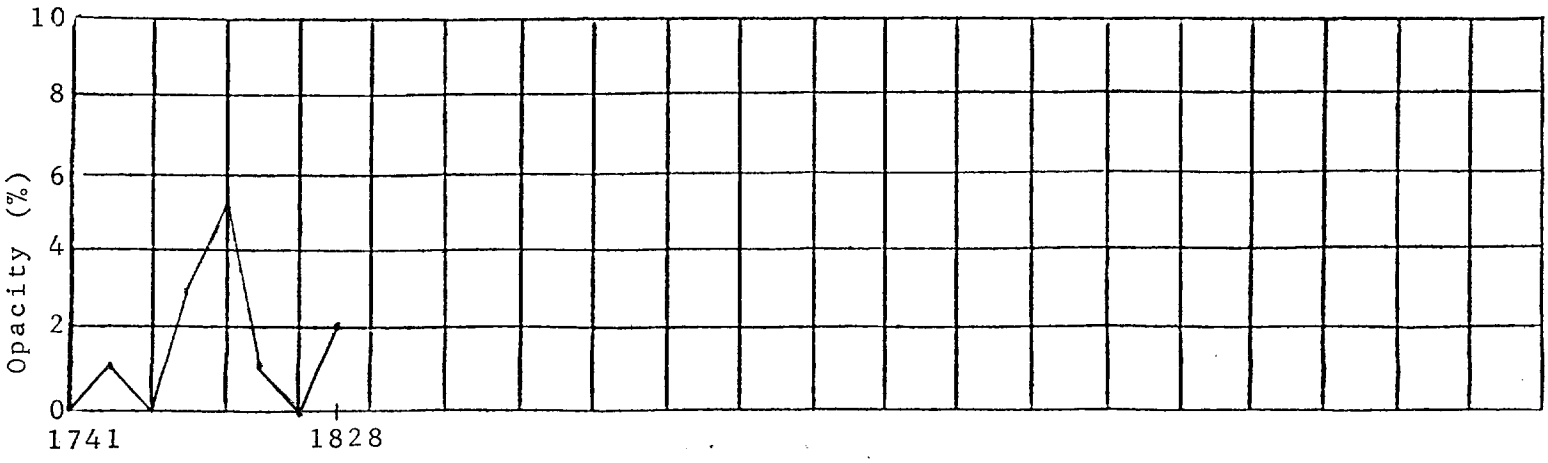
SUMMARY OF VISIBLE EMISSIONS

Run 1 continued

Date: 10-4-79
Type of Discharge: WESP
Height of Point of Discharge: 120 ft.
Wind Direction: S
Color of Plume: White
Observer No.: Opthoff
Type of Plant: Coke Battery/Armco Steel
Location of Discharge: Outlet of WESP
Description of Sky: Clear/partly cloudy
Wind Velocity: 5-10 mi/hr
Detached Plume: No
Duration of Observation: 4 hr 39 min.
Distance from Observer to Discharge Point: 200 ft.
Direction of Observer from Discharge Point: SSW
Height of Observation Point: Ground
Description of Background: Sky

SUMMARY OF AVERAGE OPACITY									
Set Number	Time		Opacity		Set Number	Time		Opacity	
	Start	End	Sum	Average		Start	End	Sum	Average
41	1747	1752	30	1					
42	1753	1758	0	0					
43	1759	1804	65	3					
44	1805	1810	115	5					
45	1811	1816	25	1					
46	1817	1822	10	0					
47	1823	1828	55	2					

Sketch Showing How Opacity Varied With Time:



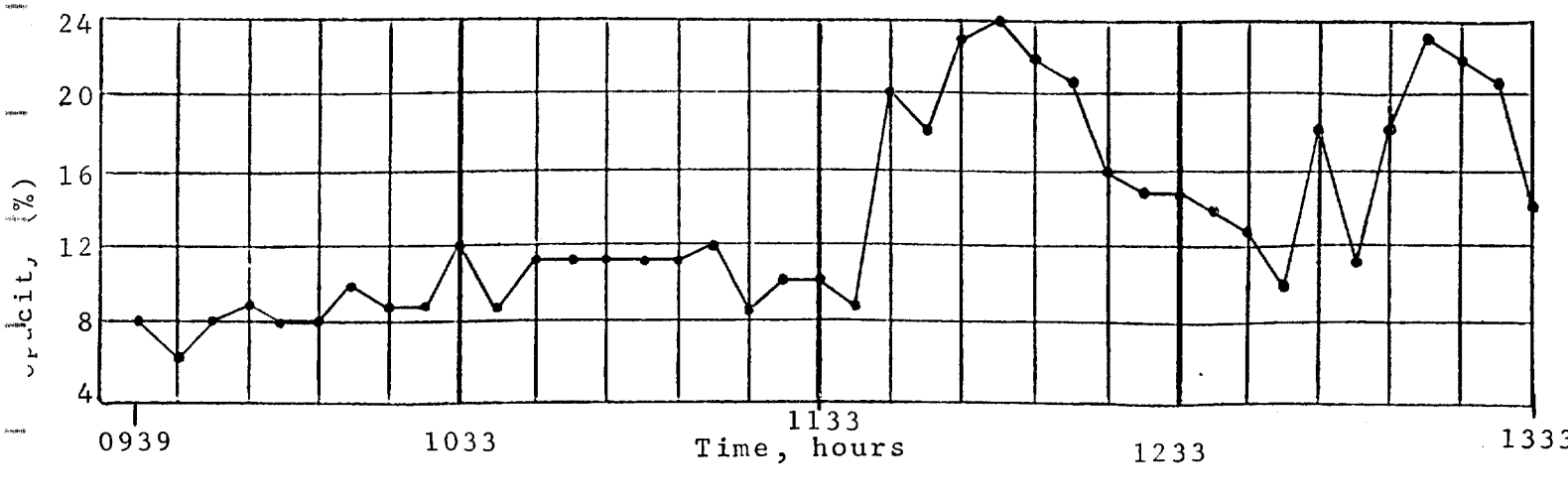
SUMMARY OF VISIBLE EMISSIONS

Run 2

Date: 10-5-79
Type of Discharge: WESP
Height of Point of Discharge: 120 ft.
Wind Direction: S
Color of Plume: White
Observer No.: Opthoff
Type of Plant: Coke Battery/Armco Steel
Location of Discharge: Outlet of WESP
Description of Sky: clear
Wind Velocity: 5-10 mi/hr
Detached Plume: No
Duration of Observation: 4 hr. 27 min.
Distance from Observer to Discharge Point: 150 ft.
Direction of Observer from Discharge Point: ESE
Height of Observation Point: Ground
Description of Background: Sky

SUMMARY OF AVERAGE OPACITY									
Set Number	Time		Opacity		Set Number	Time		Opacity	
	Start	End	Sum	Average		Start	End	Sum	Average
1	0934	0939	195	8	21	1134	1139	225	9
2	0940	0945	150	6	22	1140	1145	475	20
3	0946	0951	190	8	23	1146	1151	420	18
4	0952	0957	210	9	24	1152	1157	550	23
5	0958	1003	185	8	25	1158	1203	575	24
6	1004	1009	195	8	26	1204	1209	520	22
7	1010	1015	230	10	27	1210	1215	505	21
8	1016	1021	215	9	28	1216	1221	395	16
9	1022	1027	225	9	29	1222	1227	355	15
10	1028	1033	285	12	30	1228	1233	350	15
11	1034	1039	225	9	31	1234	1239	335	14
12	1040	1045	265	11	32	1240	1245	310	13
13	1046	1051	275	11	33	1246	1251	240	10
14	1052	1057	275	11	34	1252	1257	420	18
15	1058	1103	260	11	35	1258	1303	270	11
16	1104	1109	255	11	36	1304	1309	425	18
17	1110	1115	290	12	37	1310	1315	545	23
18	1116	1121	215	9	38	1316	1321	535	22
19	1122	1127	230	10	39	1322	1327	500	21
20	1128	1133	235	10	40	1328	1333	330	14

Sketch Showing How Opacity Varied With Time:



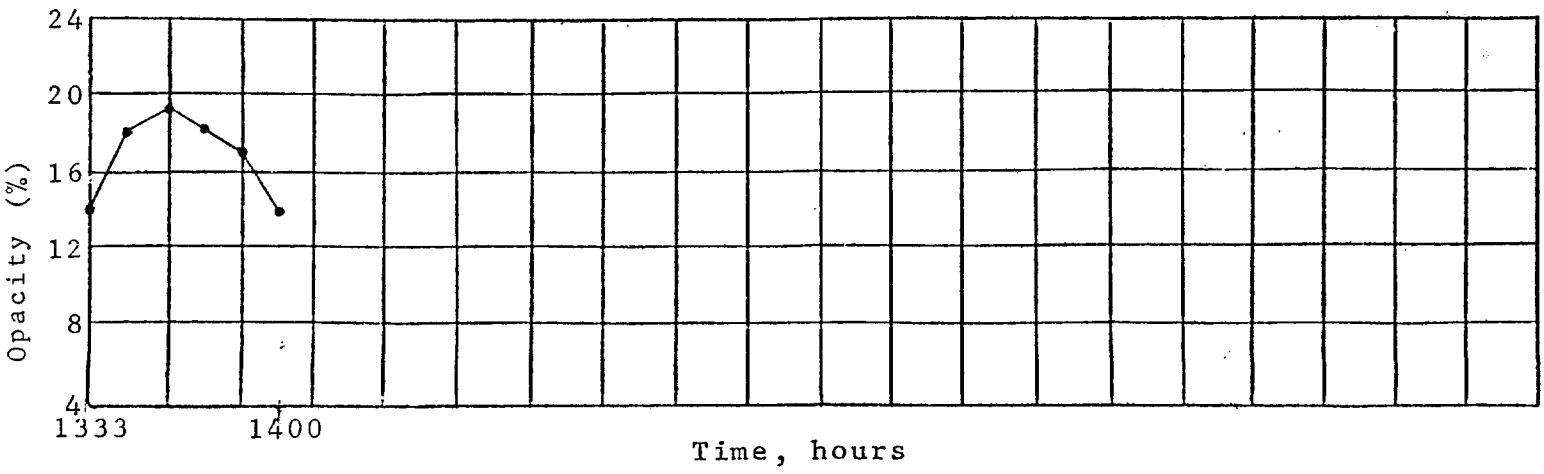
SUMMARY OF VISIBLE EMISSIONS

Run 2 continued

Date: 10-5-79
Type of Plant: Coke Battery/Armco Steel
Type of Discharge: WESP
Location of Discharge: Outlet of WESP
Height of Point of Discharge: 120 ft.
Description of Sky: clear
Wind Direction: S
Wind Velocity: 5-10 mi/hr
Color of Plume: White
Detached Plume: No
Observer's Name: Opthoff
Duration of Observation: 4 hr. 27 min.
Distance from Observer to Discharge Point: 150 ft.
Direction of Observer from Discharge Point: ESE
Height of Observation Point: Ground
Description of Background: Sky

SUMMARY OF AVERAGE OPACITY									
Set Number	Time		Opacity		Set Number	Time		Opacity	
	Start	End	Sum	Average		Start	End	Sum	Average
41	1334	1339	435	18					
42	1340	1345	465	19					
43	1346	1351	420	18					
44	1352	1357	400	17					
45	1358	1400	170	14					

Sketch Showing How Opacity Varied With Time:



SUMMARY OF VISIBLE EMISSIONS

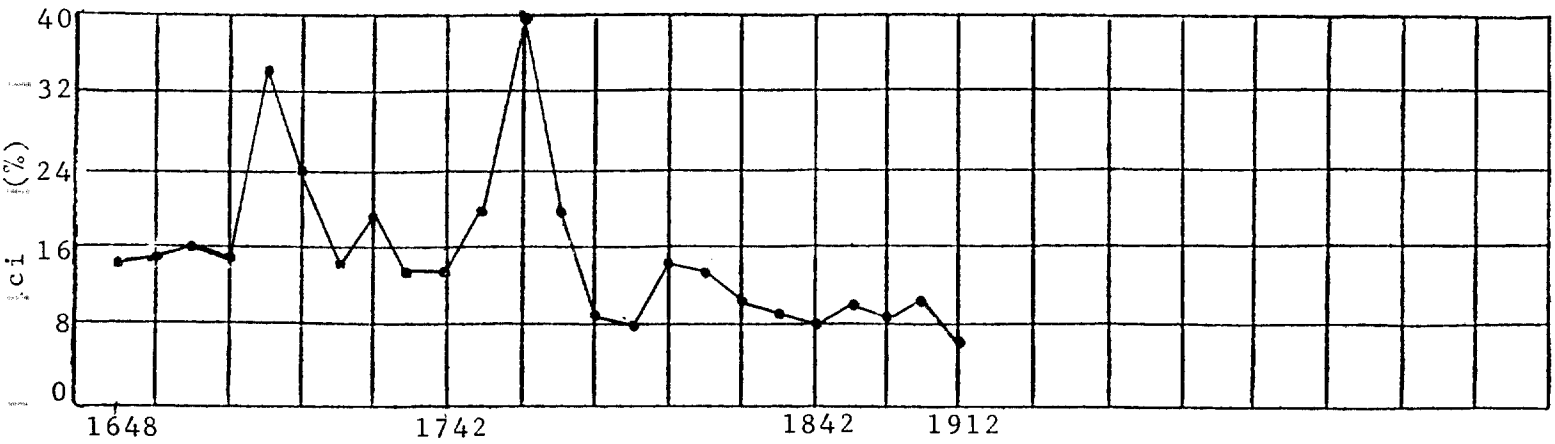
Run 3

Date: 10-5-79
Type of Discharge: WESP
Height of Point of Discharge: 120 ft.
Wind Direction: S
Color of Plume: White
Observer's Name: Opthoff
Type of Plant: Coke Battery/Armco Steel
Location of Discharge: Outlet of WESP
Description of Sky: Clear
Wind Velocity: 5-10 mi/hr
Detached Plume: No
Duration of Observation: 2 hr. 30 min.
Distance from Observer to Discharge Point: 150 ft.
Direction of Observer from Discharge Point: WSW
Height of Observation Point: Ground
Description of Background: Sky

SUMMARY OF AVERAGE OPACITY

Set Number	Time		Opacity		Set Number	Time		Opacity	
	Start	End	Sum	Average		Start	End	Sum	Average
1	1643	1648	335	14	21	1843	1848	195	8
2	1649	1654	355	15	22	1849	1854	235	10
3	1655	1700	395	16	23	1855	1900	225	9
4	1701	1706	370	15	24	1901	1906	240	10
5	1707	1712	820	34	25	1907	1912	140	6
6	1713	1718	580	24	26				
7	1719	1724	340	14	27				
8	1725	1730	450	19	28				
9	1731	1736	315	13	29				
10	1737	1742	315	13	30				
11	1743	1748	305	13	31	Readings were terminated due to darkness.			
12	1749	1754	485	20	32				
13	1755	1800	960	40	33				
14	1801	1806	485	20	34				
15	1807	1812	210	9	35				
16	1813	1818	180	8	36				
17	1819	1824	330	14	37				
18	1825	1830	300	13	38				
19	1831	1836	260	11	39				
20	1837	1842	215	9	40				

Sketch Showing How Opacity Varied With Time:



APPENDIX B-5

FUGITIVE EMISSION OBSERVATION DATA SHEETS

pany: Armco Steel Inspector: J. J. Breger

ion: Houston, Texas Date: 10-4-79

pany Rep.(s):

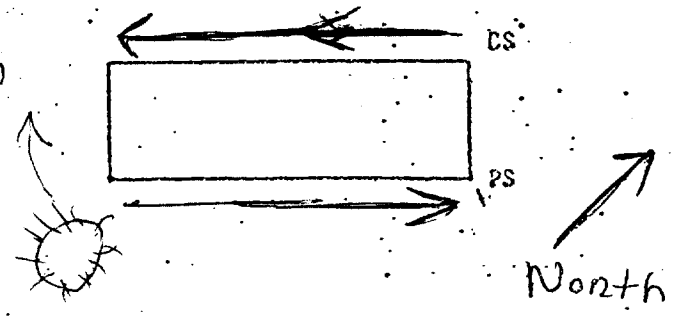
ttery number 1 & 2 Total number of: Oven doors 124 Chuck doors 62

dicate sun position, wind speed and direction, and location of traverse:

Sky condition: CLEAR / SW 10-15 mph

Run number: 01-1

Time: 14:25



Time traverse started/ completed (CS)	Oven number	Visible emissions: Oven door	Visible emissions: Chuck door	OPACITY %	Comments
1425	65	✓			
	57	✓			
	55	✓			
STOP 1426	47	✓			
START 1429	43	✓			
	42	✓			
	41	✓			
STOP 1430					MISSED OVEN 38 → 17 DUE to DOOR CAR
START 1430	16	✓			
	15	✓			
STOP 1432	3	✓			
START 1441 STOP 1442					DOOR 29 → 18 NO LEAKS
START 1443 STOP 1444					DOOR 31 → 36 NO LEAKS
					MISSED 37 → 39

mpany: Armco Steel
ocation: Houston, Texas
ttery number: 1 & 2

Inspector: J J Bregen
Date: 10/4/79
Run number: 01-1

Time traverse started/completed (PS/~~ES~~)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
START 1450	★ 7				LENTIL AREA LEAK
	13	✓	✓		
	17	✓	✓		
					22 → 27 pushCAR obscured
	★ 31				LENTIL AREA
					37 Being pushed open
	45	✓	✓		
	49		✓		
	52	✓			
	53		✓		
STOP 1455					Return to missed doors
START 1456					
STOP 1457					

Company: Armco Steel
Location: Houston Texas
Battery number: 1&2

Inspector: JJ Breger
Date: 10/4/79
Run number: Ø2-1 push side

Time traverse started/ completed (PS/~~ES~~)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
1541	*6				Lentil Area LEAK
	7	✓			
	13	✓	✓		
	17	✓			LENTIL AREA LEAK
	27	✓	✓		
	45	✓			
	~~47~~				47 DOOR OPEN
	49		✓		FLAMES OUT TOP OF C-DOOR
	53		✓		
STOP 1546					

mpany: Armco Steel
cation: Houston Texas
ttery number: 1 & 2

Inspector: J J Breger
Date: 10/4/79
Run number: Ø3-1

Time traverse started/ completed (PS/~~PS~~)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
1642					7-12 obstucted
	13	✓	✓		
		✓			LENTIL AREA
	27	✓	✓		
	37	✓	✓		
	47		✓		
1646	57	✓			RETURNED to MISSED OVENS
START 1647					#9 opened for push
STOP 1648					

PS

CS

Page ___ of ___

Company: Armco STEEL

Location: Houston Texas

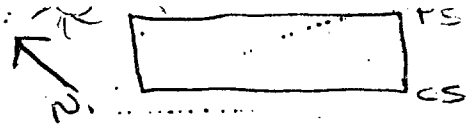
Battery number: 1 & 2

Inspector: J.J. Breger

Date: 10/4/79

Run number: Ø4-1

Time traverse started/ completed (PS) ~~(CS)~~	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
1756	67	✓	✓		(TRAVELING oppisit from RUN 1→3
	57	✓	✓		LENTIL AREA LEAK — possible JAM LEAK
	47		✓		
	*37				LENTIL AREA LEAK
	27		✓		
	19		✓		
STOP 18:00					



Company: Armco Steel
Location: Houston Texas
Battery number: 1 & 2

Inspector: JJ Breger
Date: 10/5/79
Run number: 02-2

Time traverse started/completed (PS/~~CS~~)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
10:06	4	✓	✓		START at door #4 push CAR obstuct
	8	✓	✓		
	14	✓	✓		15° open for push
	23		✓		
	24	✓			
	43		✓		
	51		✓		
	53	✓	✓		LENTIL AREA Leak
	54				"
	57	✓			
	63	✓	✓		
STOP 10:10	68	✓			Excluded door 1→3

Company: Armco Steel
Inspector: J.J. Breger
Location: Houston Texas
Date: 10/5/79
Battery number: 1 & 2
Run number: #2-2

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
1057	4	✓	✓		
	5		✓		
	14	✓	✓		
	15	✓	✓		
	23		✓		
	24	✓			
	35				Lentil Area Leak
	43	✓	✓		
	48	✓			
	53	✓			
	55				Lentil Area Leak
	57	✓			
	62	✓	✓		
	63	✓			
	66	✓	✓		
1102	68	✓			

CS

mpany: Armco Steel
ocation: Hooston Texas
ttery number: 1 & 2

Inspector: J.J. Breger
Date: 10/5/79
Run number: 3-2

Time traverse started/completed ~~(PS)~~/(CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
11:35	14	✓			start at # 13
	15	✓			FLAMES Bottom of door
	16	✓			
	18	✓			
	25	✓			
	41	✓			FLAMES ALL AROUND DOOR
	42	✓			
	43	✓			
	46	✓			
	52	✓			
	53	✓			
	58	✓			
	63	✓			
	64	✓			
STOP 11:38	12	✓			RETURN TO #1-12
START 11:39	9	✓			
	8	✓			
	6	✓			
	5	✓			

Company: Armco Steel
Location: Houston Texas
Battery number: 1 & 2
Inspector: J.J. Breeger
Date: 10/5/79
Run number: 3-2

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
11 40	4				
START 11 45	66				
11 45:00					
START PUSH SIDE					
11 47	62	✓			65 open for push
	57	✓			Left 1 AREA Leak
	53		✓		
	48	✓	✓		
	45	✓	✓		
	43	✓			
	15	✓			
	8	✓			
	5		✓		
1152	4	✓			

PS

CS

Company: Armco Steel

Location: Houston Texas

Battery number: 142

Inspector: J.J. Breger

Date: 10/5/99

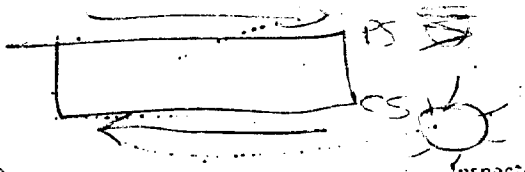
Run number: 4-3

Time traverse started/ completed (PS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
1246	5		✓		
	8	✓	✓		
	15	✓	✓		
	23		✓		
	28		✓		
	43	✓	✓		
	45	✓			
	48	✓	✓		
	53	✓	✓		
	55		✓		LENTIL AREA LEAK
	57	✓			
	42	✓	✓		
	63	✓			
1250	68	✓	✓		

PS
CS

Company: Armco Steel
Inspector: J J Bregel
Location: Houston Texas
Date: 10/5/79
Battery number: 1 & 2
Run number: 1-3

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
1724	2	✓			#4 open for push
	15	✓			
	22		✓		
	27	✓	✓		
	49	✓	✓		
	52	✓	✓		
	53	✓			
STOP 1728	55	✓			skip 56 → 62
START 1731	57	✓			back to 56 → 62
STOP 1731:30					



mpany: Armco
cation: Houston Texas
ttery number: 1&2

Inspector: J.J. Breger
Date : 10/5/79
Run number: [redacted] 2-3

Time traverse started/ completed ~~PS~~/CS	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
1807	7	✓			START DOOR #7
	9	✓			FLAME ALL
	12	✓			
	13	✓			
	14	✓			
	15	✓			
	17	✓			
	18	✓			
	19	✓			
	22	✓			
	23	✓			
	27	✓			
	37	✓			
	39	✓			
	41	✓			FLAMES TOP
	43	✓			44 open for push
	45	✓			
	47	✓			
	48	✓			

Company: Armco
Location: Houston Texas
Battery number: 1 & 2
Inspector: J.J. Bregen
Date: 10/5/79
Run number: 2-3

Time traverse started/completed (~~BS~~ CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
	49	✓			
	51	✓			
	52	✓			FLAMES Bottom
	57	✓			
	59	✓			
	62	✓			
	63	✓			
ST 18:12	~~3~~				Back to ovens 1→6
18:13	3	✓			
18:13:30	2	✓			

mpany: ARMCO
cation: HOUSTON, TEXAS
ttery number: 1 & 2

Inspector: J.J. Breger
Date: 10/5/79
Run number: 2-3

Time traverse started/ completed (PS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
1817	62	✓	✓		
	57	✓			
	52	✓			
	49	✓	✓		
	43	✓			44 open for push
	22		✓		34 → 28 missed
	5		✓		
STOP 1821	2	✓			
START 1824					BACK TO 34→28
1824:30					

...pany: Aronco
...cation: Houston Texas
...tery number: 1&2

Inspector: J.J. Breger
Date: 10/5/79
Run number: 3-3

Time traverse started/ completed (PS)/~~GS~~	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
7:07	2	✓			start #2 push car obstuctio
	22		✓		
	43		✓		
	49	~~✓~~	✓		
	52	✓			
7:10	62	✓	✓		

1 of 1

mpany: Armico

Inspector: A Boecker

tion: Houston

Date: 10-4-79

mpany Rep.(s):

Battery number: one and two

Total number of: 62 ovens

Oven doors: 124

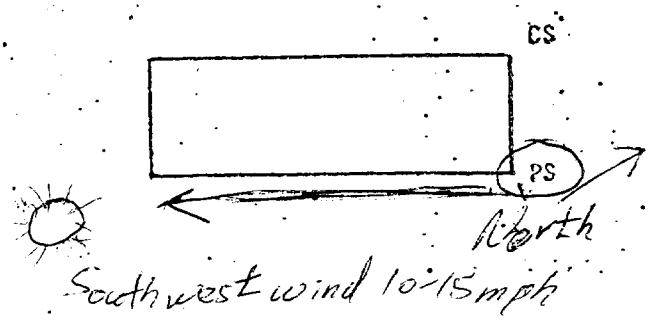
Chuck doors: 62

ndicate sun position, wind speed and direction, and location of traverse:

Sky condition: clear

Run number: one

1-1



Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven door	Visible emissions: Chuck door	OPACITY %	No opacity readings Comments
2:48	68				
	67				
	66				
	65				
	64				
	63				
	62	✓			
	61				
	~~60~~				
	59				
	58				
	57				
	56				
	55				

Company: _____ Inspector: A. Baector

Location: _____ Date: 10-4-79

Battery number: _____ Run number: one

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
	54				
	53				leak up on top (lintel)
	52				
	51				
	~~50~~				
	49				
	48				
	47				
	46				
	45	✓			
	44				
	43				
	42				
	41				
	~~40~~				
	39				
	38				
	37				Door off (ready for push)
	36				

Company: _____ Inspector: H. Baecker

Location: _____ Date: 10-4-79

Battery number: _____ Run number: One

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
	35				
	34				
	33				
	32				
	31				leak up at top (lintel)
	29				
	28				
	27				obstructed by pushear
	26				"
	25				"
	24				"
	23				"
	22				"
	21				
	~~20~~ 19				
	18				
	17	✓			
	16				
	15				

Company: _____ Inspector: A. Baecker

Location: _____ Date: 10-4-79

Battery number: _____ Run number: one

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions		OPACITY %	Comments
		Oven Door	Chuck Door		
2:53	14				
	13	✓	✓		
	12				
	11				
	9				
	8				
	7	✓			
	6				
	5				
	4				
	3				
	2				
2:53	1				

Company: Armico
Location: Houston
Battery number: one and two

Inspector: A. Baecker
Date: 10-4-79
Run number: two

1-2

Time traverse started/ completed (CS) coke side	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
3:29	6				1-5 behind door machine -obstructed-
	7	✓			
	8				
	9				
	11				
	12				
	13				
	14				
	15	✓			
	16	✓			
	17				
	18				
	19				
	21				
	22				
	23				
	24				
	25				
	26				

mpany: _____ Inspector: A. Baecker

ocation: _____ Date: 10-4-79

tery number: _____ Run number: two

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
	27	✓			
	29	✓			
3:33	34				(34-46) - obstructed by car & train
3:34	47				opened door
	49	✓	✓		open flume
	51	✓	✓		
	55	✓			green fumes
end 3:36	65	✓			

Company: _____ Inspector: A. Baecker

Location: _____ Date: 10-4-79

Battery number: _____ Run number: two

Time traverse started/completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
3:40					56 — 53 obstructed by push car
	49	✓	✓		open flames at top
	47				Door off-open
	45	✓			
	27	✓	✓		
	17	✓			and smoke at lintel
	13	✓	✓		green smoke
3:44	7	✓			

mpany: _____ Inspector: A. Baecker

ocation: _____ Date: 10-4-79

tery number: _____ Run number: 1-3

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
4:40	57	✓			Flame up on top
	55				smoke up on top (lintel area)
	47	✓	✓		
	45	✓			
	37		✓		
	27	✓	✓		
	13	✓	✓		(12-6) omit - push car
4:44					

Company:
Location:
Battery number:

Inspector: A. Boecker
Date: 10-4-79
Run number: 1-4

Time traverse started/completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
5:57	7				started at opposite ends. smoke at top (lintel)
	19				" " " "
	27				" " " "
	37				" " " "
	47	✓	✓		
	49				53-55 blocked door open - by push car
	57	✓	✓		green smoke
6:00	67				smoke at top (Lintel)

Company: Armco Inspector: A. Baecker

Location: Houston Date: 10-5-79

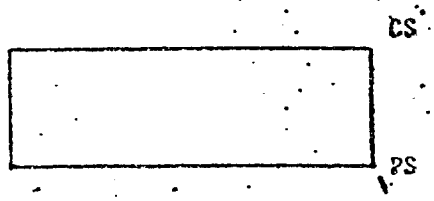
Company Rep.(s):

Battery number: One and two Total number of: 162 Ovens Oven doors: 124 Chuck doors: 62

Indicate sun position, wind speed and direction, and location of traverse:

Sky condition: clear

Run number: 2-1



Time traverse started/completed (PS CS)	Oven number	Visible emissions: Oven door	Visible emissions: Chuck door	OPACITY %	Comments
9:55	2	✓			
	18	✓			
	3	✓			
	4	✓			
	8	✓			
	31	✓			
	33	✓			
9:58 Stop					
9:59	41	✓			
	43	✓			
	46	✓			
	49	✓			
	52	✓			
	53	✓			

Company: _____ Inspector: A. Baeuker

Location: _____ Date: 10-5-79

Battery number: _____ Run number: 2-1

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
3	58	✓			
	61	✓			
	63	✓			
	64	✓			
	66	✓			
10:01					

Company: _____ Inspector: A. Baecker

Location: _____ Date: 10-5-79

Battery number: _____ Run number: 2-1

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
10:06	68	✓			
	63	✓	✓		
	62	✓			
	57	✓			
	53	✓			
	51				smoke up on top
	43	✓			
	24	✓			
	15				Door open
	14	✓			
	4	✓	✓		
10:09	8	✓			1-3 obstructed by push machine

Company: _____ Inspector: A Baecker

Location: _____ Date: 10-5-79

Battery number: _____ Run number: 2-2

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
10.58	68	✓			
	66	✓			
	63	✓			
	62	✓			
	57	✓			
	53	✓			
	48	✓			with fire
	24	✓	✓		
	23		✓		
	15	✓			green smoke
	4	✓			
11.02	5	✓			1-2 blocked by push car

Company: _____ Inspector: A. Baecker

Location: _____ Date: 10-5-79

Battery number: _____ Run number: 2-3 (Reverse)

Time traverse started/completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
11:49	4	✓			
	5	✓			
	8	✓			
	15	✓			
	43	✓			
	45	✓	✓		green smoke
	48	✓			
	53	✓			
	57	✓			
	62	✓			
	63	✓			
11:53	68	✓			
					read all doors

Company: _____ Inspector: A. Baecker

Location: _____ Date: ~~(10-5)~~ 10-5-79

Battery number: _____ Run number: 2-4

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
12:35	6	✓			
	8	✓			
	9	✓			Fire -
	14	✓			green smoke
	15	✓			" "
	16	✓			" "
	17				door open
	18	✓			green smoke
12:37 (stop)					19-27 Blocked - want Back
					37 -
12.40 start	41	✓			
	43	✓			green smoke
	45	✓			" "
	46	✓			
	53	✓			
	55	✓			
	56	✓			
	58	✓			
	61	✓			

Company: _____ Inspector: A. Baecker

Location: _____ Date: 10-5-79

Battery number: _____ Run number: 2-4

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
	64	✓			
	66	✓			
12:42	25	✓			
	26				open

Company: _____ Inspector: A. Baecker

Location: _____ Date: 10-5-79

Battery number: _____ Run number: 2-4

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
12:47	68	✓			
	63	✓			
	62	✓			
	57	✓			
	53	✓			
	48	✓			
	45	✓			
	15	✓			
	8	✓			green smoke
12:50	5	✓			

mpany: _____ Inspector: A. Baecker

ocation: _____ Date: 10-5-79

tery number: _____ Run number: 3-1

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
5:25	52	✓			62-56 blocked by push car
	49	✓			green flame
	27	✓			
	22		✓		
	15	✓			
	4				open-
5:28	2	✓			

Company: _____ Inspector: _____

Location: _____ Date: _____

Battery number: _____ Run number: 3-2 reverse direction

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
6:20	5	✓			
	22		✓		
					28—34 blocked (repeated)
	43	✓			
	44				open
	49	✓			green smoke
	52	✓			" "
	57	✓			
6:23	62	✓			green smoke
6:25	27	✓			
6:26					

Company: _____ Inspector: A. Baecker

Location: _____ Date: 10-5-79

Battery number: _____ Run number: 3-3

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
6:59	14	✓			1-13 Blocked by squish car & locomotive
	15	✓			couldn't read these doors - on lunch break and to dark
	17	✓			
	18	✓			
	19	✓			
	22	✓			
	23	✓			
	27	✓			green
	39	✓			
	42	✓			
	43	✓			
	45	✓			
	47	✓			
	52	✓			
	54	✓			
	57	✓			
7:02	63	✓			

Company: _____ Inspector: A. Baecker

Location: _____ Date: 10-5-79

Battery number: _____ Run number: _____

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
7:08	62	✓			
	52	✓			
	49	✓			
	22		✓		
7:10	1				blocked by push car

Company: Armco Steel Inspector: D. Lazarevic

Location: Date: 10/4/79

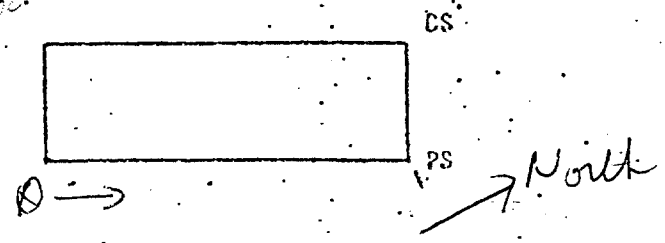
Company Rep.(s): Chuck

Battery number: 1 and 2 Total number of: 62 ovens Oven doors: 124 Chuck doors: 62

Indicate sun position, wind speed and direction, and location of traverse:

Sky condition:

Run number:



Run #1-1 Southwest winds 15 mph

Time traverse started/completed (PS/CS)	Oven number	Visible emissions: Oven door	Visible emissions: Chuck door	OPACITY %	Comments
Start (PS) 14:49	7	✓ M			Not reading opacities
	13	✓	✓		fire also
	45	✓ B	✓		21-27 door niche
Stop (PS) 14:53	49		✓		37 door off
Start (PS) 14:58					picked up
Stop (PS) 14:52:30					It was decided not to read opacities. It was too dark on the coke side to do so and the exhaust ducts were covering the lateral areas on the push side. Only leaks were noted. Fires are to be considered a leak per Lee Beck & Dan Bivins.
	Run #2-1				
Start (PS) 15:41	7	✓ B	✓		
	13	✓			
	27		✓		
	45	✓			47 door off full of coke
Stop (PS) 15:44					fire 49 chuck door

mpany: Armco Steel
Inspector: D Lazarevic
cation:
Date : 10/4/79
ttery number: 1 and
Run number:

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
(CS) 16:16 Start	Run	#3-1			Coke side was extremely difficult to read. Too dark (transformer out therefore flood lights weren't working): About 15 ovens had to be read at an angle due to wharf (coke was dumped here after quenching) and no one was allowed in this area because there wasn't enough room for clearance from quench car.
	#7	✓			
(CS) 16:17 Stop	16	✓			
(CS) 16:18 Start	#27	✓			
(CS) 16:19 Stop	37	✓			fire | Very difficult to determine from which door the emissions came from. Used a lantern light to help see the top of the ovens.
(CS) 16:21 Start	43	✓			
	45	✓			Helped only a little. Since there was only one light and 3 observers, and all 3 observers were not to walk together, it was decided (EPA) that only one person
(CS) 16:21:45 Stop	47	✓			
(CS) 16:30 Start					59-64 door machine
[illegible]					62-59 door car
(CS) 16:33:14					picked these up
(PS) 16:41	13	✓	✓		9-12 door machine
	17	✓			would read the coke side. We alternated reading the coke side between the three readers. John B (1st), August B (2nd) D Lazarevic (3rd). A second person would hold the light.
	27		✓		
	37	✓	✓		
	45	✓			
	47		✓		
(PS) 16:44	57	✓ B			49 fire Chucked

...pany: Armco Steel
...cation:
...tery number:

Inspector: D Lazarevic
Date : 10/4/79
Run number:

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions Oven Door	Visible emissions Chuck Door	OPACITY %	Comments
		Run 3-1		Cont'd	
(PS) 16:45					pickup doors 9-12
(PS) 16:45:15					9 oven door off
		Run 4-1			
(PS) 17:57	19		✓		
	27		✓		
	37	✓			
	47		✓		
	49-52	door machine			(picked up)
	57	✓	✓		
(PS) 1801	67	✓	✓		
					49 door off

PS 1 32 53 68 → N

mpany: Armco Steel Inspector: D. Lazarevic

cation: _____ Date: 10/5/79

ttery number: _____ Run number: _____

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
	Run # 1-2				
(PS) 10:05 start	4	✓	✓		
	8	✓			
	24	✓			15 door off jamb
	43	✓			
	48	✓			
	51	✓			
	53	✓	✓		
	57	✓			
	62	✓			
	63	✓	✓		smoke all over green
	68	✓			
(PS) 10:09 stop	68	✓			
	Run 2-2				
(CS) 10:44 start	2	✓			
	3	✓			
	4	✓			
	6	✓			

Company: Armco Steel
Inspector: Al Lazarenic
Location:
Date: 10/5/79
Battery number:
Run number:

Run 2-2 Cont'd

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
	8				
	9	✓			over door open at top fire
	12	✓			
	14	✓			beneath over door too
	15	✓			all in flames
	18	✓			
	25	✓			bottom door fire
(CS) 1047 stop	33	✓			
(CS) 1049 start	64	✓			37 → door 56
	69	✓			
(CS) 1050 stop	61	✓			
(CS) 1053 start	41	✓			
	43	✓			
	46	✓			
	52	✓			
	53	✓			
(CS) 1054 stop	55	door off			

mpany: Armco Steel

Inspector: D. Lazarevic

cation:

Date: 10/5/79

ttery number:

Run number:

Run 2-2 Cont'd

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
(PS) 10:57	4				following John this time
	5		✓		
	8	✓ B			
	14	✓	✓		
	15	✓	✓		green
	23		✓		
	24	✓			
	43	✓			
	48	✓			
	53	✓			
	57	✓			
	62	✓			
	63	✓			
	66	✓			
(PS) 11:01	68	✓			

...pany: Armco Steel Inspector: Al Lazarevic

...cation: ___ Date: 10/5/79

...tery number: ___ Run number: ___

5-10 mph wind

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
	Rise		3-2		Angry follow me - John
(PS) 11:47	4	✓			other end
	8	✓			
	15	✓			
	45	✓			
	48	✓			
	53	✓			
	55		✓		
	57	✓			
	62	✓			
	63	✓			
(PS) 11:51	68	✓			

Company: Armco Steel

Location:

Battery number:

Inspector: D. Lazzeri

Date: 10/5/79

Run number:

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
		Run 4+2			
(PS) 12:47	8	✓			
	15	✓			
	23		✓		
	45	✓			
	48	✓			
	53	✓			
	57	✓			
	62	✓			
	63	✓			
(PS) 12:50	68	✓			

...pany: Armco
...cation:
...ery number:

Inspector: D Lazarevic
Date : 10-5-79
Run number:

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions Oven Door	Visible emissions Chuck Door	OPACITY %	Comments
		Run	1-3		
(CS) 17:14	2	✓			
	3	✓			
	7	✓			
	9	✓			jamb
	11	✓			
	12	✓			
	13	✓			
	15	✓			
	18	✓			
	19	✓			
	22	✓			
	17	✓			
	23	✓			
(CS) 17:16	27	✓			
(CS) 17:17	37	✓			
	39	✓			
	41	✓			
	42	✓			

mpany: Armco

cation:

ttery number:

Inspector: D. Lazarevic

Date: 10-5-79

Run number:

Run 1-3 cont'd

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
	43	✓			
	45	✓			
	48	✓			
	49	✓			
(CS) 17:18	52	✓			fire at bottom
(CS) 17:19	57	✓			
	59	✓			
	63	✓			
(CS) 17:20	66	✓			
(PS) 17:25	2	✓			
	A oven door off				
	7	✓			
	15	✓			
	22		✓		
	27	✓			
	43		✓		
	49	✓	✓		
	52	✓	✓		

...pany: Armco Inspector: D Lazarevic

...cation: ___ Date: 10-5-79

...ery number: ___ Run number: ___

Run 1-3 cont'd

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	OPACITY %	Comments
(PS) 17:28 stop					56-62 door can
(PS) 17:30 start	57	✓			picked up
(PS) 17:30:32 stop					
		Run 2-3			
(PS) 18:17	2	✓			
	5		✓		
	15	✓			
	22		✓		
	23		✓		
		28-34	door		machine
		44	door off		
	49	✓	✓		
	52	✓			
	57	✓			
(PS) 18:20 stop	62				
(PS) 18:23 start					picked up
(PS) 18:23:30 stop					

mpany: Armco

cation:

ttery number:

Inspector: D. Lazarevic

Date : 10-5-79

Run number:

Time traverse started/ completed (PS/CS)	Oven number	Visible emissions Oven Door	Visible emissions Chuck Door	OPACITY %	Comments
		Run 3-3			
(PS) 19:08	2	✓			
	22		✓		
	43		✓		
	45	✓			
	49	✓	✓		
	52	✓			
	62	✓	✓		
(PS) 19:11	63	✓			
					This is the last run.
					It is getting too dark to read.

APPENDIX C

BENZENE SOLUBLE ORGANIC WEIGHTS BY FRACTION

TABLE C-1. BENZENE SOLUBLE ORGANIC WEIGHTS BY FRACTION, GRAMS

Sample Location	Sample Number	Condensate	Acetone Rinse	Benzene Rinse	110-mm Filter	Total
Inlet	1	a	0.0248	0.0299	0.0179	0.0726
	2	0.0136	0.0258	0.0471	0.0334	0.1199
	3	0.0053	0.0499	0.0427	0.0442	0.1421
Outlet	1	a	0.0067	0.0217	0.0101	0.0385
	2	0.0127	0.0096	0.0142	0.0220	0.0585
	3	0.0065	0.0105	0.0119	0.0278	0.0567

[a]Combined with acetone rinse.

APPENDIX D

GAS CHROMATOGRAMS

LABORATORY ANALYSIS REPORT

Lab Nos. _____

Project US EPA - HOUSTON (ARMCO STEEL)

Job No. 6399-20 Sampling Date OCT-4,5,1979

Investigators MATTSON, PALMER, BIRD, KNUTSON, OPTHOFF'S, Holm, etc, Log-in Date _____

Identity, Volume and Concentration of Collection Media: _____

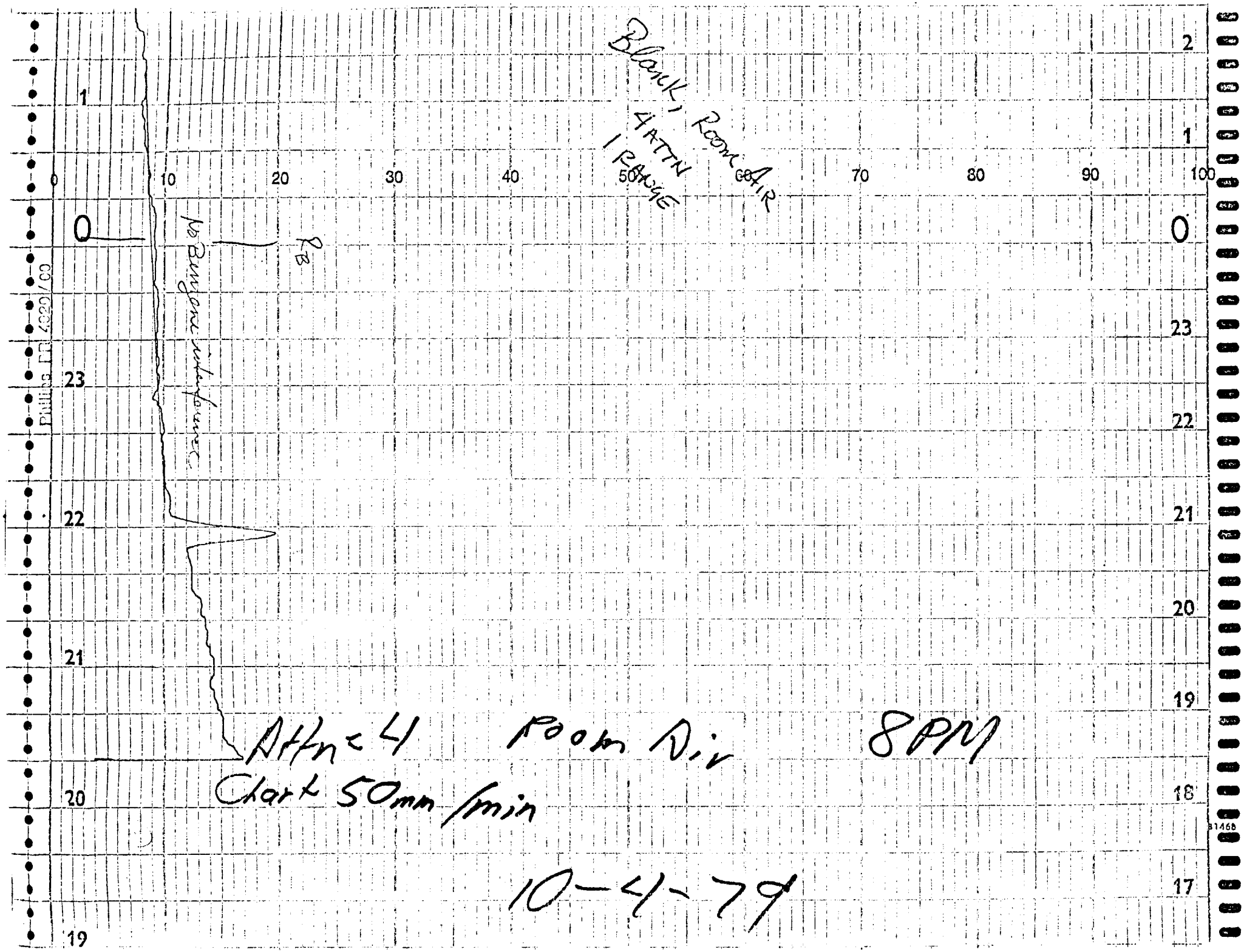
Special Instructions: _____

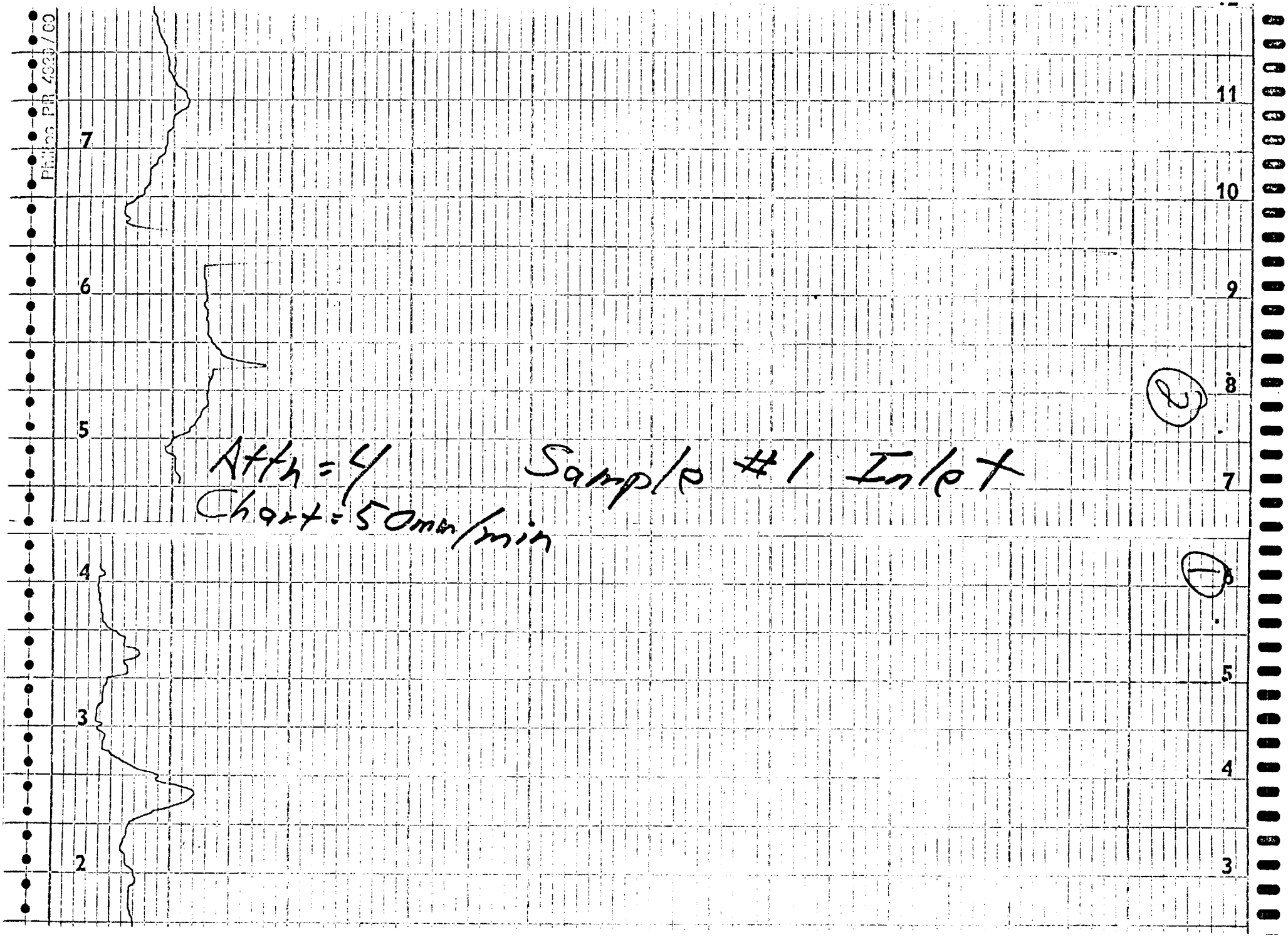
Analyses Requested: Benzene (Am)
Analyst: J. Holm
Date Completed: 10/8/79

Lab No.	Field Description: Stack or Site No.	Test No. & Date	Fraction Identification	Total Original Volume of Sample	Analyses Completed Detm'n _____ Units _____	Blank Corr.
	BLANK			PPM (DRY)	BENZENE PPM	PAGE
	TEST 1	INLET		0.7	0.7 (2,3)	
		OUTLET		0.7	0.8 (4,5)	
	TEST 2	INLET		2.1	2.1 (18)	
		OUTLET		2.9	3.0* (16,17)	
	TEST 3	INLET		2.2	2.2 (14,15)	
		OUTLET		2.1	2.1 (19,20)	
	Lab Blank					
	Q.C. Sample 1 Reference Value:					
	Q.C. Sample 2 Reference Value:					

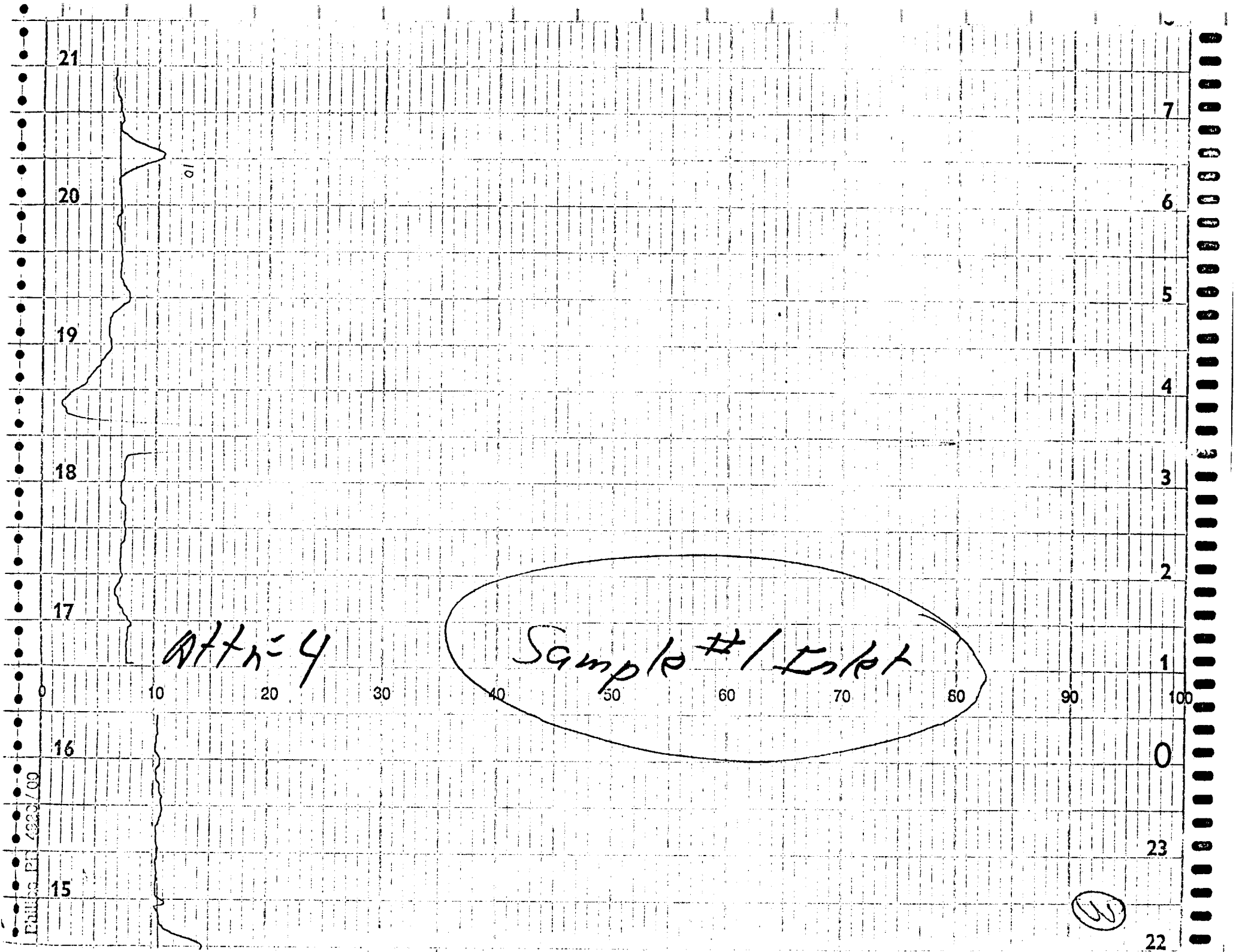
Comments: * small air sample collected during source testing. Possibly a leaky sample bag.

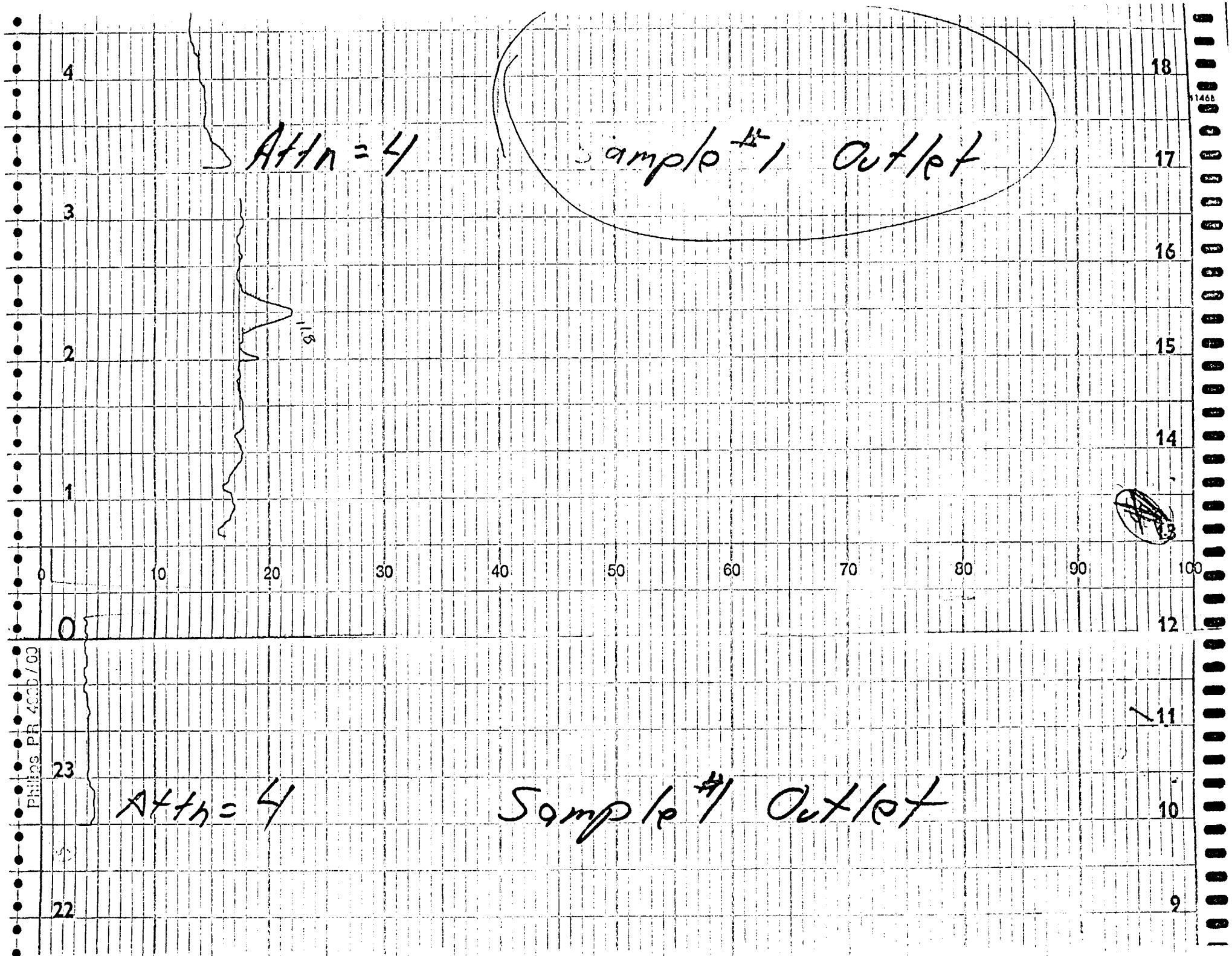
☐ Chgd Approved _____ Date _____

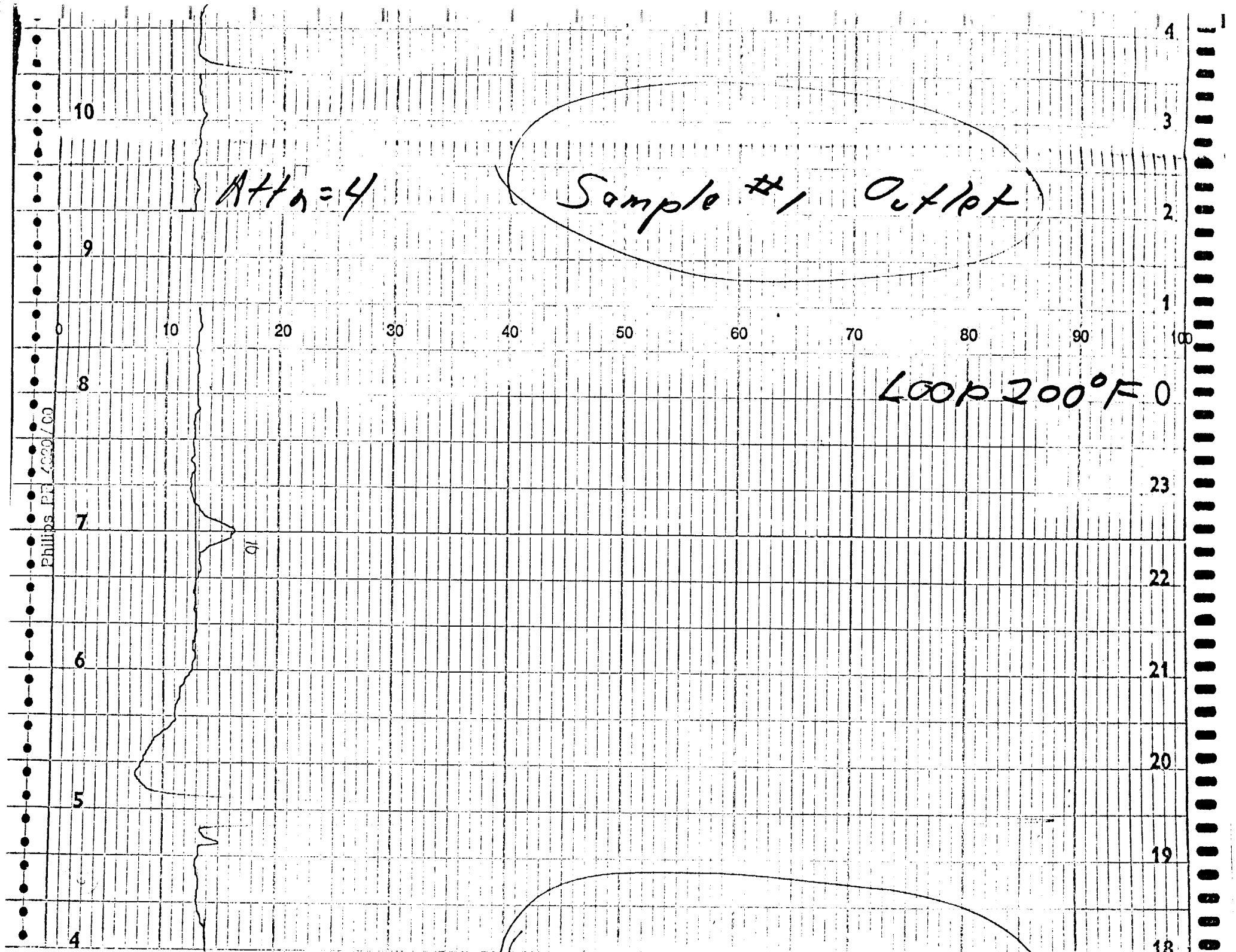

Blank, Room Air
4 ATTN
1 RANGE
0
10
20
30
40
50
60
70
80
90
100
1
0
23
22
21
20
19
2
1
0
23
22
21
20
19
18
17
Phillips PD 4020/00
RB
No Benzene interference
Attn = 4 Room Air 8PM
Chart 50mm/min
10-4-79

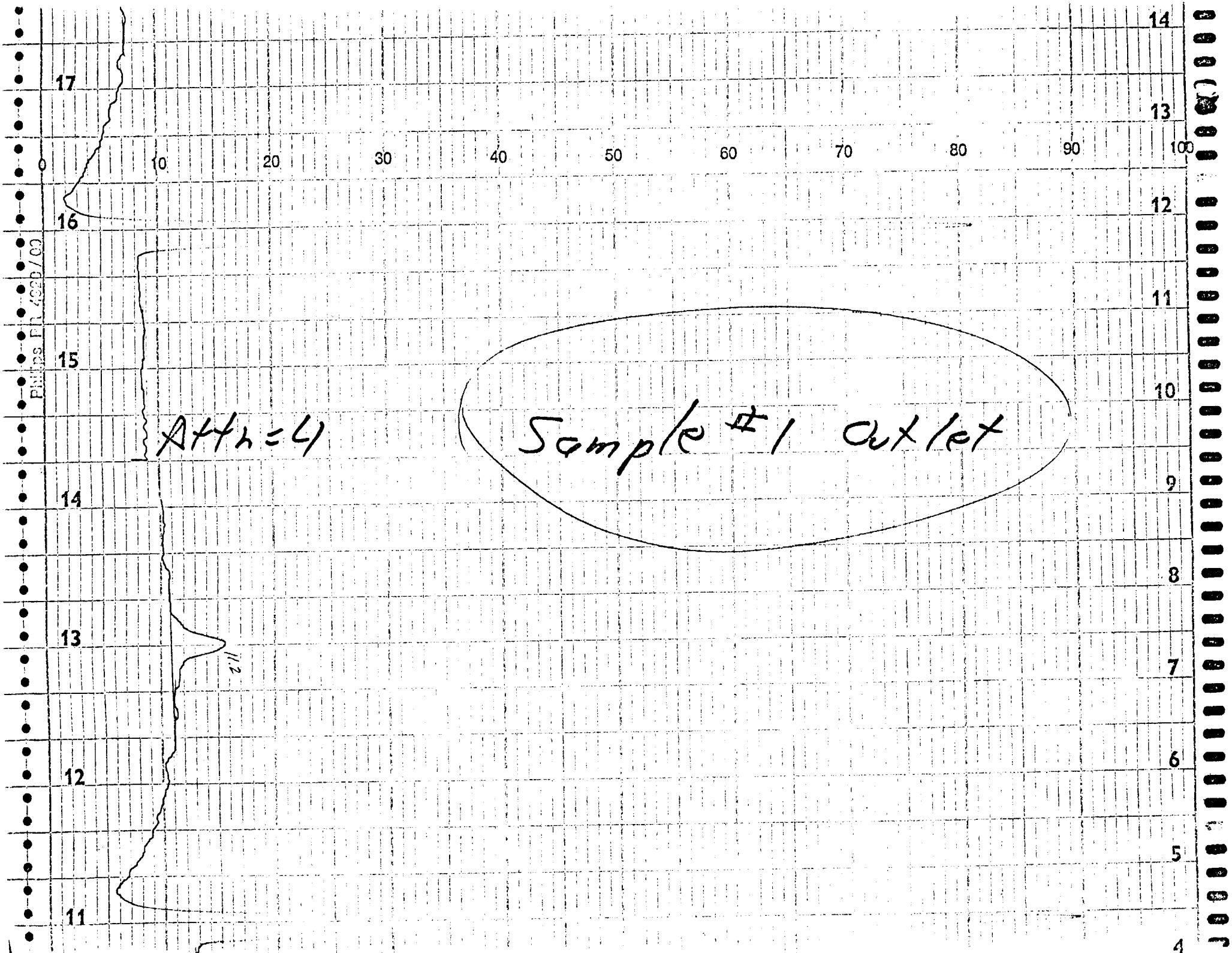

Philips PR 4020/00
Atth = 4
Chart = 50mm/min
Sample #1 Inlet
2
3
4
5
6
7
8
9
10
11
3
4
5
6
7
8

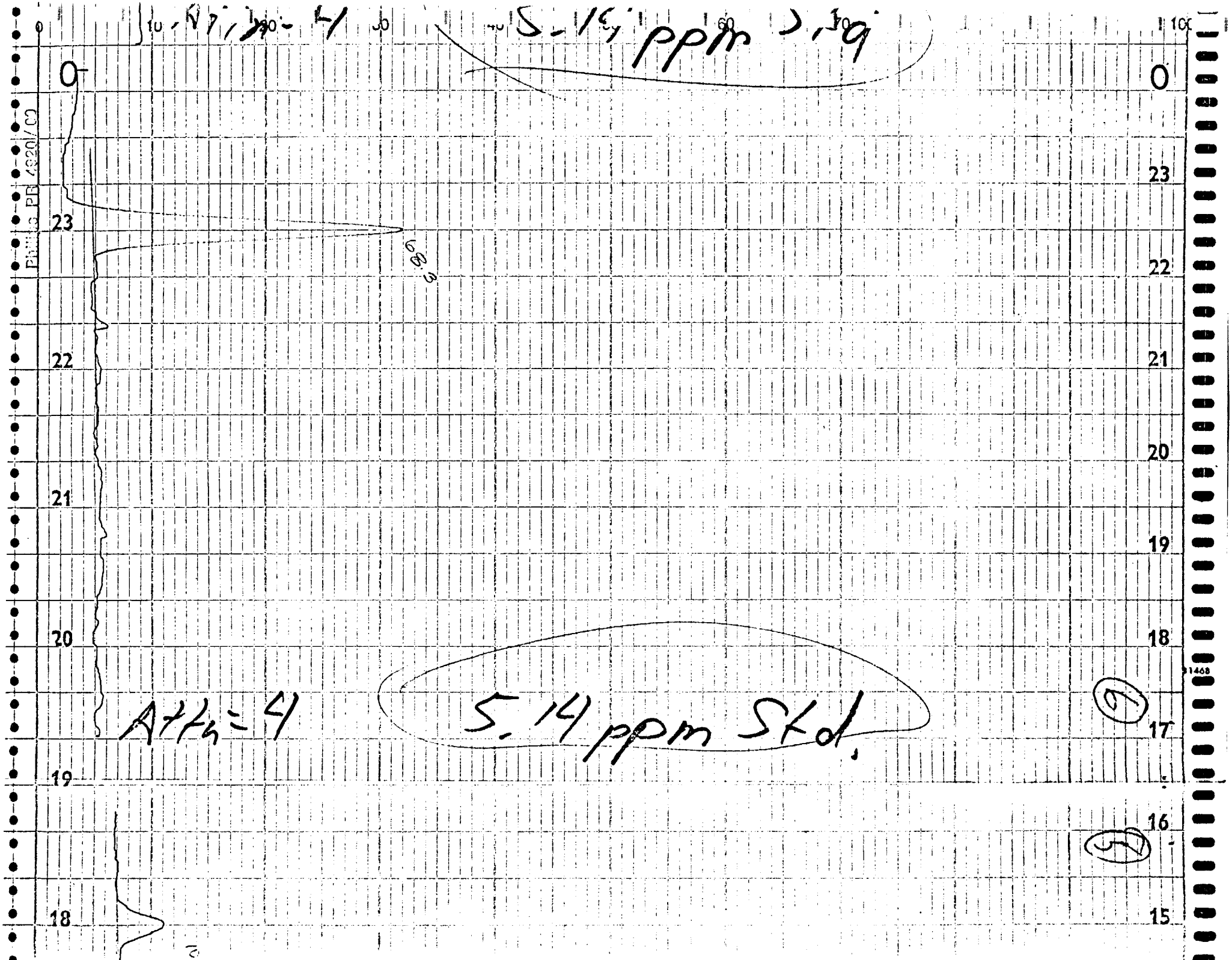
Attn = 4
Sample #1 Inlet
0
10
20
30
40
50
60
70
80
90
100
8
9
10
11
12
13
14
12
13
14
15
16
17
18
19
20
21
22


21
20
19
18
17
16
15
0
10
20
30
40
50
60
70
80
90
100
7
6
5
4
3
2
1
0
23
22
Attn=4
Sample #1 Eskt

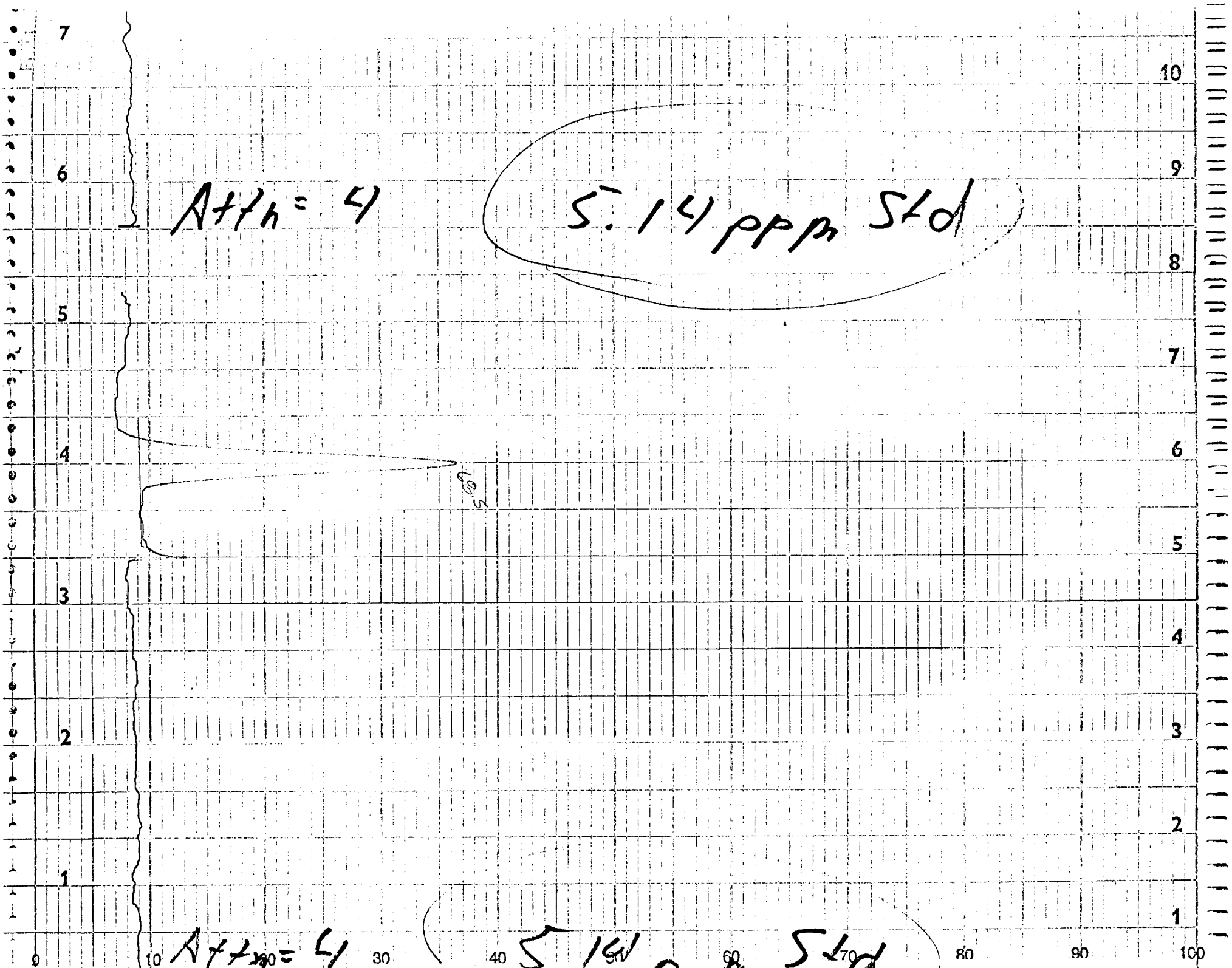

Attn = 4
Sample #1 Outlet
Attn = 4
Sample #1 Outlet
Philips PR 4000/00

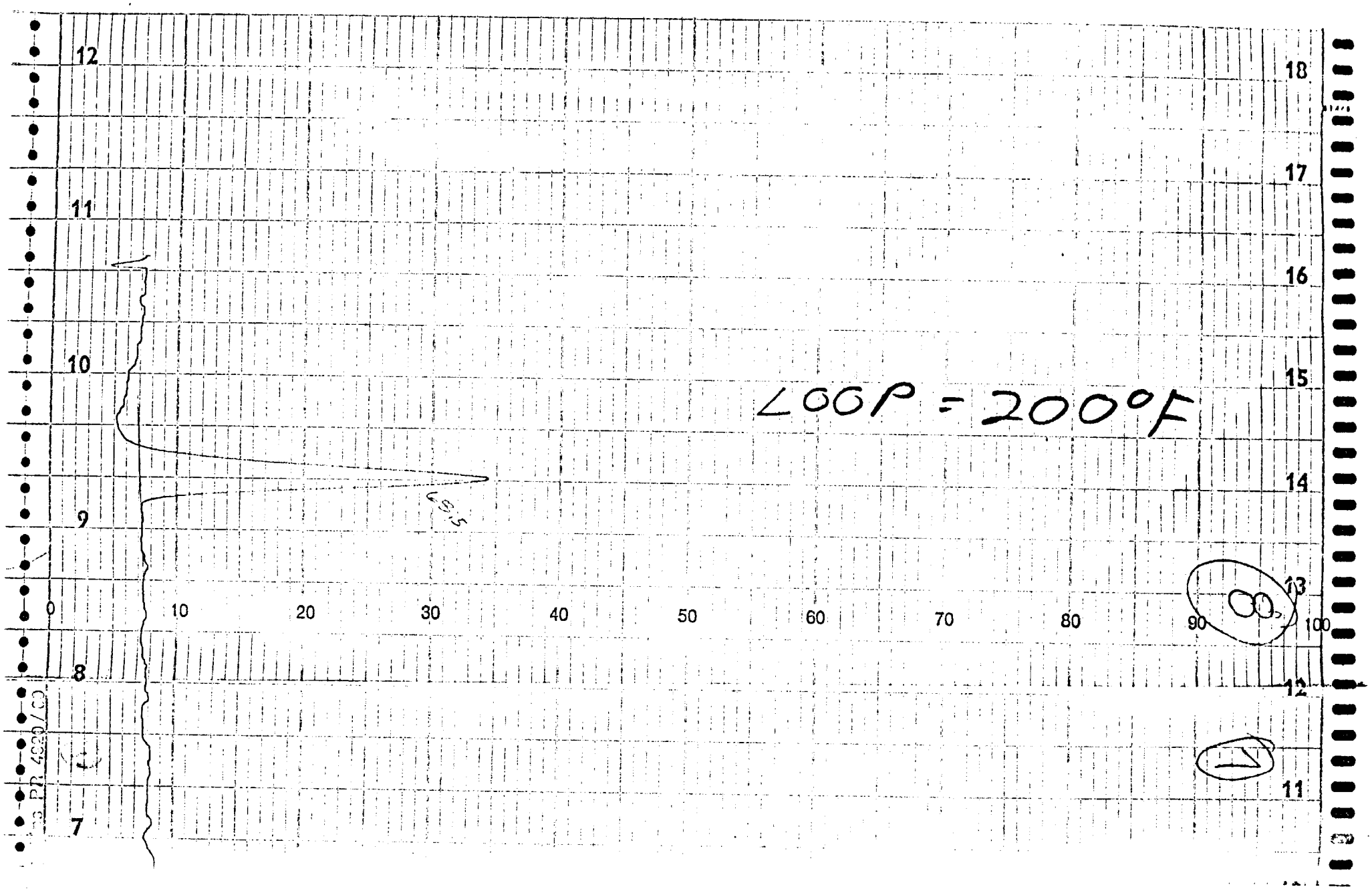

Atten=4
Sample #1 Outlet
Loop 200°F
0 10 20 30 40 50 60 70 80 90 100
Phillips PR 4020/CO

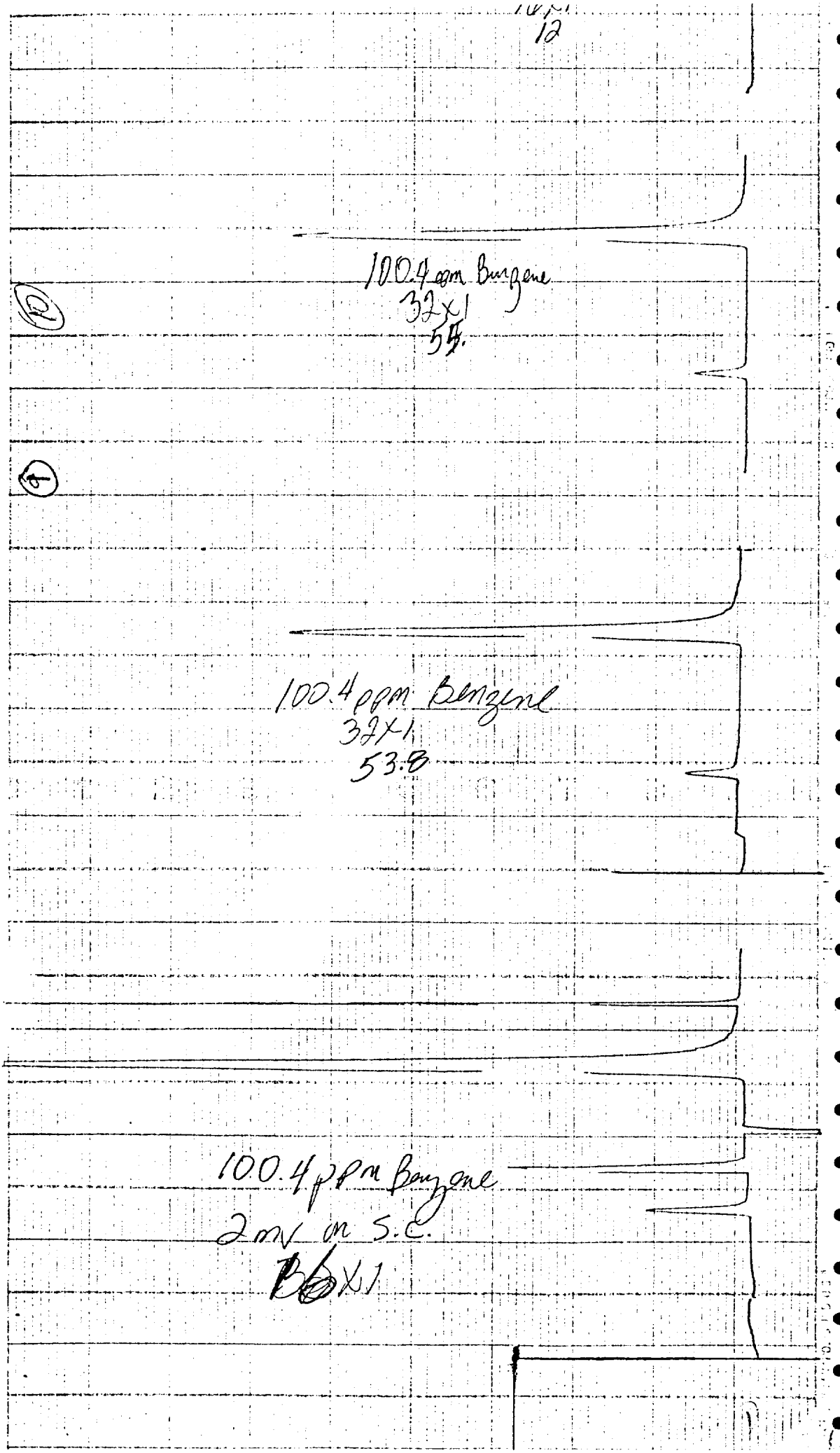

Sample #1 outlet
Attn=4
0
10
20
30
40
50
60
70
80
90
100
17
16
15
14
13
12
11
14
13
12
11
10
9
8
7
6
5
4
Phillips PR 4820/00



5.14 ppm Std.
68.3
Atta=4
5.14 ppm Std.


Atth = 4
5.14 ppm Std
Atth = 4
5.14 Std


LOOP = 200°F
12
11
10
9
8
7
18
17
16
15
14
13
12
11
0
10
20
30
40
50
60
70
80
90
100
9.5


100.4 ppm Benzene
32x1
54.
100.4 ppm Benzene
32x1
53.8
100.4 ppm Benzene
2mv on S.C.
B6x1

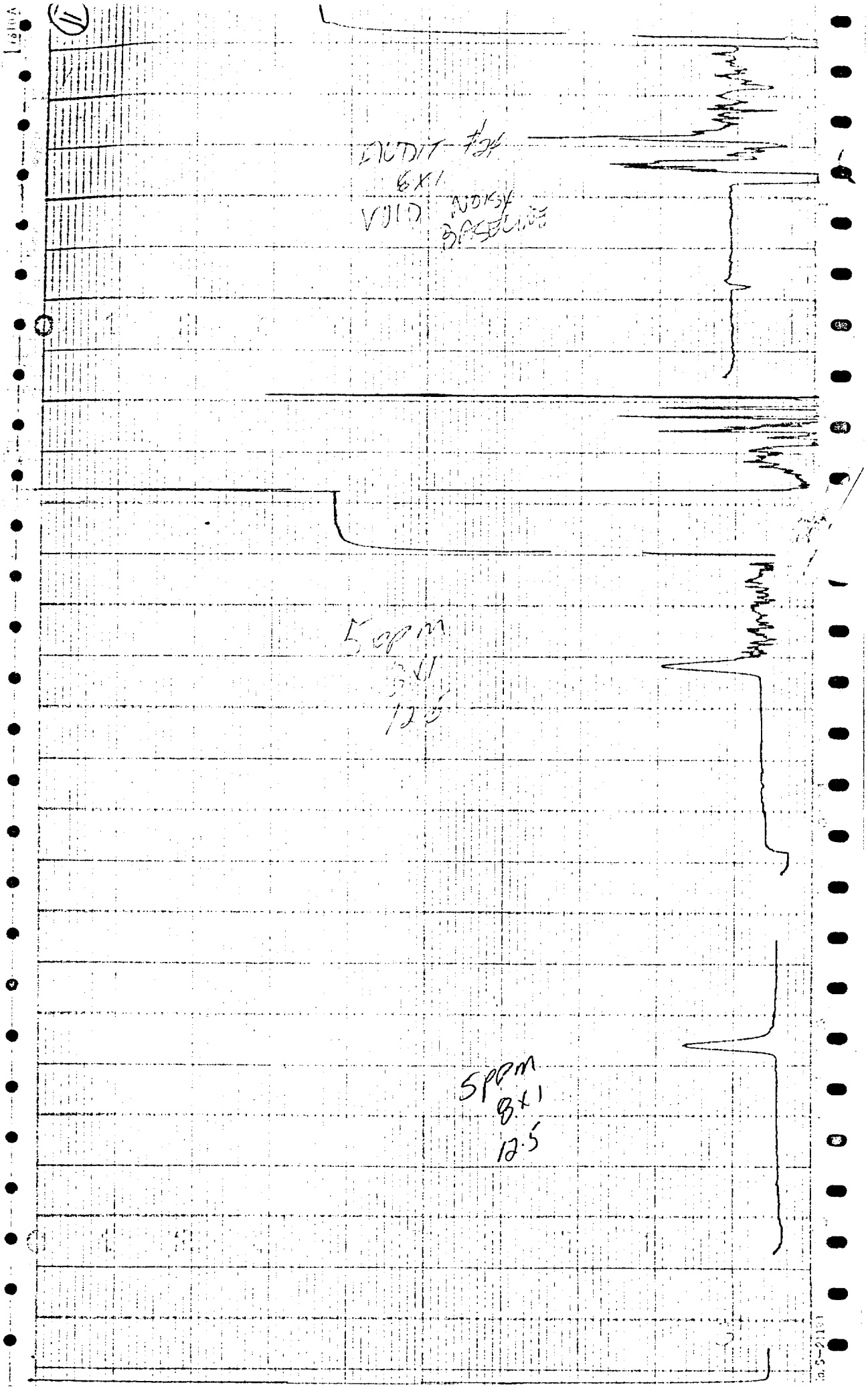
5ppm
8x1
12.5

5ppm
8x1
12.5

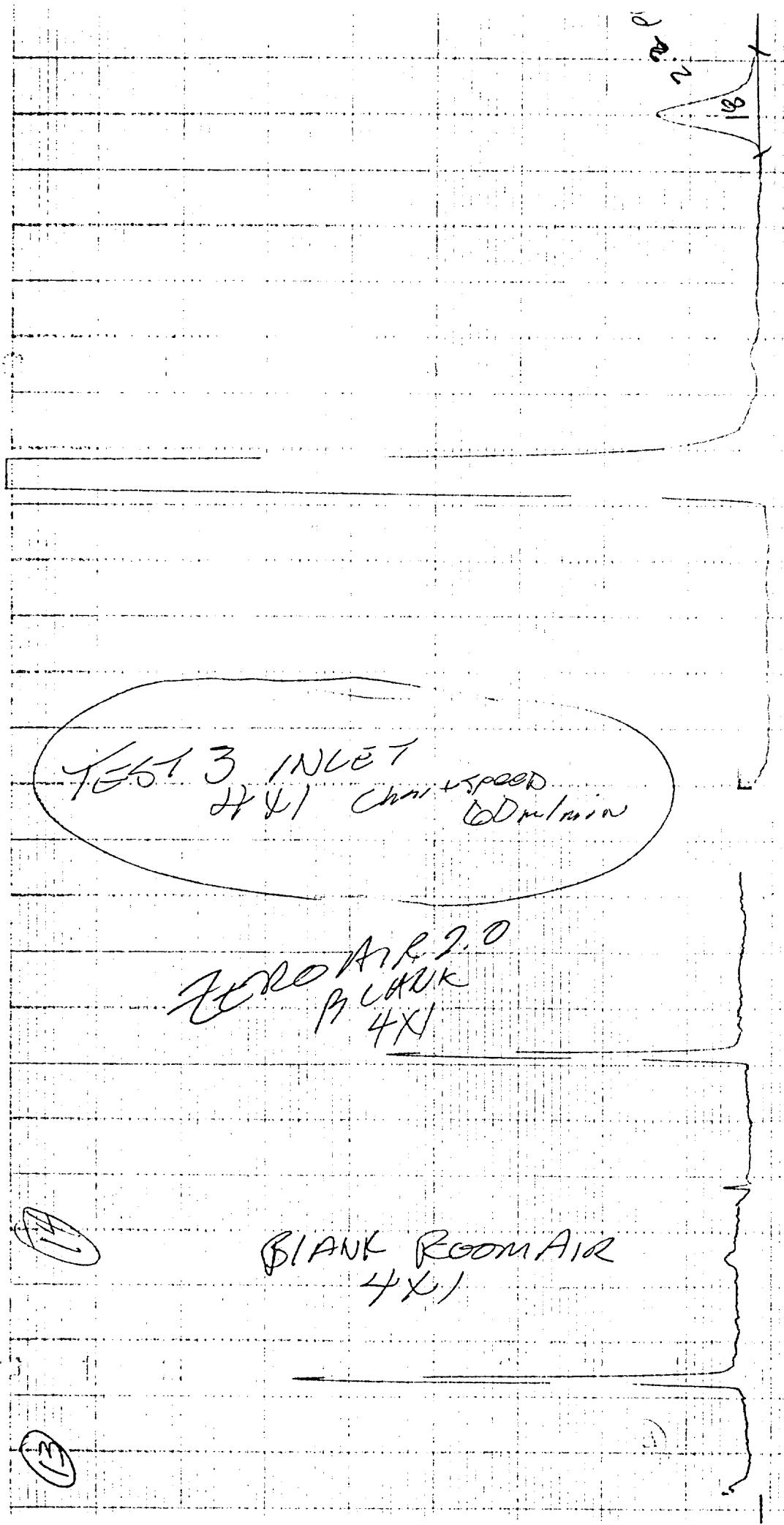
10.1ppm Benzene
16x1
12

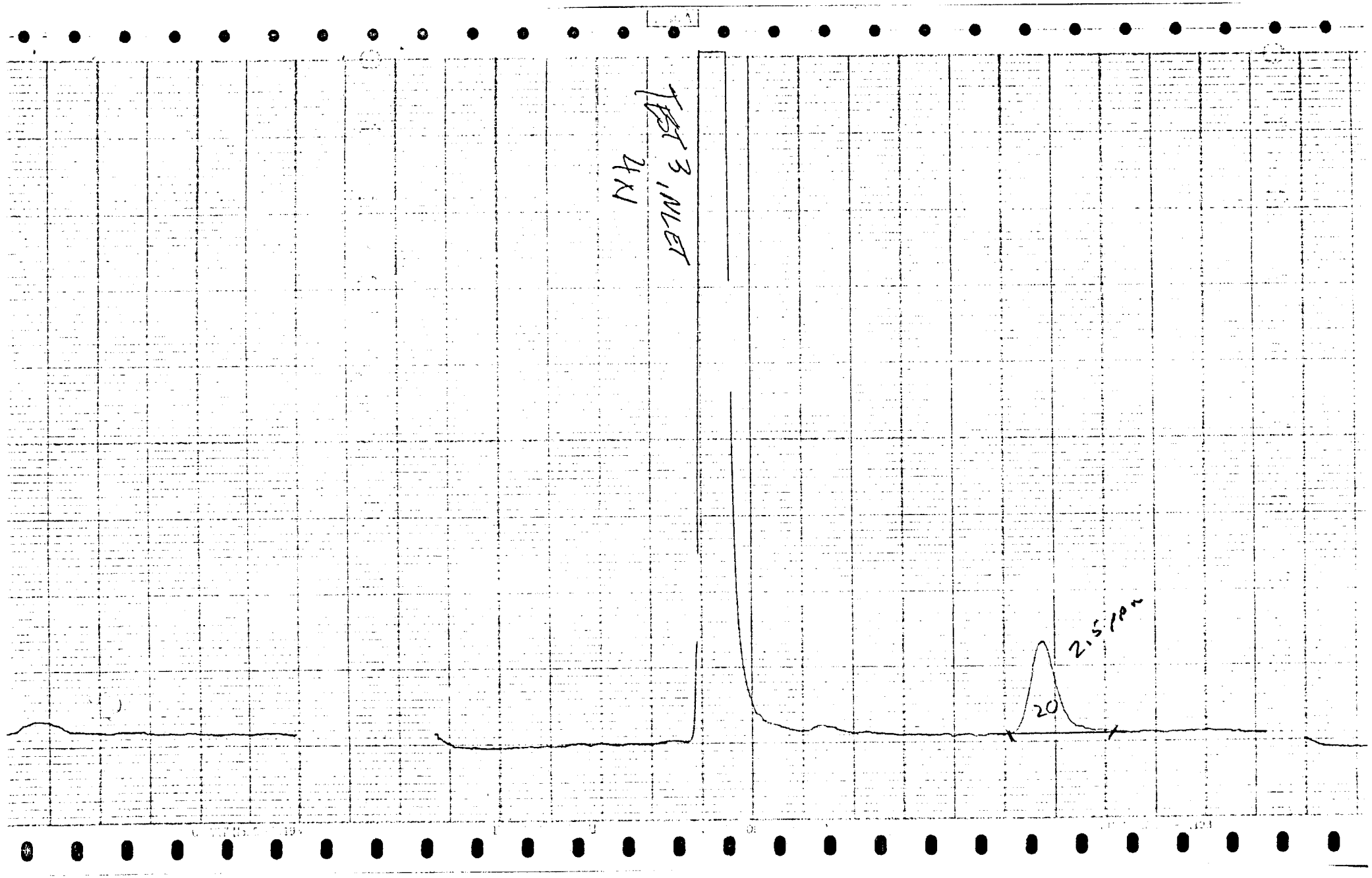
10.1ppm Benzene
16x1
12

Z310A

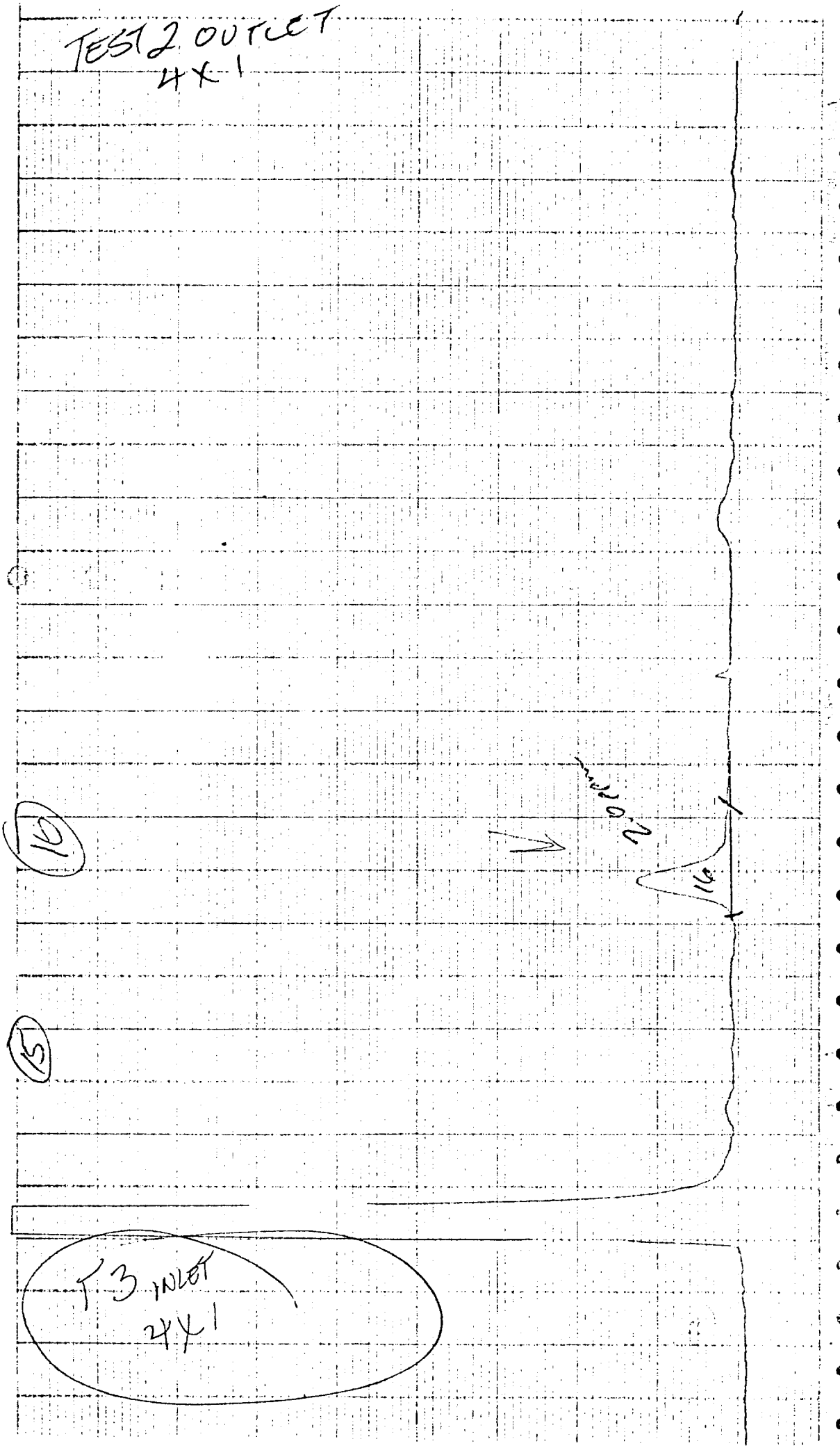


AUDIT #24
6X1
VOID NOISY BASELINE
5 ppm
8X1
12.5
5ppm
8X1
12.5

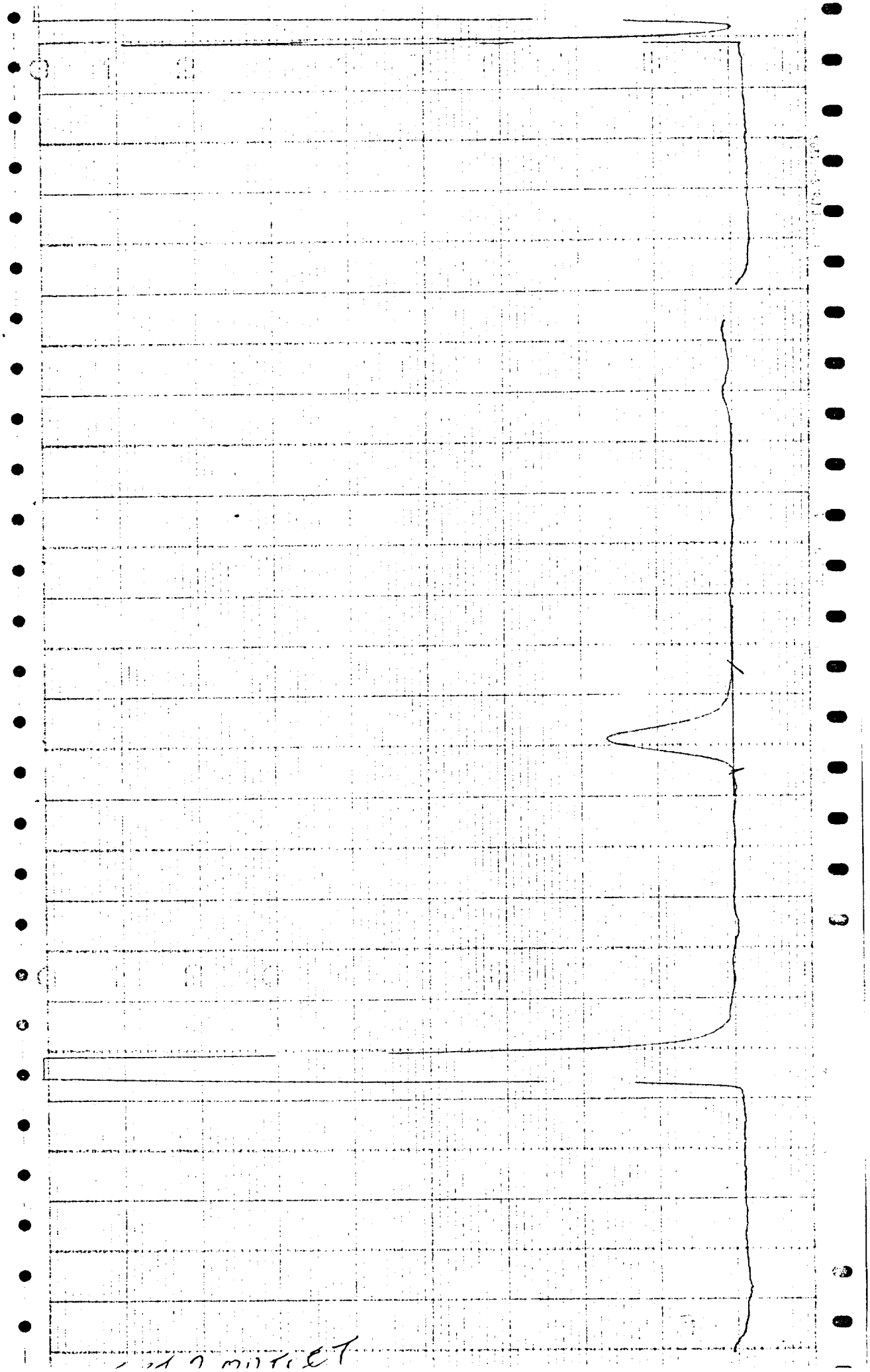

TEST 3 INLET
4X1 Chart speed 60mm/min
ZERO AIR 2.0
BLANK
4X1
BLANK ROOM AIR
4X1

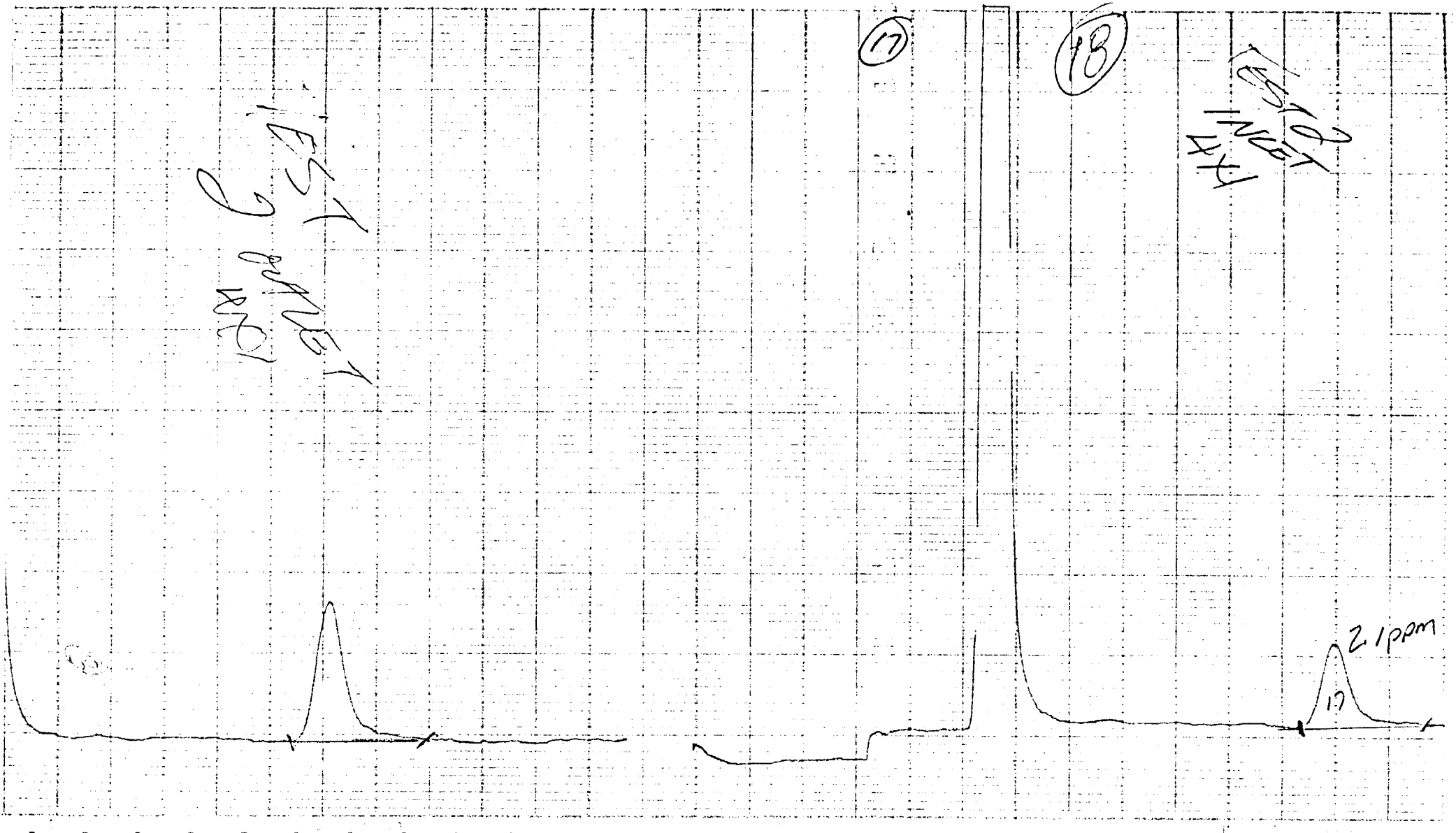

TEST 3, INLET
N4
20
2.5 ppm

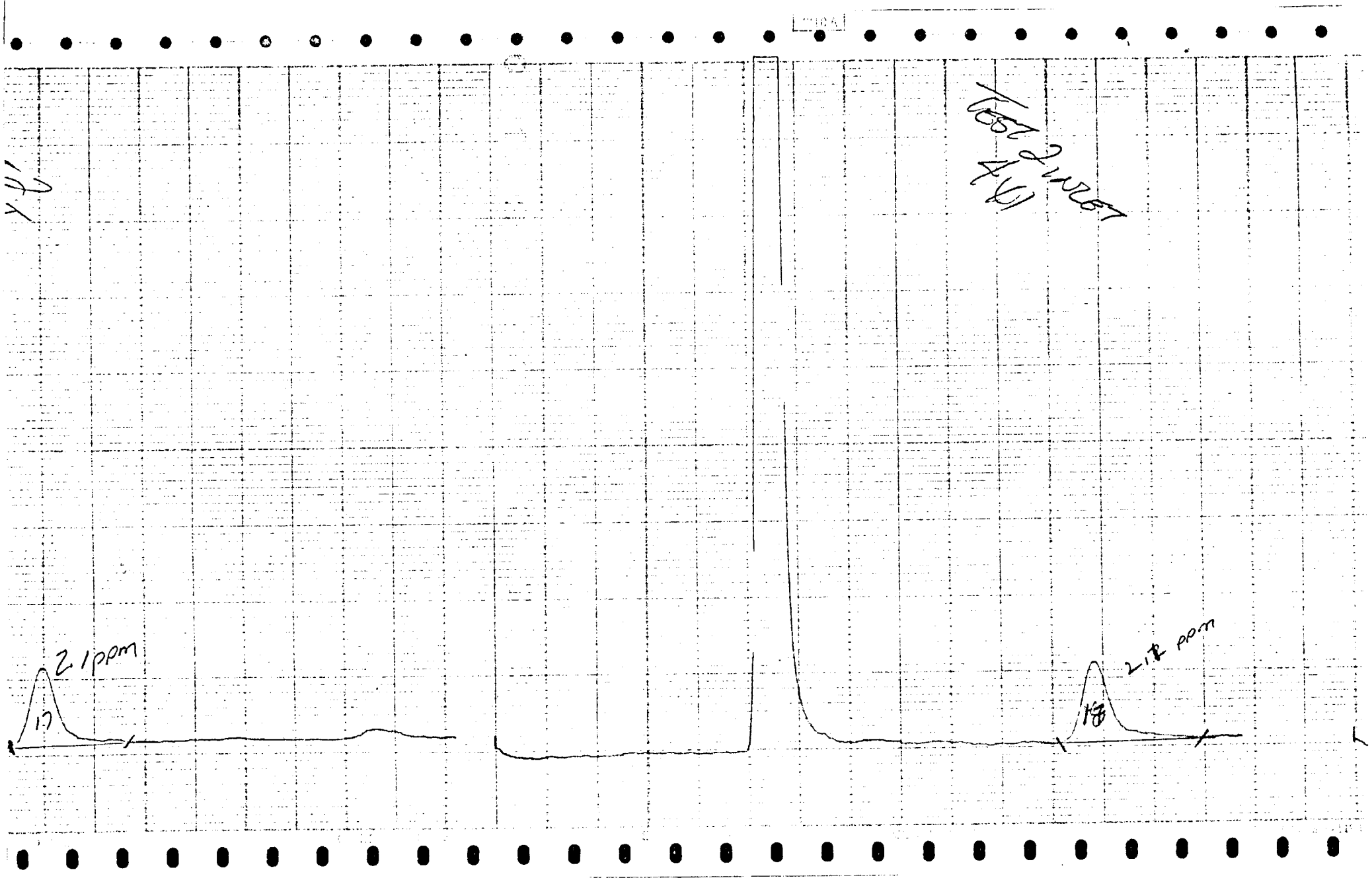
TEST 2 OUTLET
4X1



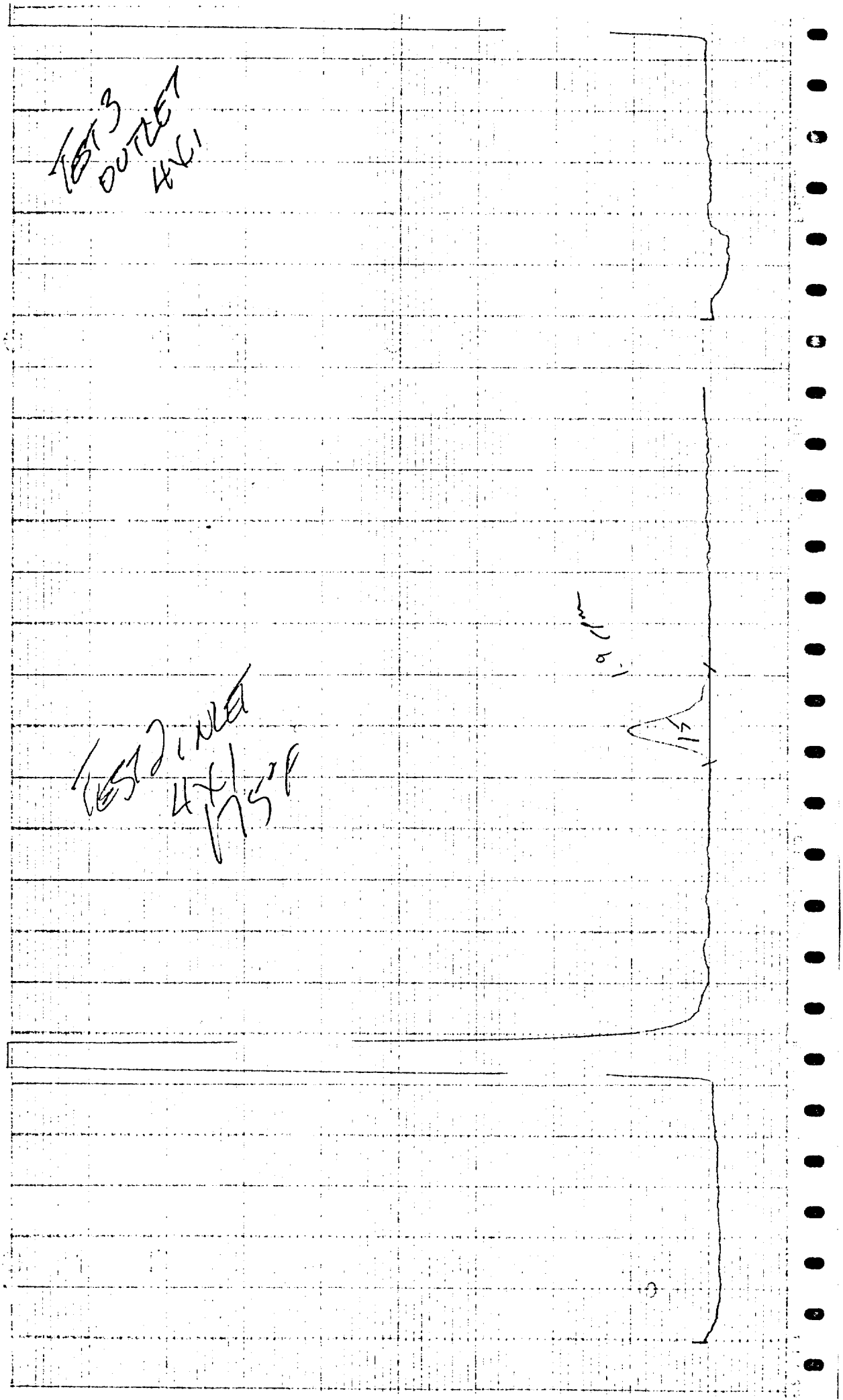
T3 INLET
4X1

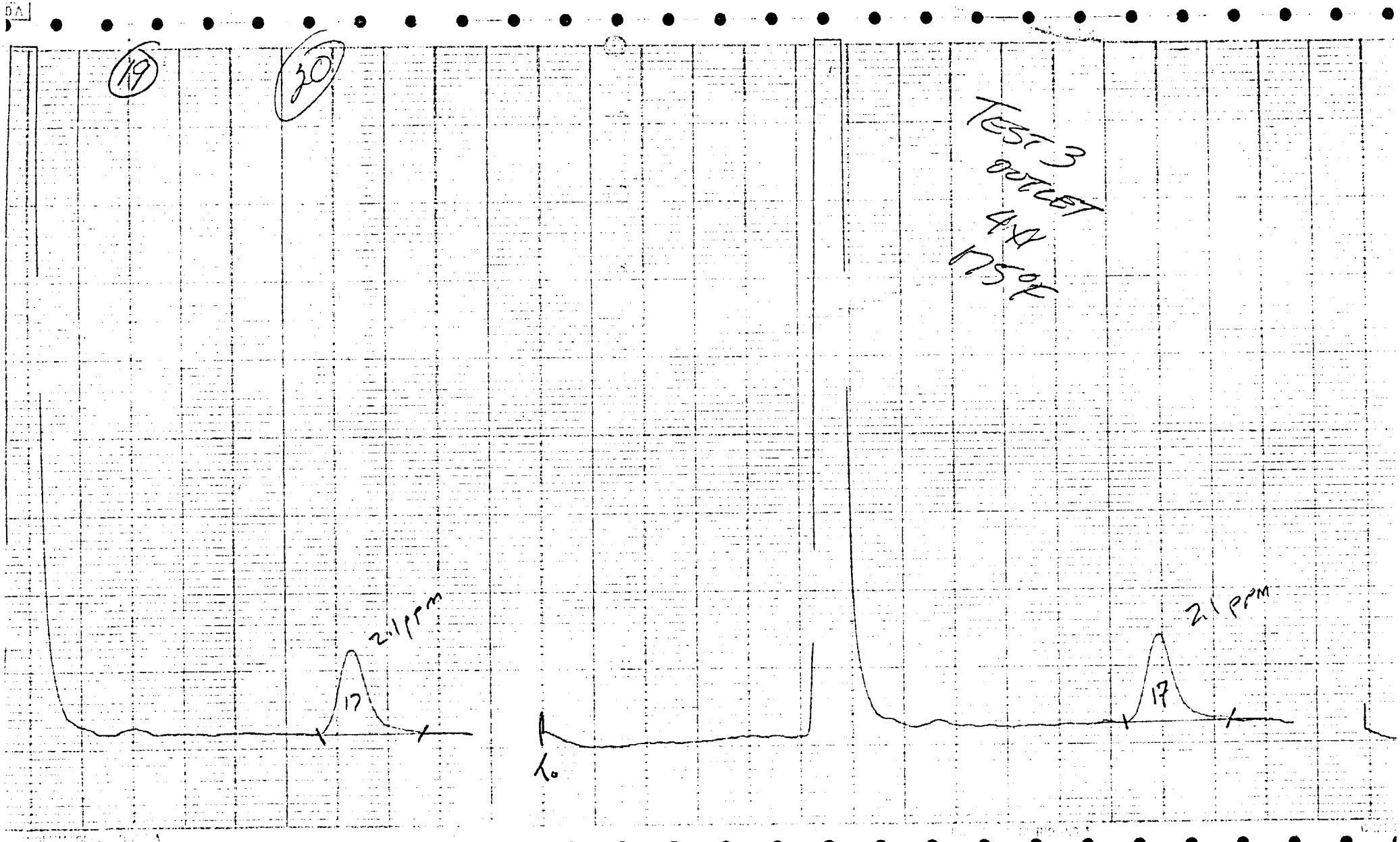


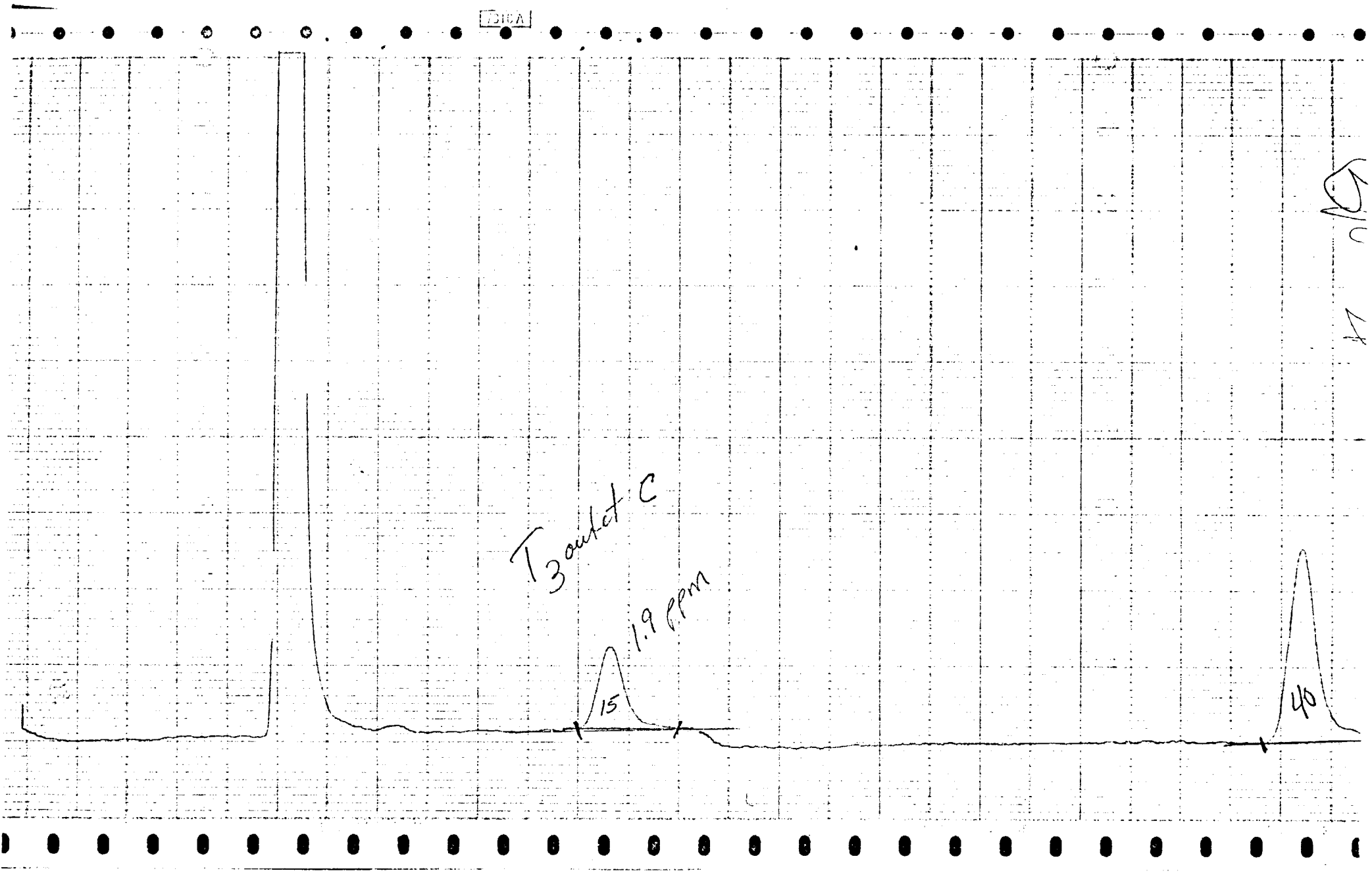

17
18
2.1ppm
17



Test 2 inlet
4(1)
2.1ppm
17
2.12 ppm
18


TEST 3
OUTLET
4X1
TEST 2 INLET
4X1
175°F


19
20
TEST 3
OUTLET
4X
175°F
2.1 ppm
17
T_0
2.1 ppm
17



T3 outlet C
1.9 ppm
15
40

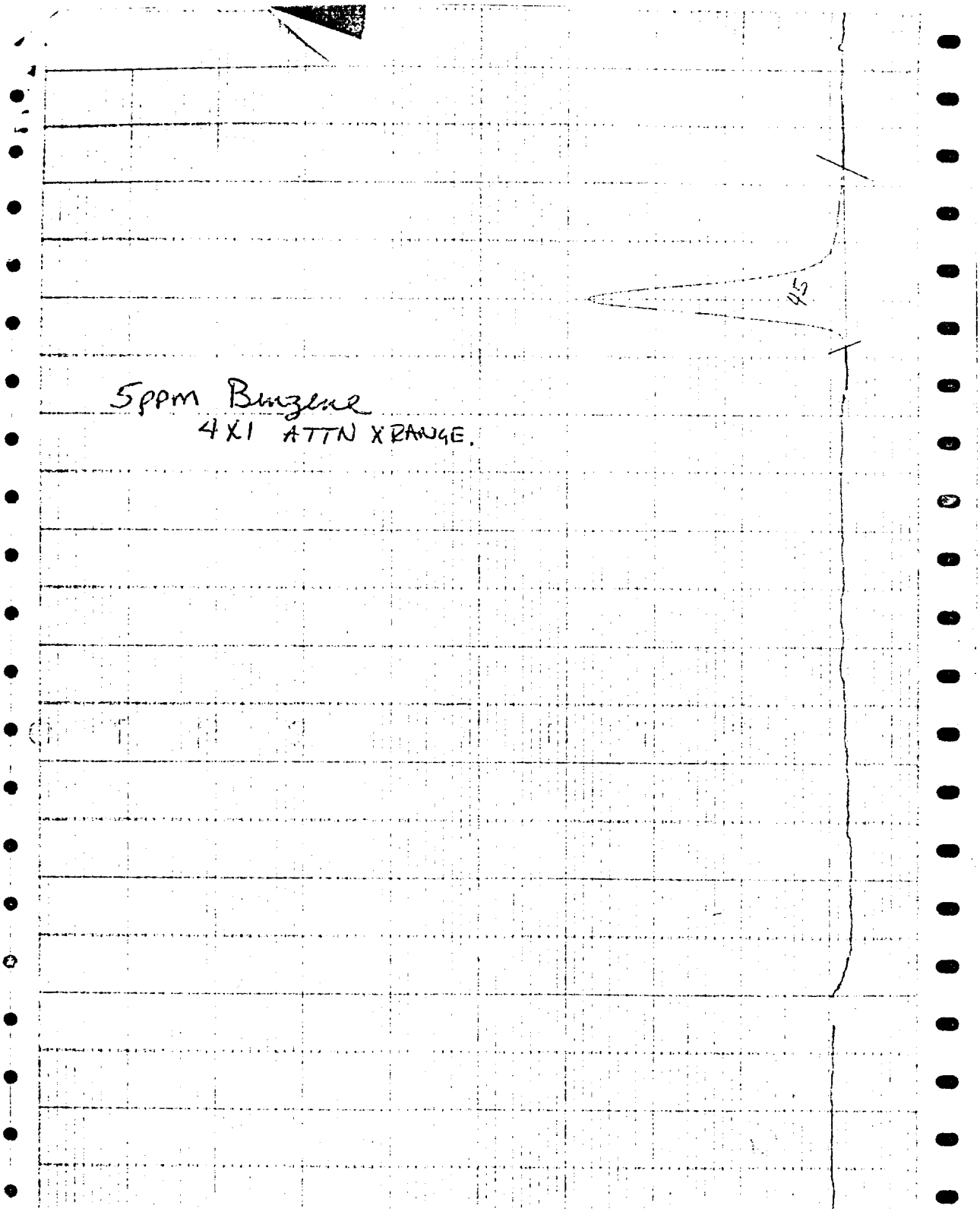
32

5ppm
4x1

36

21

5ppm Benzene


45
5ppm Benzene
4X1 ATTN XRANGE.

APPENDIX E

DETAILED SUMMARY OF SAMPLING AND ANALYTICAL PROCEDURES

E-1. Draft Benzene Soluble Organics
E-2. Determination of Benzene
E-3. Draft Method 109 (and Addendum to Method 109). Determination of Visible Emissions from Coke Oven Batteries
E-4. Method 9. Visual Determination of the Opacity of Emissions from Stationary Sources

APPENDIX E-1

BENZENE SOLUBLE ORGANICS

3 JUL 197

7/3/1978

Benzene Soluble Organic

1. Principle and Applicability

1.1 Principle. A gas sample is withdrawn isokinetically from the stack. Benzene soluble organic material is extracted from the filter and impingers, dried, and determined gravimetrically.

1.2 Applicability. This method is applicable for the determination of benzene soluble organics from stationary sources as specified by the applicable subpart.

2. Apparatus

2.1 Sampling Train. A schematic of the sampling train used in this method is shown in Figure -1. Complete construction details are given in APTD-0581 (Citation 2 in Section 7); commercial models of this train are also available. For changes from APTD-0581 and for allowable modifications of the train shown in Figure 5-1, see the following subsections.

The operating and maintenance procedures for the sampling train are described in APTD-0576 (Citation 3 in Section 7). Since correct usage is important in obtaining valid results, all users should read APTD-0576 and adopt the operating and maintenance procedures outlined in it, unless otherwise specified herein. The sampling train consists of the following components:

2.1.1 Probe Nozzle. Stainless steel (316) or glass with

sharp, tapered leading edge. The angle of taper shall be $\leq$ 30° and the taper shall be on the outside to preserve a constant internal diameter. The probe nozzle shall be of the button-hook or elbow design, unless otherwise specified by the Administrator. If made of stainless steel, the nozzle shall be constructed from seamless tubing; other materials of construction may be used, subject to the approval of the Administrator.

A range of nozzle sizes suitable for isokinetic sampling should be available, e.g., 0.32 to 1.27 cm (1/8 to 1/2 in.)--or larger if higher volume sampling trains are used--inside diameter (ID) nozzles in increments of 0.16 cm (1/16 in.). Each nozzle shall be calibrated according to the procedures outlined in Section 5.

2.1.2 Probe Liner. Borosilicate or quartz glass tubing with a heating system capable of maintaining a gas temperature at the exit end during sampling of 120 $\pm$ 14°C (248 $\pm$ 25°F). Since the actual temperature at the outlet of the probe is not usually monitored during sampling, probes constructed according to APTD-0581 and utilizing the calibration curves of APTD-0576 (or calibrated according to the procedure outlined in APTD-0576) will be considered acceptable.

Either borosilicate or quartz glass probe liners may be used for stack temperatures up to about 480°C (900°F);

quartz liners shall be used for temperatures between 480 and 900°C (900 and 1650°F). Both types of liners may be used at higher temperatures than specified for short periods of time, subject to the approval of the Administrator. The softening temperature for borosilicate is 820°C (1508°F), and for quartz it is 1500°C (2732°F).

Whenever practical, every effort should be made to use borosilicate or quartz glass probe liners. Alternatively, metal liners (e.g., 316 stainless steel, Incoloy 825,[1] or other corrosion resistant metals) made of seamless tubing may be used, subject to the approval of the Administrator.

2.1.3 Pitot Tube. Type S, as described in Section 2.1 of Method 2, or other device approved by the Administrator. The pitot tube shall be attached to the probe (as shown in Figure 5-1) to allow constant monitoring of the stack gas velocity. The impact (high pressure) opening plane of the pitot tube shall be even with or above the nozzle entry plane (see Method 2, Figure 2-6b) during sampling. The Type S pitot tube assembly shall have a known coefficient, determined as outlined in Section 4 of Method 2.

2.1.4 Differential Pressure Gauge. Inclined manometer or equivalent device (two), as described in Section 2.2 of Method 2. One manometer shall be used for velocity head (Δp) readings, and the other, for orifice differential pressure readings.

2.1.5 Filter Holder. Borosilicate glass, with a glass frit filter support and a silicone rubber gasket. Other materials of construction (e.g., stainless steel, Teflon, Viton) may be used, subject to the approval of the Administrator. The holder design shall provide a positive seal against leakage from the outside or around the filter. The holder shall be attached between the first and second impingers (or cyclone, if used).

2.1.6 Filter Heating System. Any heating system capable of maintaining a temperature around the filter holder during sampling no greater than 40°C (104°F). A temperature gauge capable of measuring temperature to within 3°C (5.4°F) shall be installed so that the temperature around the filter holder can be regulated and monitored during sampling. Heating systems other than the one shown in APTD-0581 may be used.

2.1.7 Impingers. Five impingers, one followed by a filter, then four connected in series with leak-free ground glass fittings or any similar leak-free non-contaminating fittings. The first, second, fourth, and fifth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with a 1.3 cm (1/2 in.) ID glass tube extending to about 1.3 cm (1/2 in.) from the bottom of the flask. The third impinger shall be of the Greenburg-Smith design with the standard tip. Modifications

(e.g., using flexible connections between the impingers, using materials other than glass, or using flexible vacuum lines to connect the filter holder to the condenser) may be used subject to the approval of the Administrator. The first impinger shall be empty, the second and third impingers shall contain known quantities of deionized, distilled water (Section 4.1.3), the fourth shall be empty, and the fifth shall contain a known weight of silica gel, or equivalent desiccant. A thermometer, capable of measuring temperature to within 1°C (2°F) shall be placed at the outlet of the fifth impinger for monitoring purposes.

2.1.8 Metering System. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3°C (5.4°F), dry gas meter capable of measuring volume to within 2 percent, and related equipment, as shown in Figure -1. Other metering systems capable of maintaining sampling rates within 10 percent of isokinetic and of determining sample volumes to within 2 percent may be used, subject to the approval of the Administrator. When the metering system is used in conjunction with a pitot tube, the system shall enable checks of isokinetic rates.

Sampling trains utilizing metering systems designed for higher flow rates than that described in APTD-0581 or APTD-0576 may be used provided that the specifications of this method are met.

2.1.9 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase or vice versa for elevation decrease.

2.1.10 Gas Density Determination Equipment. Temperature sensor and pressure gauge, as described in Sections 2.3 and 2.4 of Method 2, and gas analyzer, if necessary, as described in Method 3. The temperature sensor shall, preferably, be permanently attached to the pitot tube or sampling probe in a fixed configuration, such that the tip of the sensor extends beyond the leading edge of the probe sheath and does not touch any metal. Alternatively, the sensor may be attached just prior to use in the field. Note, however, that if the temperature sensor is attached in the field, the sensor must be placed in an interference-free arrangement with respect to the Type S pitot tube openings (see Method 2, Figure 2-7). As a second alternative, if a difference of not more than 1 percent in the average velocity measurement is to be introduced, the

temperature gauge need not be attached to the probe or pitot tube. (This alternative is subject to the approval of the Administrator.)

2.2 Sample Recovery. The following items are needed:

2.2.1 Probe-Liner and Probe-Nozzle Brushes. Nylon bristle brushes with stainless steel wire handles. The probe brush shall have extensions (at least as long as the probe) of stainless steel, Nylon, Teflon, or similarly inert material. The brushes shall be properly sized and shaped to brush out the probe liner and nozzle.

2.2.2 Wash Bottles--Two. Polyethylene wash bottles are recommended.

2.2.3 Plastic Storage Containers. Chemically resistant, glass sample bottles for glassware washes, 500 ml or 1000 ml. Also, air-tight containers to store silica gel.

2.2.4 Petri Dishes. For filter samples, glass, unless otherwise specified by the Administrator.

2.2.5 Graduated Cylinder and/or Balance. To measure ondensed water to within 1 ml or 1 g. Graduated cylinders shall have subdivisions no greater than 2 ml. Most laboratory balances are capable of weighing to the nearest 0.5 g or less. Any of these balances is suitable for use here and in Section 2.3.4.

2.2.6 Funnel and Rubber Policeman. To aid in transfer of silica gel to container; not necessary if silica gel is

weighed in the field.

2.2.7 Funnel. Glass to aid in sample recovery.

2.3 Analysis. For analysis the following equipment is needed.

2.3.1 Glass Weighing Dishes

2.3.2 Desiccator

2.3.3 Analytical Balance. To measure within 0.1 mg.

2.3.4 Balance. To measure within 0.5 mg.

2.3.5 Beakers. 250 ml.

2.3.6 Hygrometer. To measure the relative humidity of the laboratory environment.

2.3.7 Temperature Gauge. To measure the temperature of the laboratory environment.

2.3.8 Separatory funnel. To do liquid-liquid extractions.

2.3.9 Soxhlet Extraction Apparatus. For benzene extraction of particulate matter.

2.3.10 Ultrasonic Bath.

3. Reagents

3.1 Sampling. The reagents used in sampling are as follows:

3.1.1 Filters. Glass fiber filters, without organic binder, exhibiting at least 99.95 percent efficiency ($\leq$ 0.05 percent penetration) on 0.3-micron dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM standard method D 2986-71.

Test data from the supplier's quality control program are sufficient for this purpose.

3.1.2 Silica Gel. Indicating type, 6 to 16 mesh. If previously used, dry at 175°C (350°F) for 2 hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to the approval of the Administrator.

3.1.3 Water - Deionized, distilled water to meet ASTM specification D1193-74, Type 3.

3.1.4 Crushed Ice.

3.2 Sample Recovery.

3.2.1 Acetone. Reagent grade $\leq$ 0.001 percent residue, in glass bottles is required. Acetone from metal containers generally has a high residue blank and should not be used. Sometimes suppliers transfer acetone to glass bottles from metal containers; then acetone blanks shall be run prior to field use and only acetone with low blank values ($\leq$ 0.001 percent) shall be used.

3.2.2 Benzene. Nanograde, in glass bottles is required.

3.3 Analysis. Two reagents are required for the analysis.

3.3.1 Benzene. Same as 3.2.2.

3.3.2 Desiccant. Anhydrous calcium sulfate, indicating type. Alternatively, other types of desiccants may be used, subject to the approval of the Administrator.

3.3.3 Filters. Paper, Whatman No. 40.

4. Procedure

4.1 Sampling. The complexity of this method is such that, in order to obtain reliable results, testers should be trained and experienced with the test procedures.

4.1.1 Pretest Preparation. All the components shall be maintained and calibrated according to the procedure described in APTD-0576, unless otherwise specified herein.

Weigh several 200 to 300 g portions of silica gel in air-tight containers to the nearest 0.5 g. Record the total weight of the silica gel plus container, on each container. As an alternative, the silica gel need not be preweighed, but may be weighed directly in its impinger or sampling holder just prior to train assembly.

Check filters visually against light for irregularities and flaws or pinhole leaks. Label filters of the proper diameter on the back side near the edge using numbering machine ink. As an alternative, label the shipping containers (glass or plastic petri dishes) and keep the filters in these containers at all times except during sampling.

4.1.2 Preliminary Determinations. Select the sampling site and the minimum number of sampling points according to Method 1 or as specified by the Administrator. Determine the stack pressure, temperature, and the range of velocity heads using Method 2; it is recommended that a leak-check of the

pitot lines (see Method 2, Section 3.1) be performed. Determine the moisture content using Approximation Method 4 or its alternatives for the purpose of making isokinetic sampling rate settings. Determine the stack gas dry molecular weight, as described in Method 2, Section 3.6; if integrated Method 3 sampling is used for molecular weight determination, the integrated bag sample shall be taken simultaneously with, and for the same total length of time as, the arsenic sample run.

Select a nozzle size based on the range of velocity heads, such that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates. During the run, do not change the nozzle size. Ensure that the proper differential pressure gauge is chosen for the range of velocity heads encountered (see Section 2.2 of Method 2).

Select a suitable probe liner and probe length such that all traverse points can be sampled. For large stacks, consider sampling from opposite sides of the stack to reduce the length of probes.

Select a total sampling time greater than or equal to the minimum total sampling time specified in the test procedures for the specific industry such that (1) the sampling time per point is not less than 2 min. (or some greater time interval as specified by the Administrator), and (2) the sample volume taken (corrected to standard conditions) will

exceed the required minimum total gas sample volume. The latter is based on an approximate average sampling rate.

It is recommended that the number of minutes sampled at each point be an integer or an integer plus one-half minute, in order to avoid timekeeping errors.

In some circumstances, e.g., batch cycles, it may be necessary to sample for shorter times at the traverse points and to obtain smaller gas sample volumes. In these cases, the Administrator's approval must first be obtained.

4.1.3 Preparation of Collection Train. During preparation and assembly of the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin.

(Place 150 ml of water in the second and third impingers, and transfer approximately 200 to 300 g of preweighed silica gel from its container to the fifth impinger.) More silica gel may be used, but care should be taken to ensure that it is not entrained and carried out from the impinger during sampling. Place the container in a clean place for later use in the sample recovery. Alternatively, the weight of the silica gel plus impinger may be determined to the nearest 0.5 g and recorded.

Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and

the gasket properly placed so as to prevent the sample gas stream from circumventing the filter. Check the filter for tears after assembly is completed.

When glass liners are used, install the selected nozzle using a Viton A O-ring when stack temperatures are less than 260°C (500°F) and an asbestos string gasket when temperatures are higher. See APTD-5076 for details. Other connecting systems using either 316 stainless steel or Teflon ferrules may be used. When metal liners are used, install the nozzle as above or by a leak-free direct mechanical connection. Mark the probe with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

Set up the train as in Figure -1. Place crushed ice around the impingers.

4.1.4 Leak-Check Procedures.

4.1.4.1 Pretest Leak-Check. A pretest leak-check is recommended, but not required. If the tester opts to conduct the pretest leak-check, the following procedure shall be used.

After the sampling train has been assembled, turn on and set the filter and probe heating systems at the desired operating temperatures. Allow time for the temperatures to stabilize. If a Viton A O-ring or other leak-free connection is used in assembling the probe nozzle to the probe liner, leak-check the train at the sampling site by plugging the

nozzle and pulling a 380 mm Hg (15 in. Hg) vacuum.

Note: A lower vacuum may be used, provided that it is not exceeded during the test.

If an asbestos string is used, do not connect the probe to the train during the leak-check. Instead, leak-check the train by first plugging the inlet to the filter holder (cyclone, if applicable) and pulling a 380 mm Hg (15 in. Hg) vacuum (see Note immediately above). Then connect the probe to the train and leak-check at about 25 mm Hg (1 in. Hg) vacuum; alternatively, the probe may be leak-checked with the rest of the sampling train, in one step, at 380 mm Hg (15 in. Hg) vacuum. Leakage rates in excess of 4 percent of the average sampling rate or 0.00057 m^3/min (0.02 cfm), whichever is less, are unacceptable.

The following leak-check instructions for the sampling train described in APTD-0576 and APTD-0581 may be helpful. Start the pump with bypass valve fully open and coarse adjust valve completely closed. Partially open the coarse adjust valve and slowly close the bypass valve until the desired vacuum is reached. Do not reverse direction of bypass valve; this will cause water to back up into the filter holder. If the desired vacuum is exceeded, either leak-check at this higher vacuum or end the leak check as shown below and start over.

When the leak-cehck is completed, first slowly remove

the plug from the inlet to the probe, filter holder, or cyclone (if applicable) and immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the filter holder and silica gel from being entrained backward into the third impinger.

4.1.4.2 Leak-Checks During Sample Run. If, during the sampling run, a component (e.g., filter assembly or impinger) change becomes necessary, a leak-check shall be conducted immediately before the change is made. The leak-check shall be done according to the procedure outlined in Section 4.1.4.1 above, except that it shall be done at a vacuum equal to or greater than the maximum value recorded up to that point in the test. If the leakage rate is found to be no greater than 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate (whichever is less), the results are acceptable, and no correction will need to be applied to the total volume of dry gas metered; if, however, a higher leakage rate is obtained, the tester shall either record the leakage rate and plan to correct the sample volume as shown in Section 6.3 of this method, or shall void the sampling run.

Immediately after component changes, leak-checks are optional; if such leak-checks are done, the procedure outlined in Section 4.1.4.1 above shall be used.

4.1.4.3 Post-test Leak-Check. A leak-check is mandatory at the conclusion of each sampling run. The leak-check shall be done in accordance with the procedures outlined in

Section 4.1.4.1, except that it shall be conducted at a vacuum equal to or greater than the maximum value reached during the sampling run. If the leakage rate is found to be no greater than 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate (whichever is less), the results are acceptable, and no correction need be applied to the total volume of dry gas metered. If, however, a higher leakage rate is obtained, the tester shall either record the leakage rate and correct the sample volume as shown in Section 6.3 of this method, or shall void the sampling run.

4.1.5 Train Operation. During the sampling run, maintain an isokinetic sampling rate (within 10 percent of true isokinetic unless otherwise specified by the Administrator) and a temperature around the filter no greater than 40° C (104° F).

For each run, record the data required on a data sheet such as the one shown in Figure -2. Be sure to record the initial dry gas meter reading. Record the dry gas meter readings at the beginning and end of each sampling time increment, when changes in flow rates are made, before and after each leak check, and when sampling is halted. Take other readings required by Figure -2 at least once at each sample point during each time increment and additional readings when significant changes (20 percent variation in velocity head readings) necessitate additional

PLANT _____

LOCATION _____

OPERATOR _____

DATE _____

RUN NO. _____

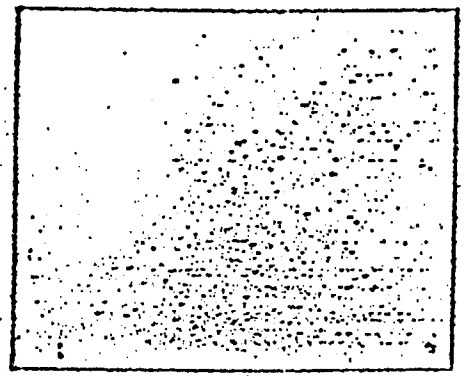
SAMPLE BOX NO. _____

METER BOX NO. _____

METER $\Delta H_@$ _____

C FACTOR _____

PITOT TUBE COEFFICIENT, C_p _____



SCHEMATIC OF STACK CROSS SECTION

AMBIENT TEMPERATURE _____

BAROMETRIC PRESSURE _____

ASSUMED MOISTURE, % _____

PROBE LENGTH, m (ft) _____

NOZZLE IDENTIFICATION NO. _____

AVERAGE CALIBRATED NOZZLE DIAMETER, cm (in.) _____

PROBE HEATER SETTING _____

LEAK RATE, m^3/min. (cfm) _____

PROBE LINER MATERIAL _____

STATIC PRESSURE, mm Hg (in. Hg) _____

FILTER NO. _____

TRAVERSE POINT NUMBER	SAMPLING TIME, (θ), min.	VACUUM mm Hg (in Hg)	STACK TEMPERATURE (T_S) °C (°F)	VELOCITY HEAD (ΔP_S), mm(in.)H_2O	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER mm H_2O (in. H_2O)	GAS SAMPLE VOLUME m^3 (ft^3)	GAS SAMPLE TEMPERATURE AT DRY GAS METER		FILTER HOLDER TEMPERATURE, °C (°F)	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, °C (°F)
							INLET, °C (°F)	OUTLET, °C (°F)		
TOTAL							Avg.	Avg.		
AVERAGE							Avg.			

Figure -2. Particulate field data.

adjustments in flow rate. Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse.

Clean the portholes prior to the test run to minimize the chance of sampling deposited material. To begin sampling, remove the nozzle cap, verify that the filter and probe heating systems are up to temperature, and that the pitot tube and probe are properly positioned. Position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Nomographs are available, which aid in the rapid adjustment of the isokinetic sampling rate without excessive computations. These nomographs are designed for use when the Type S pitot tube coefficient is 0.85 ± 0.02, and the stack gas equivalent density (dry molecular weight) is equal to 29 ± 4. APTD-0576 details the procedure for using the nomographs. If C_p and M_d are outside the above stated ranges, do not use the nomographs unless appropriate steps (see Citation 7 in Section 7) are taken to compensate for the deviations.

When the stack is under significant negative pressure (height of impinger stem), take care to close the coarse adjust valve before inserting the probe into the stack to prevent water from backing into the filter holder. If necessary, the pump may be turned on with the coarse adjust

valve closed.

When the probe is in position, block off the openings around the probe and porthole to prevent unrepresentative dilution of the gas stream.

Traverse the stack cross-section, as required by Method 1 or as specified by the Administrator, being careful not to bump the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe through the portholes; this minimizes the chance of extracting deposited material.

During the test run, make periodic adjustments to keep the temperature around the filter holder at the proper level; add more ice and, if necessary, salt to maintain a temperature of less than 20°C (68°F) at the condenser/silica gel outlet. Also, periodically check the level and zero of the manometer.

If the pressure drop across the filter becomes too high, making isokinetic sampling difficult to maintain, the filter may be replaced in the midst of a sample run. It is recommended that another complete filter assembly be used rather than attempting to change the filter itself. Before a new filter assembly is installed, conduct a leak-check (see Section 4.1.4.2).

A single train shall be used for the entire sample run, except in cases where simultaneous sampling is required in two or more separate ducts or at two or more different locations within the same duct, or, in cases where equipment failure necessitates a change of trains. In all other situations, the

use of two or more tains will be subject to the approval of the Administrator.

Note that when two or more trains are used, separate analyses of the sample fraction from each train shall be performed, unless otherwise specified by the Administrator. Consult with the Administrator for details concerning the calculation of results when two or more trains are used.

At the end of the sample run, turn off the coarse adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final dry gas meter reading, and conduct a post-test leak-check, as outlined in Section 4.1.4.3. Also, leak-check the pitot lines as described in Method 2, Section 3.1; the lines must pass this leak-check, in order to validate the velocity head data.

4.1.6 Calculation of Percent Isokinetic. Calculate percent isokinetic (see Calculations, Section 6) to determine whether the run was valid or another test run should be made. If there was difficulty in maintaining isokinetic rates due to source conditions, consult with the Administrator for possible variance on the isokinetic rates.

4.2 Sample Recovery. Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period. Allow the probe to cool.

When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over it to prevent losing or gaining particulate matter. Do not cap off the probe tip tightly while

the sampling train is cooling down as this would create a vacuum in the filter holder, thus drawing water from the impingers into the filter holder.

Before moving the sample train to the cleanup site, remove the probe from the sample train and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Cap the filter inlet where the probe was fastened. Remove the umbilical cord from the last impinger and cap the impinger. If a flexible line is used between the first impinger and the filter holder, disconnect the line at the filter holder and let any condensed water or liquid drain into the impingers. Cap off the filter holder outlet and impinger inlet. Either ground-glass stoppers, plastic caps, or serum caps may be used to close these openings.

Transfer the probe and filter-impinger assembly to the cleanup area. This area should be clean and protected from the wind so that the chances of contaiminating or losing the sample will be minimized.

Save portions of the acetone and benzene used for cleanup as blanks. Take 200 ml of each liquid directly from the wash bottle being used and place them in separate glass sample containers label "Acetone Blank" and "Benzene Blank," respectively.

Inspect the train prior to and during disassembly and note any abnormal conditions. Treat the samples as follows:

Container No. 1. Carefully remove the filter from the

filter holder and place it in its identified petri dish container. Use a pair of tweezers and/or clean disposable surgical gloves to handle the filter. If it is necessary to fold the filter, do so such that the particulate cake is inside the fold. Carefully transfer to the petri dish any particulate matter and/or filter fibers which adhere to the filter holder gasket, by using a dry Nylon bristle brush and/or a sharp-edged blade. Seal the container.

Container No. 2. The contents of the first impinger are transferred to container No. 2. Transfer the contents in the following manner:

1. Cap the impinger ball joints.

2. Rotate and agitate the impinger, so that the impinger contents might serve as a rinse solution.

3. Transfer the contents of the impinger to a 500 ml graduated cylinder. The outlet ball joint cap should be removed and the contents drained through this opening. The impinger parts (inner and outer tubes) must not be separated while transferring their contents to the cylinder.

Measure the liquid volume to within ± 1 ml. Alternatively, determine the weight of the liquid to within ± 0.5 g by using a balance. The volume or weight of liquid present, along with a notation of any color or film observed in the impinger catch, is recorded in the log. This inforamtion is needed, along with the silica gel data, to calculate the stack gas moisture content (see Method 5, Figure 5-3).

Container No. 3. This contains the acetone rinse of the train from the nozzle to the front half of the filter holder. Taking care to see that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover particulate matter or any condensate from the probe nozzle probe fitting, probe liner, and front half of the filter holder by washing these components with acetone and collecting the wash in a glass container. Perform the rinsing as follows:

Carefully remove the probe nozzle and clean the inside surface by rinsing with acetone from a wash bottle and brushing with a Nylon bristle brush. Brush until the rinse shows no visible particles, after which make a final rinse of the inside surface with acetone.

Brush and rinse the inside parts of the Swagelok[1] fitting with acetone in a similar way until no visible particles remain.

Rinse the probe liner with acetone by tilting and rotating the probe while squirting acetone into its upper end so that all inside surfaces will be wetted with the rinse solution. Let the acetone drain from the lower end into the sample container. A funnel (glass) may be used to aid in transferring liquid washes to the container. Follow the acetone rinse with a probe brush. Hold the probe in an inclined position, squirt acetone into the upper end

[1] Brand name

as the probe brush is being pushed with a twisting action through the probe; hold a sample container underneath the lower end of the probe, and catch any liquid and particulate matter which is brushed from the probe. Run the brush through the probe with rinsing three times or more until no visible particulate matter is carried out with the rinse or until none remains in the probe liner on visual inspection. With stainless steel or other meal probes, run the brush through in the above prescribed manner at least six times since metal probes have small crevices in which particulate matter can be entrapped. Rinse the brush with acetone and quantitatively collect these washings in the sample container. After the brushing, make a final acetone rinse of the probe as described above.

It is recommended that two people be used to clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contamination.

Clean the inside of the front half of the filter holder by rubbing the surfaces with a Nylon bristle brush and rinsing with acetone. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder.

Rinse the first impinger with acetone also by pouring in approximately 50 ml of acetone and agitating. Drain the acetone through the outlet arm of the impinger into the No. 3 sample container.

After all washings and particulate matter have been collected in the sample container, tighten the lid on the sample container so that liquid will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to determine whether or not leakage occurred during transport. Label the container to clearly identify its contents.

Container No. 4. This contains the benzene rinse of the sampling train from the nozzle to the front half of the filter holder. The procedure described under the acetone rinse should be followed except that benzene is used as the washing liquid.

Container No. 5. Note the color of the indicating silica gel to determine if it has been completely spent and make a notation of its condition. Transfer the silica gel from the fifth impinger to its original container and seal. A funnel may make it easier to pour the silica gel without spilling. A rubber policeman may be used as an aid in removing the silica gel from the impinger. It is not necessary to remove the small amount of dust particles that adhere to the impinger wall and are difficult to remove. Since the gain in weight is to be used for moisture calculation, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, follow the procedure for Container No. 5 in Section 4.3.

Impinger Water. Treat the remaining impingers as follo Make a notation of any color or film in the liquid catch. Measure the liquid which is in the first three impingers to within ± 1 ml by using a graduated cylinder or by weighing it to within ± 0.5 gr. by using a balance (if one is available). Record the volume or weight of liquid present. This information is required to calculate the moisture content of the effluent gas.

Discard the liquid after measuring and recording the volume or weight.

If a different type of condenser is used, measure the amount of moisture condensed either volumetrically or gravimetrically.

Whenever possible, containers should be shipped in such a way that they remain upright at all times.

4.3 Analysis.

4.3.1 Container No. 5. This step may be conducted in the field. Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 gram.

4.3.2 Container No. 1. Charge a distillation flask with 125-150 ml of benzene and one glass bead and assemble to the Soxhlet extractor. Transfer quantitatively the contents of Container No. 1 to the Soxhlet extractor and assemble to the condenser. Pass cold water through the condenser and bring the benzene to reflux using either a steam bath or hot plat. Adjust the heat so that the Soxhlet cycles 5 or 6

times per hour and extract the sample for 6 hours.

After the extraction is complete, filter the contents of the distillation flask through a Whatman No. 40filter into a tared 250 ml glass beaker. Evaporate the contents to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

4.3.3 Container No. 2. Note the level of the liquid in the container and confirm on the analysis sheet whether or not leakage occurred during transport. If a noticeable amount of leakage occurred, either void the sample or use methods subject to the approval of the Administrator to correct the final results.

Transfer the contents of the container to a 250 ml separatory funnel. Add 50 ml of benzene and shake vigorously for at least one minute. Allow the liquids to separate and draw off the lower (aqueous) layer and save. Drain the upper (benzene) layer into a tared 250 ml glass beaker. Return the aqueous layer to the separatory funnel and repeat the extraction with two additional portions of benzene. Filter the extract through a Whatman #4D paper filter to remove any visible particulate matter. Evaporate the extract to dryness at room temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

4.3.4 Container No. 3. Note the level of the liquid in the container and confirm on the analysis sheet whether or not leakage occurred during transport. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the

approval of the Administrator, to correct the final results. Transfer the contents to a glass 250 ml beaker and evaporate to dryness at ambient temperature and pressure.

Add 50 ml of benzene to the residue in the beaker and agitate for 1 hour in an ultrasonic bath. Filter the contents through a Whatman No. 40 filter into a tared 250 ml glass beaker. Evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

4.3.5 Container No. 4. Note the level of the liquid in the container and confirm on the analysis sheet whether or not leakage occurred during transport. If a noticeable amount of leakage occurred, either void the sample or use methods subject to the approval of the Administrator to correct the final results. Measure the liquid in this container either volumetrically to ± 1 ml or gravimetrically to ± 0.5 gr. Transfer the contents or a tared 250 ml glass beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg. weight.

4.3.6 Blank Containers.

4.3.6.1 Acetone Blank Container. Measure the acetone in this container either volumetrically or gravimetrically. Transfer the acetone to a 250 ml glass beaker and evaporate to dryness at ambient temperature and pressure.

Add 50 ml of benzene to the residue in the beaker and agitate for 1 hour in an ultrasonic bath. Filter the contents through a Whatman No. 40 filter into a tared 250 ml glass beaker. Evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight; report the results to the nearest 0.1 mg.

4.3.6.2 Benzene Blank Container. Measure the benzene in this container either volumetrically or gravimetrically. Transfer the benzene to a tared 250 ml glass beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

4.3.6.3 Filter Blank. Treat the blank filter according to the instructions in Section 4.3.2.

5. Calibration

Maintain a laboratory log of all calibration.

5.1 Probe Nozzle. Probe nozzles shall be calibrated before their initial use in the field. Using a micrometer, measure the inside diameters of the nozzle to the nearest 0.025 mm (0.001 in). Make three separate measurements using different diameters each time and obtain the average of the measurements. The difference between the high and low numbers shall not exceed 0.1 mm (0.004 in). When nozzles become nicked, dented, or corroded, they shall be reshaped, sharpened, and recalibrated before use. Each nozzle shall be permanently and uniquely identified.

5.2 Pitot Tube. The Type S pitot tube assembly shall be calibrated according to the procedure outlined in Section 4 of Method 2.

5.3 Metering System. Before its initial use in the field, the metering system shall be calibrated according to the procedure outlined in APTD-0576. Instead of physically adjusting the dry gas meter dial readings to correspond to the wet test meter readings, calibration factors may be used to mathematically correct the gas meter dial readings to the proper values. Before calibrating the metering system, it is suggested that a leak-check be conducted. For metering systems having diaphragm pumps, the normal leak-check procedure will not detect leakages within the pump. For these cases the following leak-check procedure is suggested: make a 10-minute calibration run at 0.00057 m^3/min (0.02 cfm); at the end of the run, take the difference of the measured wet test meter and dry gas meter volumes; divide the difference by 10, to get the leak rate. The leak rate should not exceed 0.00057 m^3/min (0.02 cfm).

After each field use, the calibration of the metering system shall be checked by performing three calibration runs at a single, intermediate orifice setting (based on the previous field test), with the vacuum set at the maximum value reached during the test series. To adjust the vacuum, insert a valve between the wet test meter and the inlet of the metering system. Calculate the average value of the calibration factor. If the calibration has changed by more than 5 percent, recalibrate the meter over the full range of orifice settings, as outlined in APTD-0576.

Alternative procedures, e.g., using the orifice meter coefficients, may be used, subject to the approval of the Administrator.

Note: If the dry gas meter coefficient values obtained before and after a test series differ by more than 5 percent, the test series shall either be voided, or calculations for the test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

5.4 Probe Heater Calibration. The probe heating system shall be calibrated before its initial use in the field according to the procedure outlined in APTD-0576. Probes constructed according to APTD-0581 need not be calibrated if the calibration curves in APTD-0576 are used.

5.5 Temperature Gauges. Use the procedure in Section 4.3 of Method 2 to calibrate in-stack temperature gauges. Dial thermometers, such as are used for the dry gas meter and condenser outlet, shall be calibrated against mercury-in-glass thermometers.

5.6 Leak Check of Metering System Shown in Figure 5-1. That portion of the sampling train from the pump to the orifice meter should be leak checked prior to initial use and after each shipment. Leakage after the pump will result in less volume being recorded than is actually sampled. The following procedure is suggested (see Figure 5-4): Close the main valve on the meter box. Insert a one-hole rubber stopper with rubber tubing attached into the orifice exhaust pipe. Disconnect and vent the low side of the orifice manometer. Close off the low side orifice tap. Pressurize the system to 13 to 18 cm

(5 to 7 in.) water column by blowing into the rubber tubing. Pinch off the tubing and observe the manometer for one minute. A loss of pressure on the manometer indicates a leak in the meter box; leaks, if present, must be corrected.

5.7 Barometer. Calibrate against a mercury barometer.

6. Calculations

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after the final calculation. Other forms of the equations may be used as long as they give equivalent results.

6.1 Nomenclature.

A_n = Cross-section area of nozzle, m^2 (ft^2).

B_{ws} = Water vapor in the gas stream, proportion by volume.

C_a = Acetone blank residue concentration, mg/ml.

C_s = Concentration of benzene soluble organic matter in stack gas, dry basis, corrected to standard conditions, g/dscm (g/dscf).

I = Percent of isokinetic sampling.

C_b = Benzene blank residue conc., mg/ml

C_1 = Weight from evaporation of container 1

C_2 = Weight from evaporation of container 2

C_3 = Weight from evaporation of container 3

C_4 = Weight from evaporation of container 4

F_b = Filter blank mass, mg

L_a = Maximum acceptable leakage rate for either a pretest leak check or for a leak check following a component change; equal to 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate, whichever is less.

L_i = Individual leakage rate observed during the leak check conducted prior to the "i^{th}" component change (i = 1, 2, 3....n), m^3/min (cfm).

L_p = Leakage rate observed during the post-test leak check, m^3/min (cfm).

m_{bs} = Total amount of benzene soluble organics collected, mg.

M_w = Molecular weight of water, 18.0 g/g-mole (18.0g/lb-mole).

m_a = Mass of residue of acetone blank after evaporation, Sec. 4.3.6.1 mg.

m_b = Mass of residue of benzene blank after evaporation, Sec. 4.3.6.3, mg.

P_{bar} = Barometric pressure at the sampling site, mm Hg (in. Hg).

P_s = Absolute stack gas pressure, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 mm Hg-m^3/°K-g-mole (21.85 in. Hg-ft^3/°R-lb-mole).

S_1 = Benzene soluble organic in sample container 1.

S_2 = Benzene soluble organic in sample container 2.

S_3 = Benzene soluble organic in sample container 3.

S_4 = Benzene soluble organic in sample container 4.

T_m = Absolute average dry gas meter temperature (see Figure 5-2), °K (°R).

T_s = Absolute average stack gas temperature (see Figure 5-2), °K (°R).

T_{std} = Standard absolute temperature, 293° (528°R).

V_a = Volume of acetone blank, ml.

V_{aw} = Volume of acetone used in wash, ml.

V_{bs} = Volume of benzene used in sample recovery, ml.

V_{lc} = Total volume of liquid collected in all the impingers and silica gel (see Figure 5-3), ml.

V_m = Volume of gas sample as measured by dry gas meter, dcm (dcf).

$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{w(std)}$ = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).

v_s = Stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 5, m/sec (ft/sec).

W_a = Weight of residue in acetone wash, mg.

Y = Dry gas meter calibration factor.

ΔH = Average pressure differential across the orifice meter (see Figure 5-2), mm H_2O (in. H_2O).

Θ = Total sampling time, min.

Θ_1 = Sampling time interval, from the beginning of a run until the first component change, min.

Θ_i = Sampling time interval, between two successive component changes, beginning with the interval between the first and second changes, min.

Θ_p = Sampling time interval, from the final (n^{th}) component change until the end of the sampling run, min.

13.6 = Specific gravity of mercury.

60 = Sec/min.

100 = Conversion to percent.

6.2 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 5-2).

6.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20°C, 760 mm Hg or 68°F, 29.92 in. Hg) by using Equation 5-1.

$$V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m}\right)\left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right] = K_1 V_m Y \frac{P_{bar} + (\Delta H/13.6)}{T_m}$$

Equation 5-1

where:

K_1 = 0.3858 °K/mm Hg for metric units.

= 17.64 °R/in. Hg for English units

Note: Equation 5-1 can be used as written unless the leakage rate observed during any of the mandatory leak checks (i.e., the post-test leak check or leak checks conducted prior to component changes) exceeds L_a. If L_p or L_i exceeds L_a, Equation 5-1 must be modified as follows:

(a) Case I. No component changes made during sampling run. In this case, replace V_m in Equation 5-1 with the expression:

$$[V_m - (L_p - L_a)\,\Theta]$$

(b) Case II. One or more component changes made during the sampling run. In this case, replace V_m in Equation 5-1 by the expression:

$$[V_m - (L_1 - L_a)\,\Theta_1 - \sum_{i=2}^{n} (L_i - L_a)\,\Theta_i - (L_p - L_a)\,\Theta_p]$$

and substitute only for those leakage rates (L_i or L_p) which exceed L_a.

6.4 Volume of water vapor.

$$V_{w(std)} = V_{1c}\left(\frac{\rho_w}{M_w}\right)\left(\frac{RT_{std}}{P_{std}}\right) = K_2\,V_{1c}$$

Equation 5-2

where:

K_2 = 0.001333 m^3/ml for metric units

0.04707 ft^3/ml for English units.

6.5 Moisture Content.

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}} \qquad \text{Equation 5-3}$$

Note: In saturated or water droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis (Equation 5-3), and a second from the assumption of saturated conditions. The lower of the two values of B_{ws} shall be considered correct. The procedure for determining the moisture content based upon assumption of saturated conditions is given in the Note of Section 1.2 of Method 4. For the purposes of this method, the average stack gas temperature from Figure 5-2 may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is ± 1°C (2°F).

6.6 Blank Concentration

6.6.1 Benzene blank concentration

$$C_b = \frac{m_b}{V_b} \qquad 5\text{-}4$$

6.6.2 Acetone blank concentration

$$C_a = \frac{m_a - [(50\ ml)\ C_b]}{V_a} \qquad 5\text{-}5$$

6.7 Benzene Soluble Catch

$$m_{bs} = S_1 + S_2 + S_3 + S_4 \qquad 5\text{-}6$$

where:

$$S_1 = C_1 - F_b \qquad 5\text{-}7$$

$$S_2 = C_2 - (150\ C_b) \qquad 5\text{-}8$$

$$S_3 = C_3 - (V_a\ C_a) - (50\ C_b) \qquad 5\text{-}9$$

$$S_4 = C_4 - (V_{bs}\ C_b) \qquad 5\text{-}10$$

6.8 Benzene Soluble Matter Concentration

$$C_s = (0.001\ g/mg)\ [m_{bs}/V_m\ (std)] \qquad 5\text{-}11$$

6.9 Conversion Factors

From	To	Multiply by
scf	m^3	0.02832
g/ft^3	gr/ft^3	15.43
g/ft^3	lb/ft^3	2.205×10^{-3}
g/ft^3	g/m^3	35.31

6.10 Isokinetic Variation.

6.10.1 Calculation from Raw Data

$$I = \frac{100\ T_s\ [K_3 V_{lc} + (V_m\ Y/T_m)\ (P_{bar} + \Delta H/13.6)]}{60\ \Theta v_s\ P_s\ A_n}$$

Equation 5-7

where:

K_3 = 0.003454 mm Hg-m^3/ml-°K for metric units

= 0.002669 in. Hg-ft^3/ml-°R for English units.

6.11.2 Calculation from Intermediate Values.

$$I = \frac{T_s\ V_{m(std)}\ P_{std}\ 100}{T_{std}\ v_s\ \Theta\ A_n\ P_s\ 60\ (1 - B_{ws})}$$

$$= K_4\ \frac{T_s\ V_{m(std)}}{P_s\ v_s\ A_n\ \Theta\ (1 - B_{ws})}$$

Equation 5-8

where:

K_4 = 4.320 for metric units

= 0.09450 for English units.

6.12 Acceptable Results. If 90 percent $\leq$ I $\leq$ 110 percent, the results are acceptable. If the results are low in comparison to the standard and I is beyond the acceptable range, or, if I is less than 90 percent, the Administrator may opt to accept the results. Use Citation 4 to make judgments. Otherwise, reject the results and repeat the test.

7. Bibliography

1. Addendum to Specifications for Incinerator Testing at Federal Facilities. PHS, NCAPC. Dec. 6, 1967.

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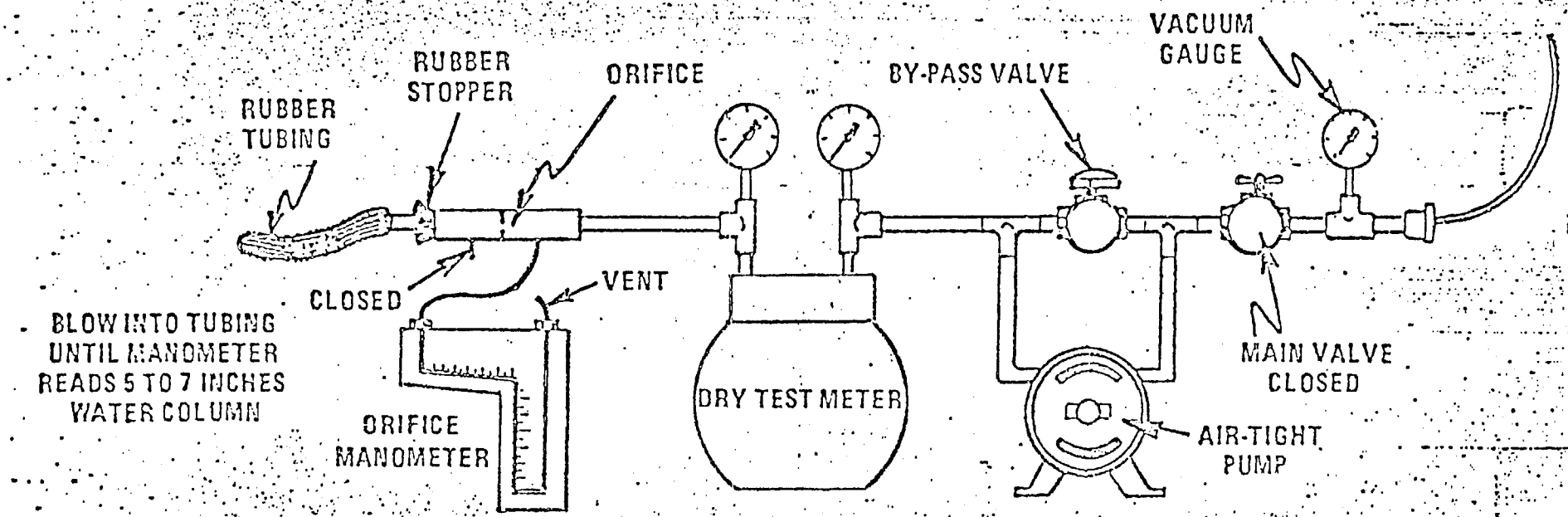

Figure - 4. Leak check of meter box.

APPENDIX E-2

DETERMINATION OF BENZENE
(INCLUDING SUPPLEMENTS A AND B)

OCT 26 1978

METHOD ~~111~~: DETERMINATION OF BENZENE FROM STATIONARY SOURCES

INTRODUCTION

Performance of this method should not be attempted by persons unfamiliar with the operation of a gas chromatograph, nor by those who are unfamiliar with source sampling, as there are many details that are beyond the scope of this presentation. Care must be exercised to prevent exposure of sampling personnel to benzene, a carcinogen.

1. Principle and Applicability

1.1 Principle. An integrated bag sample of stack gas containing benzene and other organics is subjected to gas chromatographic (GC) analysis, using a flame ionization detector (FID).

1.2 Applicability. The method is applicable to the measurement of benzene in stack gases only from specified processes. It is not applicable where the benzene is contained in particulate matter.

2. Range and Sensitivity

The procedure described herein is applicable to the measurement of benzene in the 0.1 to 70 ppm range. The upper limit may be extended by extending the calibration range or by dilution of the sample.

3. Interferences

The chromatograph columns and the corresponding operating parameters herein described have been represented as being useful for producing an adequate resolution of benzene. However, resolution interferences may be encountered on some sources. Also, the chromatograph operator may know of a column that will produce a superior resolution of benzene without reducing the response to benzene as specified in Section 4.3.1.

In any event, the chromatograph operator shall select a column which is best suited to his particular analysis problem, subject to the approval of the Administrator. Such approval shall be considered automatic provided that confirming data produced through a demonstrably adequate supplemental analytical technique, such as analysis with a different column or G.C./mass spectroscopy, is available for review by the Administrator.

4. Apparatus

4.1 Sampling (see Figure III-1).

4.1.1 Probe. Stainless steel, Pyrex[1] glass, or Teflon tubing according to stack temperature, each equipped with a glass wool plug to remove particulate matter.

4.1.2 Sample Line. Teflon, 6.4 mm outside diameter, of sufficient length to connect probe to bag. A new unused piece is employed for each series of bag samples that constitutes an emission test.

4.1.3 Male (2) and female (2) stainless steel quick connects, with ball checks (one pair without) located as shown in Figure III-1.

4.1.4 Tedlar or aluminized Mylar bags, 100 liter capacity. To contain sample.

4.1.5 Rigid leakproof containers for 4.1.4, with covering to protect contents from sunlight.

4.1.6 Needle Valve. To adjust sample flow rate.

4.1.7 Pump--Leak-free. Minimum capacity 2 liters per minute.

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

4.1.8 Charcoal Tube. To prevent admission of benzene and other organics to the atmosphere in the vicinity of samplers.

4.1.9 Flow Meter. For observing sample flow rate; capable of measuring a flow range from 0.10 to 1.00 liters per minute.

4.1.10 Connecting Tubing. Teflon, 6.4 mm outside diameter, to assemble sample train (Figure III-1).

4.2 Sample Recovery.

4.2.1 Tubing. Teflon, 6.4 mm outside diameter, to connect bag to gas chromatograph sample loop. A new unused piece is employed for each series of bag samples that constitutes an emission test, and is to be discarded upon conclusion of analysis of those bags.

4.3 Analysis.

4.3.1 Gas Chromatograph. With FID, potentiometric strip chart recorder and 1.0 to 2.0 ml sampling loop in automatic sample valve. The chromatographic system shall be capable of producing a response to 0.1 ppm benzene that is at least as great as the average noise level. (Response is measured from the average value of the baseline to the maximum of the waveform, while standard operating conditions are in use.)

4.3.2 Chromatographic Columns. Columns other than those listed below can be used, provided that the precision and accuracy of the analysis of benzene standards are not impaired. Information confirming that adequate resolution of the benzene peak is accomplished should be available. Adequate resolution is defined as an area overlap of not more than 10 percent of the benzene peak. Calculation of area overlap is explained in Appendix E, Supplement A: "Determination of Adequate Chromatographic Peak Resolution."

4.3.2.1 Column A: Benzene in the Presence of Aliphatics. Stainless Steel, 2.44 m x 3.2 mm, containing 10 percent 1, 2, 3,tris (2-cyanoethoxy) propane (TCEP) on 80/100 Chromosorb P AW.

4.3.2.2 Column B: Benzene With Separation of the Isomers of Xylene. Stainless steel, 1.83 m x 3.2 mm, containing 5 percent SP 1200/1.75 percent Bentone 34 on 100/120 Supelcoport.

4.3.3 Flow Meters (2). Rotameter type, 0 to 100 ml/min capacity.

4.3.4 Gas Regulators. For required gas cylinders.

4.3.5 Thermometer. Accurate to one degree centigrade, to measure temperature of heated sample loop at time of sample injection.

4.3.6 Barometer. Accurate to 5 mm Hg, to measure atmospheric pressure around gas chromatograph during sample analysis.

4.3.7 Pump--Leak-free. Minimum capacity 100 ml/min.

4.3.8 Recorder. Strip chart type, optionally equipped with disc integrator or electronic integrator.

4.3.9 Planimeter. Optional, in place of disc or electronic integrator, for 4.3.8 to measure chromatograph peak areas.

4.4 Calibration. 4.4.2 through 4.4.6 are for section 7.1 which is optional.

4.4.1 Tubing. Teflon, 6.4 mm outside diameter, separate pieces marked for each calibration concentration.

4.4.2 Tedlar or Aluminized Mylar Bags. 50-liter capacity, with valve; separate bag marked for each calibration concentration.

4.4.3 Syringe. 1.0 µl, gas tight, individually calibrated, to dispense liquid benzene.

4.4.4 Syringe. 10 µml, gas tight, individually calibrated, to dispense liquid benzene.

4.4.5 Dry Gas Meter, With Temperature and Pressure Gauges. Accurate to ±2 percent, to meter nitrogen in preparation of standard gas mixtures, calibrated at the flowrate used to prepare standards.

4.4.6 Midget Impinger/Hot Plate Assembly. To vaporize benzene.

5. Reagents

It is necessary that all reagents be of chromatographic grade.

5.1 Analysis.

5.1.1 Helium Gas or Nitrogen Gas. Zero grade, for chromatographic carrier gas.

5.1.2 Hydrogen Gas. Zero grade.

5.1.3 Oxygen Gas or Air as Required by the Detector. Zero grade.

5.2 Calibration. Use one of the following options: either 5.2.1 and 5.2.2, or 5.2.3.

5.2.1 Benzene, 99 Mol percent pure benzene certified by the manufacturer to contain a minimum of 99 Mol percent benzene; for use in the preparation of standard gas mixtures as described in Section 7.1.

5.2.2 Nitrogen Gas. Zero grade, for preparation of standard gas mixtures as described in Section 7.1.

5.2.3 Cylinder Standards (3). Gas mixture standards (50, 10, and 5 ppm benzene in nitrogen cylinders) for which the gas composition has been certified with an accuracy of ±3 percent or better by the manufacturer. The manufacturer must have recommended a maximum shelf life for each cylinder so that the concentration does not change by greater than ±5 percent from the certified value. The date of gas cylinder preparation, certified benzene concentration and recommended maximum shelf life must have been affixed to the cylinder before shipment from the gas manufacturer

to the buyer. These gas mixture standards may be directly used to prepare a chromatograph calibration curve as described in Section 7.2.2.

5.2.3.1 Cylinder Standards Certification. The concentration of benzene in nitrogen in each cylinder must have been certified by the manufacturer by a direct analysis of each cylinder using an analytical procedure that the manufacturer had calibrated on the day of cylinder analysis. The calibration of the analytical procedure shall, as a minimum, have utilized a threepoint calibration curve. It is recommended that the manufacturer maintain two calibration standards and use these standards in the following way: (1) a high concentration standard (between 50 and 100 ppm) for preparation of a calibration curve by an appropriate dilution technique; (2) a low concentration standard (between 5 and 10 ppm) for verification of the dilution technique used. If the difference between the apparent concentration read from the calibration curve and the true concentration assigned to the low concentration standard exceeds 5 percent of the true concentration, determine the source of error and correct it, then repeat the three-point calibration.

5.2.3.2 Establishment and Verification of Calibration Standards. The concentration of each calibration standard must have been established by the manufacturer using reliable procedures. Additionally, each calibration standard must have been verified by the manufacturer by one of the following procedures, and the agreement between the initially determined concentration value and the verification concentration value must be within ±5 percent: (1) verification value determined by comparison with a gas mixture prepared in accordance with the procedure described in Section 7.1.1 and using 99 Mol percent benzene, or (2) verification value obtained by having the calibration standard analyzed

by the National Bureau of Standards. All calibration standards must be reverified on a time interval consistent with the shelf life of the cylinder standards sold.

5.2.4 Audit Cylinder Standards (2). Gas mixture standards identical in preparation to those in Section 5.2.3 (benzene in nitrogen cylinders), except the concentrations are only known to the person supervising the analysis of samples. The concentrations of the audit cylinders should be: one low concentration cylinder in the range of 5 to 20 ppm benzene, and one high concentration cylinder in the range of 100 to 300 ppm benzene. When available, audit cylinders may be obtained by contacting: EPA, Environmental Monitoring and Support Laboratory, Quality Assurance Branch (MD-77), Research Triangle Park, North Carolina 27711. If audit cylinders are not available at EPA, an alternate source must be secured.

6. Procedure

6.1 Sampling. Assemble the sample train as in Figure 111-1. Perform a bag leak check according to Section 7.3.2. Join the quick connects as illustrated, and determine that all connections between the bag and the probe are tight. Place the end of the probe at the centroid of the stack and start the pump with the needle valve adjusted to yield a flow of 0.5 lpm. After a period of time sufficient to purge the line several times has elapsed, connect the vacuum line to the bag and evacuate the bag until the rotameter indicates no flow. At all times, direct the gas exiting the rotameter away from sampling personnel. Then reposition the sample and vacuum lines and begin the actual sampling, keeping the rate constant. At the end of the sample period, shut off the pump, disconnect the sample line from the bag, and disconnect the

vacuum line from the bag container. Protect the bag container from sunlight.

6.2 Sample Storage. Sample bags must be kept out of direct sunlight. Analysis must be performed within 4 days of sample collection.

6.3 Sample Recovery. With a new piece of Teflon tubing identified for that bag, connect a bag inlet valve to the gas chromatograph sample valve. Switch the valve to receive gas from the bag through the sample loop. Arrange the equipment so the sample gas passes from the sample valve to a 0-100 ml/min rotameter with flow control valve followed by a charcoal tube and a 0-1 inch w.g. pressure gauge. Sample flow may be maintained either by a vacuum pump or container pressurization if the collection bag remains in the rigid container. After sample loop purging is ceased, allow the pressure gauge to return to zero before activating the gas sampling valve.

6.4 Analysis. Set the column temperature to 80°C for column A or 75°C for column B, and the detector temperature to 225°C. When optimun hydrogen and oxygen flow rates have been determined, verify and maintain these flow rates during all chromatograph operations. Using zero helium or nitrogen as the carrier gas, establish a flow rate in the range consistent with the manufacturer's requirements for satisfactory detector operation. A flow rate of approximately 20 ml/min should produce adequate separations. Observe the base line periodically and determine that the noise level has stabilized and that base line drift has ceased. Purge the sample loop for thirty seconds at the rate of 100 ml/min, then activate the sample valve. Record the injection time (the position of the pen on the chart at the time of sample injection), the sample number, the sample loop temperature, the column temperature, carrier gas flow

rate, chart speed and the attenuator setting. Record the laboratory pressure. From the chart, note the peak having the retention time corresponding to benzene, as determined in Section 7.2.1. Measure the benzene peak area, A_m, by use of a disc integrator, electronic integrator, or a planimeter. Record A_m and the retention time. Repeat the injection at least two times or until two consecutive values for the total area of the benzene peak do not vary more than 5 percent. The average value for these two total areas will be used to compute the bag concentration.

6.5 Measure the ambient temperature and barometric pressure near the bag. From a water saturation vapor pressure table, determine and record the water vapor content of the bag as a decimal figure. (Assume the relative humidity to be 100 percent unless a lesser value is known.)

7. Standards, Calibration and Quality Assurance

7.1 Standards.

7.1.1 Preparation of Benzene Standard Gas Mixtures. (Optional--- delete if cylinder standards are used.) Assemble the apparatus shown in Figure III-2. Evacuate a 50-liter Tedlar or aluminized Mylar bag that has passed a leak check (described in Section 7.3.2) and meter in about 50 liters of nitrogen. Measure the barometric pressure, the relative pressure at the dry gas meter, and the temperature at the dry gas meter. While the bag is filling use the 10 µl syringe to inject 10 µl of 99 + percent benzene through the septum on top of the impinger. This gives a concentration of approximately 50 ppm of benzene. In a like manner, use the other syringe to prepare dilutions having approximately 10 and 5 ppm benzene concentrations. To calculate the specific concentrations, refer to section 8.1. These gas mixture standards may be used for seven days

from the date of preparation, after which time preparation of new gas mixtures is required. (Caution: Contamination may be a problem when a bag is reused if the new gas mixture standard is a lower concentration than the previous gas mixture standard.)

7.2 Calibration.

7.2.1 Determination of Benzene Retention Time. This section can be performed simultaneously with Section 7.2.2. Establish chromatograph conditions identical with those in section 6.3, above. Determine proper attenuator position. Flush the sampling loop with zero helium or nitrogen and activate the sample valve. Record the injection time, the sample loop temperature, the column temperature, the carrier gas flow rate, the chart speed and the attenuator setting. Record peaks and detector responses that occur in the absence of benzene. Maintain conditions, with the equipment plumbing arranged identically to section 6.3, and flush the sample loop for 30 seconds at the rate of 100 ml/min with one of the benzene calibration mixtures and activate the sample valve. Record the injection time. Select the peak that corresponds to benzene. Measure the distance on the chart from the injection time to the time at which the peak maximum occurs. This distance divided by the chart speed, is defined as the benzene peak retention time. Since it is quite likely that there will be other organics present in the sample, it is very important that positive identification of the benzene peak be made.

7.2.2 Preparation of Chromatograph Calibration Curve. Make a gas chromatographic measurement of each standard gas mixture (described in Section 5.2.3 or 7.1.1) using conditions identical with those listed in

Sections 6.3 and 6.4 . Flush the sampling loop for 30 seconds at the rate of 100 ml/min with one of the standard gas mixtures and activate the sample valve. Record C_c, the concentration of benzene injected, the attenuator setting, chart speed, peak area, sample loop temperature, column temperature, carrier gas flow rate, and retention time. Record the laboratory pressure. Calculate A_c, the peak area multiplied by the attenuator setting. Repeat until two consecutive injection areas are within 5 percent, then plot the average of those two values vs C_c. When the other standard gas mixtures have been similarly analyzed and plotted, draw a straight line through the points. Perform calibration daily, or before and after each set of bag samples, whichever is more frequent.

7.3 Quality Assurance.

7.3.1 Analysis Audit. Immediately after the preparation of the calibration curve and prior to the sample analyses, perform the analysis audit described in Appendix E, Supplement B: "Procedure for Field Auditing GC Analysis."

7.3.2 Bag Leak Checks. While performance of this section is required subsequent to bag use, it is also advised that it be performed prior to bag use. After each use, make sure a bag did not develop leaks as follows: to leak check, connect a water manometer and pressurize the bag to 5-10 cm H_2O (2-4 in. H_2O). Allow to stand for 10 minutes. Any displacement in the water manometer indicates a leak. Also, check the rigid container for leaks in this manner. (Note: an alternative leak

check method is to pressurize the bag to 5-10 cm H_2O or 2-4 in. H_2O and allow to stand overnight. A deflated bag indicates a leak.) For each sample bag in its rigid container, place a rotameter in line between the bag and the pump inlet. Evacuate the bag. Failure of the rotameter to register zero flow when the bag appears to be empty indicates a leak.

8. Calculations

8.1 Optional Benzene Standards Concentrations. Calculate each benzene standard concentration prepared in accordance with Section 7.1.1 as follows:

$$C_c = \frac{B\mu l \; \frac{.8787\ \mu g}{\mu l} \; \frac{10^3\ \mu g}{mg} \; \frac{\mu g\ mole}{78.11\ \mu g} \; \frac{24.055\ \mu l}{\mu g\ mole} \; 10^6}{V_m \; Y \; \frac{10^6\ \mu l}{l} \; \frac{293}{T_m} \; \frac{P_m}{760}}$$

$$= \frac{B\ (270.6)}{V_m \; Y \; \frac{293}{T_m} \; \frac{P_m}{760}} \qquad \text{Equation III-1}$$

Where:

C_c = Benzene standard concentration in ppm.

B = Number of µl of benzene injected.

V_m = Gas volume measured by dry gas meter in liters.

Y = Dry gas meter calibration factor.

P_m = Absolute pressure of the dry gas meter, mm Hg.

T_m = Absolute temperature of the dry gas meter, °A.

.8787 = Density of benzene at 293°A.

78.11 = Molecular weight of benzene.

24.055 = Ideal gas at 293°A, 760 mm Hg.

10^6 = Conversion factor, ppm.

8.2 Benzene Sample Concentrations. From the calibration curve described in Section 7.2.2 above, select the value of C_c that corresponds to A_c. Calculate C_s as follows:

$$C_s = \frac{C_c P_r T_i}{P_i T_r (1-S_{wb})} \qquad \text{Equation III-2}$$

where:

S_{wb} = The water vapor content of the bag sample, as analyzed.

C_s = The concentration of benzene in the sample in ppm.

C_c = The concentration of benzene indicated by the gas chromatograph, in ppm.

P_r = The reference pressure, the laboratory pressure recorded during calibration, mm Hg.

T_i = The sample loop temperature on the absolute scale at the time of analysis, °A.

P_i = The laboratory pressure at time of analysis, mm Hg.

T_r = The reference temperature, the sample loop temperature recorded during calibration, °A.

9. References

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3. Bulletins 743A, 740C, and 740D. "Separation of Hydrocarbons" 1974. Supelco, Inc. Bellefonte, Pennsylvania 16823.

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5.

6.

couple of memos from J. Hull.

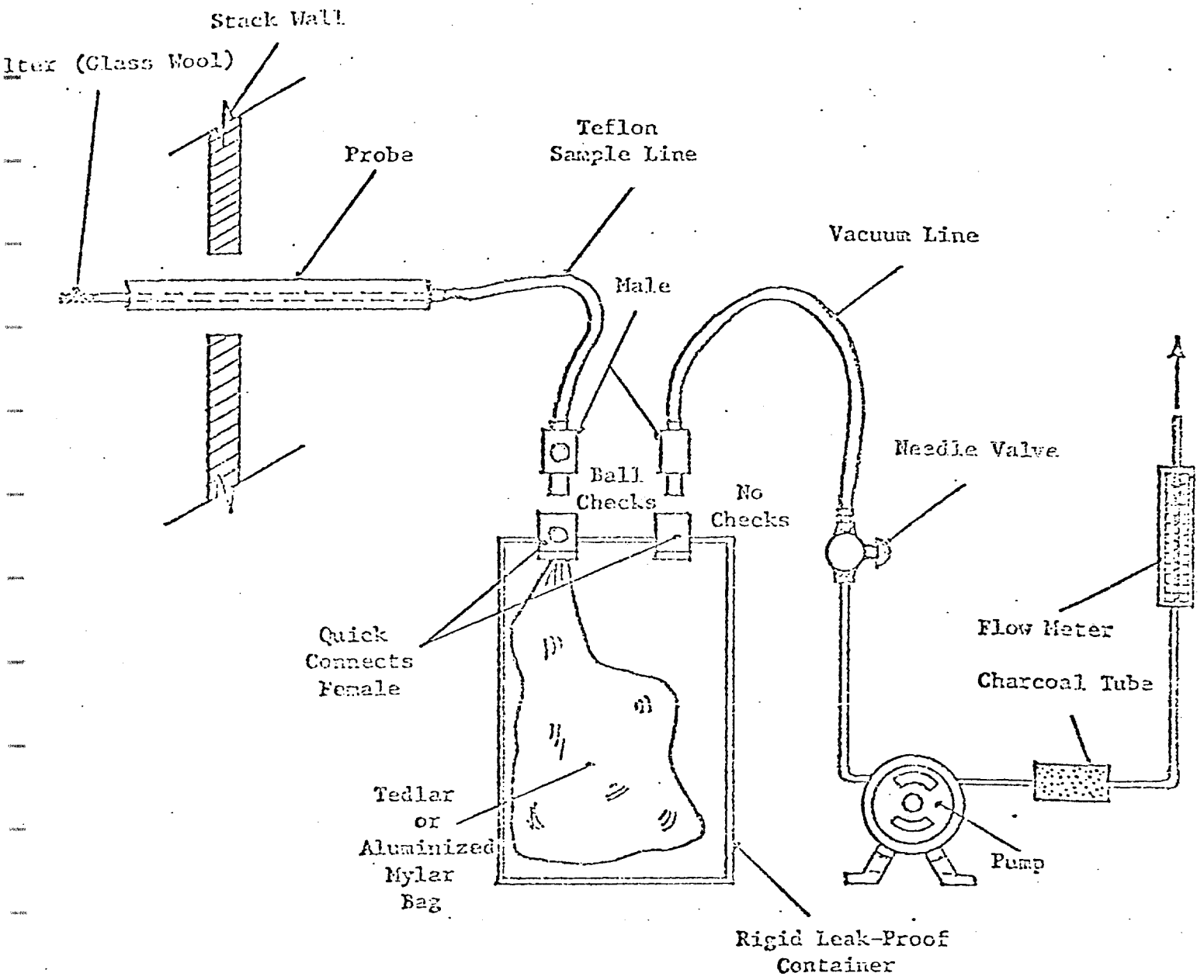

Figure III-1. Integrated-bag sampling train. (Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.)

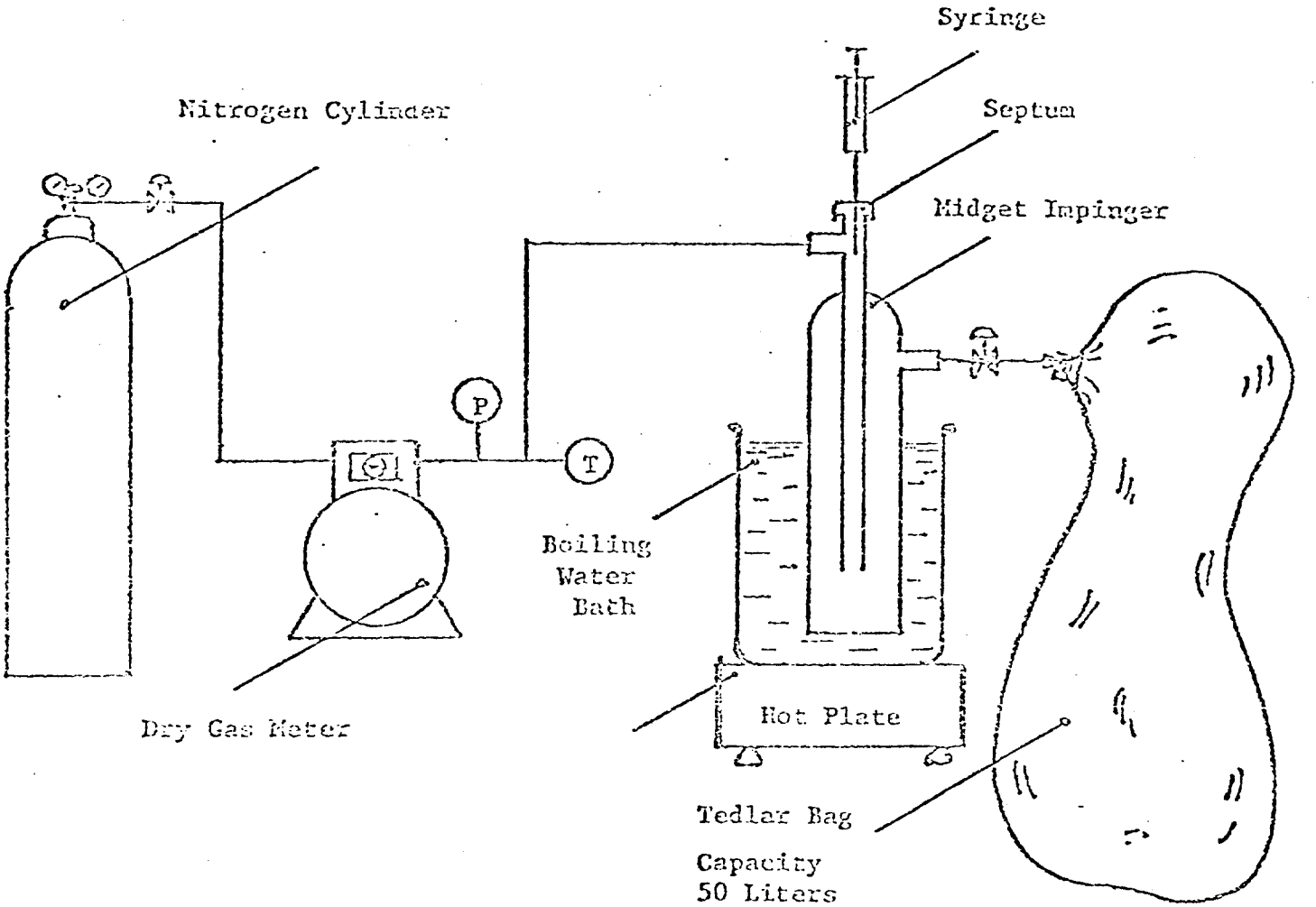

Figure III-2. Preparation of Benzene Standards.
(optional)

Method III

SUPPLEMENT A

DETERMINATION OF ADEQUATE CHROMATOGRAPHIC PEAK RESOLUTION

In this method of dealing with resolution, the extent to which one chromatographic peak overlaps another is determined.

For convenience, consider the range of the elution curve of each compound as running from $-2\sigma_s$ to $+2\sigma$. This range is used in other resolution criteria, and it contains 95.45 percent of the area of a normal curve. If two peaks are separated by a known distance, b, one can determine the fraction of the area of one curve that lies within the range of the other. The extent to which the elution curve of a contaminant compounds overlaps the curve of a compound that is under analysis is found by integrating the contaminant curve over the limits $b-2\sigma_s$ to $b+2\sigma_s$, where σ_s is the standard deviation of the sample curve.

There are several ways this calculation can be simplified. Overlap can be determined for curves of unit area and then actual areas can be introduced. The desired integration can be resolved into two integrals of the normal distribution function for which there are convenient calculation programs and tables. An example would be Program 15 in Texas Instruments Program Manual ST1, 1975, Texas Instruments Inc., Dallas, Texas 75222.

$$\frac{1}{\sqrt{2\pi}\,\sigma_c}\int_{b-2\sigma_s}^{b+2\sigma_s} e^{-\frac{t_c^2}{2\sigma_c}}\,dt = \frac{1}{\sqrt{2\pi}}\int_{\frac{b-2\sigma_s}{\sigma_c}}^{\infty} e^{-\frac{x^2}{2}}\,dx - \frac{1}{\sqrt{2\pi}}\int_{\frac{b+2\sigma_s}{\sigma_c}}^{\infty} e^{-\frac{x^2}{2}}\,dx.$$

The following calculation steps are required:*

1. $2\sigma_s = t_s/\sqrt{2 \ln 2}$

2. $\sigma_c = t_c/2\sqrt{2 \ln 2}$

3. $x_1 = (b-2\sigma_s)/\sigma_c$

4. $x_2 = (b+2\sigma_s)/\sigma_c$

5. $$Q(x_1) = \frac{1}{\sqrt{2\pi}} \int_{x_1}^{\infty} e^{-\frac{x^2}{2}} dx$$

6. $$Q(x_2) = \frac{1}{\sqrt{2\pi}} \int_{x_2}^{\infty} e^{-\frac{x^2}{2}} dx$$

7. $I_o = Q(x_1) - Q(x_2)$.

8. $A_o = I_o A_c/A_s$

9. % overlap = $A_o \times 100$

* (Note: In most instances, $Q(x_2)$ is very small and may be neglected.)

Where:

A_s = The area of the sample peak of interest determined by electronic integration, or by the formula $A_s = h_s t_s$.

A_c = The area of the contaminant peak, determined in the same manner as A_s.

b = The distance on the chromatographic chart that separates the maxima of the two peaks.

h_s = The peak height of the sample compound of interest, measured from the average value of the baseline to the maximum of the curve.

t_s = The width of the sample peak of interest at 1/2 of peak height.

t_c = The width of the contaminant peak at 1/2 of peak height.

σ_s = The standard deviation of the sample compound of interest elution curve.

σ_c = The standard deviation of the contaminant elution curve.

$Q(x_1)$ = The integral of the normal distribution function from x_1 to infinity.

$Q(x_2)$ = The integral of the normal distribution function from x_2 to infinity.

I_o = The overlap integral.

A_o = The area overlap fraction

In judging the suitability of alternate gas chromatographic columns, or the effects of altering chromatographic conditions, one can employ the area overlap as the resolution parameter with a specific maximum permissible value.

The use of Gaussian functions to describe chromatographic elution curves is widespread. However, some elution curves are highly asymetric. In those cases where the sample peak is followed by a contaminant that has a leading edge that rises sharply but the curve then tails off, it may be possible to define an effective width for t_c as "twice the distance from the leading edge to a perpendicular line through the maxim of the contaminant curve, measured along a perpendicular bisection of that line."

SUPPLEMENT B

PROCEDURE FOR FIELD AUDITING GC ANALYSIS

Responsibilities of audit supervisor and analyst at the source sampling site include the following:

A. Check that audit cylinders are stored in a safe location both before and after the audit to prevent vandalism of same.

B. At the beginning and conclusion of the audit, record each cylinder number and cylinder pressure. Never analyze an audit cylinder when the pressure drops below 200 psi.

C. During the audit, the analyst is to perform a minimum of two consecutive analyses of each audit cylinder gas. The audit must be conducted to coincide with the analysis of source test samples. Normally, it will be conducted immediately after the GC calibration and prior to the sample analyses.

D. At the end of the audit analyses, the audit supervisor requests the calculated concentrations from the analyst, and then compares the results with the actual audit concentrations. If each measured concentration agrees with the respective actual concentration within ± 10 percent, he then directs the analyst to begin the analysis of source samples. Audit supervisor judgment and/or supervisory policy determines course of action when agreement is not within ± 10 percent. Where a consistent bias in excess of 10 percent is found, it may be possible to proceed with the sample analyses, with a corrective factor to be applied to the results at a later time. However, every attempt should be made to locate the cause of the discrepancy, as it may be misleading. The audit

supervisor is to record each cylinder number, cylinder pressure (at the end of the audit) and all calculated concentrations. The individual being audited must not under any circumstance be told the actual audit concentrations until the calculated concentrations have been submitted to the audit supervisor.

FIELD AUDIT REPORT

PART A - To be filled out by organization supplying audit cylinders

1. Organization supplying audit sample(s) and shipping address

   _____

2. Audit supervisor, organization, and phone number

   _____

   _____

3. Shipping instructions - Name, Address, Attention

   _____

   _____

   _____

4. Guaranteed arrival date for cylinders_____

5. Planned shipping date for cylinders_____

6. Details on audit cylinders from last analysis

	Low Conc.	High Conc.
a. Date of last analysis	_____	_____
b. Cylinder number	_____	_____
c. Cylinder pressure, PSI	_____	_____
d. Audit gas(es)/balance gas	_____	_____
e. Audit gas(es) ppm	_____	_____
f. Cylinder construction	_____	_____

PART B - To be filled out by audit supervisor

1. Process sampled _____

_____

2. Location of audit _____

_____

3. Name of individual audited _____

4. Audit date _____

5. Audit results

	Low Conc. Cylinder	High Conc. Cylinder
a. Cylinder number	_____	_____
b. Cylinder pressure before audit, psi	_____	_____
c. Cylinder pressure after audit, psi	_____	_____
d. Measured concentration, ppm		
Injection #1*	_____	_____
Injection #2*	_____	_____
Average *	_____	_____
e. Actual audit concentration, ppm (Part A, 6e)	_____	_____

* Results of two consecutive injections which meet the sample analysis criteria of the test method.

f. Audit accuracy*

Low Conc. Cylinder _____

High Conc. Cylinder _____

$$* \text{ Percent accuracy} = \frac{\text{Measured Conc.} - \text{Actual Conc.}}{\text{Actual Conc.}} \times 100$$

g. Problems detected (if any)_____

_____

_____

_____

APPENDIX E-3

DRAFT METHOD 109 (AND ADDENDUM TO METHOD 109)

11/1/78

File 9-3-15.5

METHOD 109 - DETERMINATION OF VISIBLE EMISSIONS FROM COKE OVEN BATTERIES, PART C

DRAFT
DO NOT QUOTE OR CITE

Preamble

Part C of this method establishes the procedures for determining emissions from coke oven doors. During the coking cycle leaks in the seal between the oven door and oven frame (door jamb), as well as leaks in the seal between the chuck door and chuck door frame, can cause emissions to occur. Due to varying pressures within the coke oven a leak from any one oven door can intermittently occur, stopping and starting at any time during the full coking cycle. Each oven door and each chuck door on the battery is a potential emission source. Due to the large number and variability of potential leaks, it would be nearly impossible to identify the occurrence and duration of all door leaks on a battery at any given time; this method is not intended to do so. Instead, this method involves a successive inspection of all the oven doors and chuck doors on a single battery. To perform the inspection, the observer chooses to first inspect either the pushside or cokeside of the battery. The observer then takes a position on the ground at one end of the chosen side of the battery. The observer then walks along the ground to the other end of the coke battery looking at all the oven and chuck doors and noting the doors which have visible emissions. The observer completes the inspection by observing the doors on the other (coke or push) side of the battery. During the inspection the number of the ovens with leaking doors are recorded; an emission rate, percent doors leaking, is calculated based on the number of potential sources.

PART C - DETERMINATION OF VISIBLE EMISSIONS FROM COKE OVEN DOORS

1. Principle and Applicability

1.1 Principle.

The visible emissions emitted from coke oven doors (including chuck doors) are determined visually by an observer who is familiar with coke oven battery operations.

1.2 Applicability.

Part C of this method is applicable for the determination of the emissions from leaking coke oven doors and chuck doors from by-product coke oven batteries. The appropriate number of runs as specified in the applicable subpart is required for determining compliance.

2. Definitions

2.1 Oven. A chamber used for the destructive distillation of coal to produce coke.

2.2 Coke oven battery. A facility for the production of coke containing one or more ovens with an integral heating system.

2.3 Pushside. The side of a battery from which the coke is pushed when emptying an oven.

2.4 Cokeside. The side of a battery on which the quench car for receiving the coke during pushing is located.

2.5 Oven door. The removable structures utilized for sealing the ends (cokeside and pushside) of each oven on a slot type by-product battery.

2.6 Chuck door (leveler bar door). The small door on the push side which is opened during the oven charging period in order to permit

the leveler bar to enter the oven and level the coal. The chuck door is usually an integral part of the push side door; however, in some cases, the chuck door might be a separate door located above the oven door.

2.7 Door jamb. The metal casing built into the oven that forms the housing to which the oven door is fitted and attached; the door jamb face forms the surface to which the door is sealed.

2.8 Buckstay. The metal structure located around and between the ovens which forms the support of the coke oven battery.

2.9 Oven door leak - a leak which is emitted from the sealing area between the door jamb and coke oven door.

2.10 Chuck door leak - a leak which is emitted from the sealing area between the chuck door and chuck door frame.

2.11 Jamb leak. A leak which is emitted from a crack between the door jamb and brickwork.

2.12 Buckstay leak - a leak which is emitted from a crack between the buckstays and oven brickwork.

2.13 Lintel area - the area of the coke oven between the top edge of the oven door and the top edge of the battery.

2.1.4 Battery traverse. The act conducted by the inspector consisting of walking the length of the battery from one pinion wall to the other pinion wall.

3. Procedure

3.1 Observations

3.1.1 General. The observer "inspects" the coke oven battery by conducting a traverse around the battery. The observer conducts a battery traverse from a location on the ground as close to the battery as safety and visibility conditions permit; this is generally outside of the pusher machine and quench car tracks. During a run (inspection) the observer first chooses either the coke side or push side of the battery and then begins a traverse by walking on the ground at a steady pace from one end to the other end of the battery. The observer should travel along the side of the battery at a normal walking pace, pausing only to make appropriate entries on the door inspection sheet (Figure 109-4). The traverse should take approximately 4 minutes (per side) to complete (70 oven battery). An average traverse rate of 6 seconds per oven on each side of the battery is the maximum time permitted, excluding the time during which an observer may wait for the hot car, pusher machine, or door machine to move from a position blocking the view of a series of doors. Once the traverse is completed on the coke or push side of the battery the observer moves around to the other side of the battery to inspect the remaining doors and complete the traverse. The entire door inspection (one run) of a battery is to be completed within a period of forty-five minutes.

3.1.2 Procedure. The observer records the time and then starts a traverse along one side of the battery. During the traverse, the observer looks around the entire perimeter of each oven door and chuck door in order to identify all leaks. Upon noting an oven door leak or chuck door leak, the observer pauses and records the information (oven number, location of leak) on the door inspection sheet (Figure 109-4).

If a piece of equipment obstructs the observer's view during the traverse, the observer has three options:

1. The observer may wait for the equipment to move before completing the traverse.
2. The observer may complete the traverse and then, once the equipment has moved, return to inspect the ovens on a particular side of a battery either immediately after completing the traverse on that side, or after completing the entire traverse around both sides of the battery.
3. The observer may simply exclude from the inspection the ovens blocked from view by the coke oven equipment. (If this option is chosen, the total number of sources on the battery is still used to determine the percent leaks).

When the traverse of one battery side is completed, record the time. The observer then either inspects the series of doors previously blocked from view by machinery or the observer moves to the other side of the battery. The observer records the time the traverse on the second side of the battery is started and then conducts the traverse. The time the traverse of the second side is finished is recorded and then the observer conducts any required inspection of doors previously blocked from view by machinery in order to complete the run.

The following are not recorded as door emissions:

3.1.2.1 Emissions from buckstay leaks.

3.1.2.2 Emissions from jamb leaks.

3.1.2.3 Steam vapor.

3.1.2.4 Emissions from ovens with the doors removed.

3.1.2.5 Emissions from oven doors on which maintenance work is being conducted.

3.1.3 Visual interference. Occasionally, the observer's vision will be obscured by fugitive emissions from other sources at the coke battery (e.g. steam from the coke oven wharf). If the fugitive emissions are of such a magnitude as to delay the observer's traverse, this should be noted on the data sheet.

3.2 Recording data.

3.2.1 General. Record all the information requested at the top of the data form prior to starting the inspection. Record the time all traverses begin and start, including the times for the inspections of doors previously blocked from view by battery machinery. If the inspection is delayed because of operations occurring on the battery or because of fugitive emissions, this should be explicitly noted (i.e., the period of time delayed shall be recorded). Prior to beginning a traverse on either side of the battery, record in column 1 of the data sheet which side (coke or push) is being inspected.

3.2.2 Emissions. For each oven with door emissions record the oven number in column 2 of the data form and the source(s) of the leak by checking either column 3 if the oven door is leaking or colunm 4 if the chuck door is leaking. If both sources of the same oven are leaking check both columns. Note that since the coke side and push side are inspected separately, each oven number can appear twice on the data sheet for each run.

4. Calculations

Determine the total number of doors (all potential sources) on the coke oven battery by multiplying the number of ovens in the battery by three (3) for batteries with chuck doors and two (2) for batteries without chuck doors (some batteries charging preheated coal). For each run, sum the total number of leaking oven doors and leaking chuck doors recorded in columns 3 and 4 of the data sheet (one sum for both coke side and push side). Divide this sum by the total number of doors on the battery; multiply by 100 to determine the percent of doors leaking. Round this percentage off to the nearest tenth of one percent and record this percentage as the coke oven door emission rate for the run.

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Addendum to Method 109

1. Emissions Opacity.

The observers will record the opacity of the emissions from the doors. Therefore, the procedure section of Method 109 is modified by replacing the third sentence of paragraph 3.1.2 with the following:

Upon noting an oven door leak or chuck door leak, the observer pauses to look at the lintel area (defined in 2.13) above the door in order to determine the opacity of the emissions; the inspector momentarily observes the emissions long enough to make a single determination of the opacity. The observer then records the information (oven number, location of leak, opacity of emissions) on the door inspection sheet (figure 109-4).

2. Jamb leaks.

Jamb leaks (as defined in section 2.11) will be recorded for these emissions tests. When a jamb leak is noted the observer should record the same information required for a door leak except that the notation "jamb leak" should be made in the comment column; columns 3 and 4 of the data form should be left blank unless a door or chuck door leak is also present.

3. Certification.

All observers will be certified according to the procedures of Method 9.

4. Multiple observers.

In order to prevent interference among observers the following procedures should be used when multiple observers are recording emissions:

a) All observers will make "simultaneous" traverses of each battery side (i.e. one observer will not traverse the coke side of a battery while another observer traverses the push side). In addition,

one observer should not begin a traverse of the second side of the battery until all observers have completed the first traverse and are ready to proceed.

b) two of the observers will simultaneously start their traverses of a given side of the battery from opposite ends (pinion walls) of the battery. The third observer will start the traverse from either end; the observer will start the traverse not less than 1 minute after nor more than 2 minutes after the other observer.

Company: SSS Steel

Inspector: Roy Neulicht

Location: Pittsburgh, PA

Date: 9/9/79

Company Rep.(s): John Smith

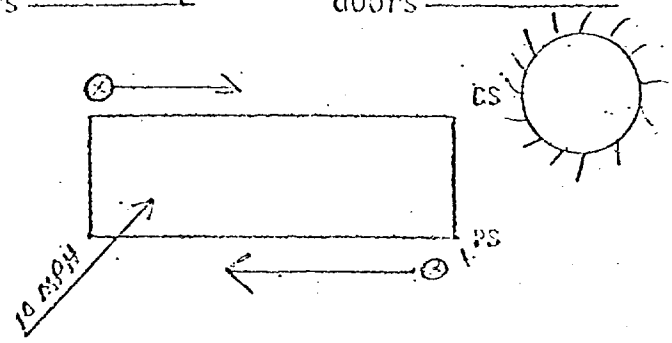
Battery number: one

Total number of: Oven doors: 80 Chuck doors: 40

Indicate sun position, wind speed and direction and location of traverse:

Sky condition: Clear

Run number: One



Time traverse started/ completed (PS/CS)	Oven number	Visible emissions: Oven Door	Visible emissions: Chuck Door	% Opacity	Comments
PS 10:01	4	X		20	
	8	X	X	30	
	15		X	10	
	18		X	10	Jamb leak
PS 10:05	20			5	Jamb leak
CS 10:15	3	X		5	
	6	X		5	
					7-15 Door Machine
	17	X		10	
CS 10:20	18			10	
CS 10:20					7-15 Observed no leaks
10:21					

APPENDIX E-4

METHOD 9

Rom, Jerome J., Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment, Environmental Protection Agency, Air Pollution Control Office Publication No. APTD-0576.

Shell Development Co. Analytical Department, Determination of Sulfur Dioxide and Sulfur Trioxide in Stack Gases, Emeryville Method Series, 4516/59a.

METHOD 9—VISUAL DETERMINATION OF THE OPACITY OF EMISSIONS FROM STATIONARY SOURCES

Many stationary sources discharge visible emissions into the atmosphere; these emissions are usually in the shape of a plume. This method involves the determination of plume opacity by qualified observers. The method includes procedures for the training and certification of observers, and procedures to be used in the field for determination of plume opacity. The appearance of a plume as viewed by an observer depends upon a number of variables, some of which may be controllable and some of which may not be controllable in the field. Variables which can be controlled to an extent to which they no longer exert a significant influence upon plume appearance include: Angle of the observer with respect to the plume; angle of the observer with respect to the sun; point of observation of attached and detached steam plume; and angle of the observer with respect to a plume emitted from a rectangular stack with a large length to width ratio. The method includes specific criteria applicable to these variables.

Other variables which may not be controllable in the field are luminescence and color contrast between the plume and the background against which the plume is viewed. These variables exert an influence upon the appearance of a plume as viewed by an observer, and can affect the ability of the observer to accurately assign opacity values to the observed plume. Studies of the theory of plume opacity and field studies have demonstrated that a plume is most visible and presents the greatest apparent opacity when viewed against a contrasting background. It follows from this, and is confirmed by field trials, that the opacity of a plume, viewed under conditions where a contrasting background is present can be assigned with the greatest degree of accuracy. However, the potential for a positive error is also the greatest when a plume is viewed under such contrasting conditions. Under conditions presenting a less contrasting background, the apparent opacity of a plume is less and approaches zero as the color and luminescence contrast decrease toward zero. As a result, significant negative bias and negative errors can be made when a plume is viewed under less contrasting conditions. A negative bias decreases rather than increases the possibility that a plant operator will be cited for a violation of opacity standards due to observer error.

Studies have been undertaken to determine the magnitude of positive errors which can be made by qualified observers while reading plumes under contrasting conditions and using the procedures set forth in this method. The results of these studies (field trials) which involve a total of 769 sets of 25 readings each are as follows:

(1) For black plumes (133 sets at a smoke generator), 100 percent of the sets were read with a positive error[1] of less than 7.5 percent opacity; 99 percent were read with a positive error of less than 5 percent opacity.

(2) For white plumes (170 sets at a smoke generator, 168 sets at a coal-fired power plant, 298 sets at a sulfuric acid plant), 99 percent of the sets were read with a positive error of less than 7.5 percent opacity; 95 percent were read with a positive error of less than 5 percent opacity.

The positive observational error associated with an average of twenty-five readings is therefore established. The accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

1. *Principle and applicability.*

1.1 Principle. The opacity of emissions from stationary sources is determined visually by a qualified observer.

1.2 Applicability. This method is applicable for the determination of the opacity of emissions from stationary sources pursuant to § 60.11(b) and for qualifying observers for visually determining opacity of emissions.

2. *Procedures.* The observer qualified in accordance with paragraph 3 of this method shall use the following procedures for visually determining the opacity of emissions:

[1] For a set, positive error=average opacity determined by observers' 25 observations—average opacity determined from transmissometer's 25 recordings.

2.1 Position. The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. Consistent with maintaining the above requirement, the observer shall, as much as possible, make his observations from a position such that his line of vision is approximately perpendicular to the plume direction, and when observing opacity of emissions from rectangular outlets (e.g. roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight should not include more than one plume at a time when multiple stacks are involved, and in any case the observer should make his observations with his line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g. stub stacks on baghouses).

2.2 Field records. The observer shall record the name of the plant, emission location, type facility, observer's name and affiliation, and the date on a field data sheet (Figure 9–1). The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background are recorded on a field data sheet at the time opacity readings are initiated and completed.

2.3 Observations. Opacity observations shall be made at the point of greatest opacity in that portion of the plume where condensed water vapor is not present. The observer shall not look continuously at the plume, but instead shall observe the plume momentarily at 15-second intervals.

2.3.1 Attached steam plumes. When condensed water vapor is present within the plume as it emerges from the emission outlet, opacity observations shall be made beyond the point in the plume at which condensed water vapor is no longer visible. The observer shall record the approximate distance from the emission outlet to the point in the plume at which the observations are made.

2.3.2 Detached steam plume. When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the opacity of emissions should be evaluated at the emission outlet prior to the condensation of water vapor and the formation of the steam plume.

2.4 Recording observations. Opacity observations shall be recorded to the nearest 5 percent at 15-second intervals on an observational record sheet. (See Figure 9–2 for an example.) A minimum of 24 observations shall be recorded. Each momentary observation recorded shall be deemed to represent the average opacity of emissions for a 15-second period.

2.5 Data Reduction. Opacity shall be determined as an average of 24 consecutive observations recorded at 15-second intervals. Divide the observations recorded on the record sheet into sets of 24 consecutive observations. A set is composed of any 24 consecutive observations. Sets need not be consecutive in time and in no case shall two sets overlap. For each set of 24 observations, calculate the average by summing the opacity of the 24 observations and dividing this sum by 24. If an applicable standard specifies an averaging time requiring more than 24 observations, calculate the average for all observations made during the specified time period. Record the average opacity on a record sheet. (See Figure 9–1 for an example.)

3. *Qualifications and testing.*

3.1 Certification requirements. To receive certification as a qualified observer, a candidate must be tested and demonstrate the ability to assign opacity readings in 5 percent increments to 25 different black plumes and 25 different white plumes, with an error not to exceed 15 percent opacity on any one reading and an average error not to exceed 7.5 percent opacity in each category. Candidates shall be tested according to the procedures described in paragraph 3.2. Smoke generators used pursuant to paragraph 3.2 shall be equipped with a smoke meter which meets the requirements of paragraph 3.3.

The certification shall be valid for a period of 6 months, at which time the qualification procedure must be repeated by any observer in order to retain certification.

3.2 Certification procedure. The certification test consists of showing the candidate a complete run of 50 plumes—25 black plumes and 25 white plumes—generated by a smoke generator. Plumes within each set of 25 black and 25 white runs shall be presented in random order. The candidate assigns an opacity value to each plume and records his observation on a suitable form. At the completion of each run of 50 readings, the score of the candidate is determined. If a candidate fails to qualify, the complete run of 50 readings must be repeated in any retest. The smoke test may be administered as part of a smoke school or training program, and may be preceded by training or familiarization runs of the smoke generator during which candidates are shown black and white plumes of known opacity.

3.3 Smoke generator specifications. Any smoke generator used for the purposes of paragraph 3.2 shall be equipped with a smoke meter installed to measure opacity across the diameter of the smoke generator stack. The smoke meter output shall display instack opacity based upon a pathlength equal to the stack exit diameter, on a full 0 to 100 percent chart recorder scale. The smoke meter optical design and performance shall meet the specifications shown in Table 9–1. The smoke meter shall be calibrated as prescribed in paragraph 3.3.1 prior to the conduct of each smoke reading test. At the completion of each test, the zero and span drift shall be checked and if the drift exceeds ±1 percent opacity, the condition shall be corrected prior to conducting any subsequent test runs. The smoke meter shall be demonstrated, at the time of installation, to meet the specifications listed in Table 9–1. This demonstration shall be repeated following any subsequent repair or replacement of the photocell or associated electronic circuitry including the chart recorder or output meter, or every 6 months, whichever occurs first.

TABLE 9–1—SMOKE METER DESIGN AND PERFORMANCE SPECIFICATIONS

Parameter:	*Specification*
a. Light source	Incandescent lamp operated at nominal rated voltage.

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Parameter:	*Specification*
b. Spectral response of photocell.	Photopic (daylight spectral response of the human eye—reference 4.3).
c. Angle of view	15° maximum total angle.
d. Angle of projection.	15° maximum total angle.
e. Calibration error.	±3% opacity, maximum.
f. Zero and span drift.	±1% opacity, 30 minutes.
g. Response time	≤5 seconds.

3.3.1 Calibration. The smoke meter is calibrated after allowing a minimum of 30 minutes warmup by alternately producing simulated opacity of 0 percent and 100 percent. When stable response at 0 percent or 100 percent is noted, the smoke meter is adjusted to produce an output of 0 percent or 100 percent, as appropriate. This calibration shall be repeated until stable 0 percent and 100 percent readings are produced without adjustment. Simulated 0 percent and 100 percent opacity values may be produced by alternately switching the power to the light source on and off while the smoke generator is not producing smoke.

3.3.2 Smoke meter evaluation. The smoke meter design and performance are to be evaluated as follows:

3.3.2.1 Light source. Verify from manufacturer's data and from voltage measurements made at the lamp, as installed, that the lamp is operated within ±5 percent of the nominal rated voltage.

3.3.2.2 Spectral response of photocell. Verify from manufacturer's data that the photocell has a photopic response; i.e., the spectral sensitivity of the cell shall closely approximate the standard spectral-luminosity curve for photopic vision which is referenced in (b) of Table 9–1.

3.3.2.3 Angle of view. Check construction geometry to ensure that the total angle of view of the smoke plume, as seen by the photocell, does not exceed 15°. The total angle of view may be calculated from: $\theta = 2 \tan^{-1} d/2L$, where θ=total angle of view; d=the sum of the photocell diameter+the diameter of the limiting aperture; and L=the distance from the photocell to the limiting aperture. The limiting aperture is the point in the path between the photocell and the smoke plume where the angle of view is most restricted. In smoke generator smoke meters this is normally an orifice plate.

3.3.2.4 Angle of projection. Check construction geometry to ensure that the total angle of projection of the lamp on the smoke plume does not exceed 15°. The total angle of projection may be calculated from: $\theta = 2 \tan^{-1} d/2L$, where θ= total angle of projection; d= the sum of the length of the lamp filament + the diameter of the limiting aperture; and L= the distance from the lamp to the limiting aperture.

3.3.2.5 Calibration error. Using neutral-density filters of known opacity, check the error between the actual response and the theoretical linear response of the smoke meter. This check is accomplished by first calibrating the smoke meter according to 3.3.1 and then inserting a series of three neutral-density filters of nominal opacity of 20, 50, and 75 percent in the smoke meter pathlength. Filters calibarted within ±2 percent shall be used. Care should be taken when inserting the filters to prevent stray light from affecting the meter. Make a total of five nonconsecutive readings for each filter. The maximum error on any one reading shall be 3 percent opacity.

3.3.2.6 Zero and span drift. Determine the zero and span drift by calibrating and operating the smoke generator in a normal manner over a 1-hour period. The drift is measured by checking the zero and span at the end of this period.

3.3.2.7 Response time. Determine the response time by producng the series of five simulated 0 percent and 100 percent opacity values and observing the time required to reach stable response. Opacity values of 0 percent and 100 percent may be simulated by alternately switching the power to the light source off and on while the smoke generator is not operating.

4. *References.*

4.1 Air Pollution Control District Rules and Regulations, Los Angeles County Air Pollution Control District, Regulation IV, Prohibitions, Rule 50.

4.2 Weisburd, Melvin I., Field Operations and Enforcement Manual for Air, U.S. Environmental Protection Agency, Research Triangle Park, N.C., APTD–1100, August 1972, pp. 4.1–4.36..

4.3 Condon, E. U., and Odishaw, H., Handbook of Physics, McGraw-Hill Co., N.Y., N.Y., 1958, Table 3.1, p. 6–52.

FIGURE 9-1
RECORD OF VISUAL DETERMINATION OF OPACITY

PAGE___of___

COMPANY_____
LOCATION_____
TEST NUMBER_____
DATE_____
TYPE FACILITY_____
CONTROL DEVICE_____

HOURS OF OBSERVATION_____
OBSERVER_____
OBSERVER CERTIFICATION DATE_____
OBSERVER AFFILIATION_____
POINT OF EMISSIONS_____
HEIGHT OF DISCHARGE POINT_____

	Initial			Final
CLOCK TIME				
OBSERVER LOCATION Distance to Discharge				
Direction from Discharge				
Height of Observation Point				
BACKGROUND DESCRIPTION				
WEATHER CONDITIONS Wind Direction				
Wind Speed				
Ambient Temperature				
SKY CONDITIONS (clear, overcast, % clouds, etc.)				
PLUME DESCRIPTION Color				
Distance Visible				
OTHER INFORMATION				

SUMMARY OF AVERAGE OPACITY

Set Number	Time	Opacity	
	Start--End	Sum	Average

Readings ranged from ____ to ____ % opacity

The source was/was not in compliance with ____ at the time evaluation was made.

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FIGURE 9-2 OBSERVATION RECORD PAGE ___ OF ___

COMPANY _____ OBSERVER _____
LOCATION _____ TYPE FACILITY _____
TEST NUMBER _____ POINT OF EMISSIONS _____
DATE _____

Hr.	Min.	Seconds 0	15	30	45	STEAM PLUME (check if applicable) Attached	Detached	COMMENTS
	0							
	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	27							
	28							
	29							

FIGURE 9-2 OBSERVATION RECORD (Continued) PAGE ___ OF ___

COMPANY _____ OBSERVER _____
LOCATION _____ TYPE FACILITY _____
TEST NUMBER _____ POINT OF EMISSIONS _____
DATE _____

Hr.	Min.	Seconds 0	15	30	45	STEAM PLUME (check if applicable) Attached	Detached	COMMENTS
	30							
	31							
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							
	41							
	42							
	43							
	44							
	45							
	46							
	47							
	48							
	49							
	50							
	51							
	52							
	53							
	54							
	55							
	56							
	57							
	58							
	59							

[FR Doc.74-26150 Filed 11-11-74;8:45 am]

APPENDIX F

EXAMPLE CALCULATION

Nomenclature

A_s = Stack area, inches^2

C_f = Concentration (filterable), gr/dscf

C_p = Pitot tube correction factor, dimensionless

CM_f = Concentration (filterable), mg/dscm

D_n = Sampling nozzle diameter, inches

ER_f = Emission rate (filterable), lb/hr

ERM_f = Emission rate (filterable), kg/hr

M_d = Mole fraction of dry gas, g/g-mole

MW = Molecular weight of wet stack gas

MW_d = Molecular weight of dry stack gas

P_b = Barometric pressure, inches mercury

P_m = Average orifice pressure drop, inches water

P_s = Absolute stack gas pressure, inches mercury

P_{st} = Static pressure of stack gas, inches mercury

Q_a = Actual stack gas flowrate at stack conditions, acfm

Q_{am} = Actual stack gas flowrate at stack condtions, acm/min

Q_m = Dry stack gas flowrate at standard conditions, dscm/min

Q_s = Dry stack gas flowrate at standard conditions, dscfm

SW_f = Filterable sample weight, mg

T_m = Average meter temperature, F

T_s = Stack temperature, F

T_t = Net time of test, minutes

V_m = Volume of dry gas at meter conditions, cf

$V_{m_{std}}$ = Volume of dry gas at standard conditions, dscf

V_s = Stack gas velocity at stack conditions, fpm

V_w = Total condensate collected in sampling train, ml

$V_{w_{gas}}$ = Volume of water vapor at standard conditions, scf

ΔP_s = Velocity pressure, inches water

%I = Percent of isokinetic variation, dimensionless

%M = Percent moisture, dimensionless

Calculation of Particulate Emissions

The dry volume of sampled gas corrected to standard conditions of 68 F and 29.92 in. Hg is calculated as follows:

$$V_{m_{std}} = \frac{17.65 * V_m * \left[P_b + \left(\frac{P_m}{13.6}\right)\right]}{T_m + 460}$$

The dry stack gas flowrate corrected to standard conditions is calculated using the following set of equations sequentially:

$$V_{w_{gas}} = 0.0471 * V_w$$

$$\%M = \frac{100 * V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}}$$

$$M_d = \frac{100 - \%M}{100}$$

$$MW_d = (\%CO_2 * 44/100) + (\%O_2 * 32/100) + \left[(\%CO + \%N_2) * 28/10\right.$$

$$MW = (MW_d * M_d) + 18(1 - M_d)$$

$$P_s = P_b + P_{st}$$

$$V_s = 5120.8 * C_p * \sqrt{\Delta P_s * (T_s + 460)} * \sqrt{\frac{1}{P_s * MW}}$$

$$Q_s = \frac{0.1225 * V_s * A_s * M_d * P_s}{T_s + 460}.$$

Stack gas flowrate may be expressed metrically as dry standard cubic meters per minute (dscm/min), in terms of actual cubic feet per minute (acfm), and metrically as actual cubic meters per minute (acm /min) with use of the following equations:

$$Q_m = Qs * 0.02832$$

$$Qa = \frac{0.05667 * Qs * (T_s + 460)}{P_s * M_d}$$

$$Qam = Qa * 0.02832.$$

The equation employed to determine percent of isokinetic variation is:

$$\%I = \frac{1032 * (T_s + 460) * V_{m_{std}}}{V_s * T_t * P_s * M_d * (D_n)^2}.$$

To determine the concentration of benzene soluble organic matter in grains per dry standard cubic foot (gr/dscf), the following equation is used:

$$C_f = 0.01543 * \frac{SW_f}{V_{m_{std}}}.$$

When metric units are desired, the concentration is calculated in milligrams per dry standard cubic meter (mg/dscm) as follows:

$$CM_f = \frac{SW_f}{(0.02832)(V_{m_{std}})}.$$

Filterable BSO concentrations are obtained by summing the weight of particulate matter collected on the filter and all portions of the train preceding it.

The emission rate of BSO matter can be calculated from the filterable BSO concentration using the following equation:

$$ER_f = 0.00857 * C_f * Q_s.$$

When metric units are desired, the emission rate is calculated as kilograms per hour.

$$ERM_f = ER_f * 0.4536.$$

To avoid rounding errors it is preferable to carry out the calculation of concentration and emission rate in one operation.

Example Calculation

Using the data from Run 1, the sample volume is calculated using the formula on page 2.

Given:

$V_m = 118.824$

$P_b = 29.81$

$P_m = 2.78$

$T_m = 100.4$

then:

$V_{m_{std}} = 112.3$ dscf

Percent moisture in the stack during the test is then determined from the measured condensate volume.

Given:

V_w = 10.8 ml

then:

$V_{w_{gas}}$ = 0.509 scf

%M = 0.451

M_d = 0.995

Using the data from the Orsat analysis conducted during this run, the molecular weight of the stack gas can be determined.

Given:

$\%CO_2$ = <0.1

$\%O_2$ = 19.5

%CO = 0.1

$\%N_2$ = 80.4

then:

MW_d = 28.78

MW = 28.73

The flowrate in dry standard cubic feet can then be calculated using the formulae on page 3.

Given:

P_{st} = -0.33

C_p = 0.833

$\sqrt{\Delta P_s} * (T_s + 460)$ = 32.74

A_s = 5,662.5 in^2

T_s = 95.0F

then:

P_s = 29.48 in Hg

V_s = 4799 fpm

Q_s = 175900 dscfm

Q_m = 4982 dscm/min

Q_a = 188600 acfm

Q_{am} = 5342 acm/min

Utilizing the sampled volume and the flowrate, the percent of isokinetic variation can be calculated.

Given:

T_t = 132 min

D_n = 0.1875 in

then:

%I = 98.4

Given the analytical data, the concentrations and emission rates may be calculated for benzene soluble organic.

Given:

SW_f = 72.6 mg

then:

C_f = 0.010 gr/dscf

CM_f = 22.8 mg/dscm

ER_f = 15.0 lb/hr

ERM_f = 6.83 kg/hr

APPENDIX G

CALIBRATION DATA

METER AND ORIFICE CALIBRATION

Date 8-29-79 Client _____ Meter Box Number #2

Barometric Pressure Pb ("Hg) 29.09 Calibrator [illegible] Gas Meter Number _____

	Orifice Manometer Setting, Δm (in. H_2O)	Gas Volume Wet Test Meter V_w (ft^3)	Gas Volume Dry Gas Meter V_d (ft^3)	Temperature: Wet Test Meter t_w (°F)	Temperature: Dry Gas Meter Inlet t_{di} (°F)	Temperature: Dry Gas Meter Outlet t_{do} (°F)	Temperature: Dry Gas Meter Average t_d (°F)	Vacuum Wet Test Meter P_w (in. H_2O)	Time θ (min)	γ	K_m
Stop	0.5	1186.000	247.024	73.0	80	76	78	0.10	15:15		
Start		1180.000	241.040	72.5	72	72	72	0.10			
Average	29.13	(5) [illegible]	5.984	72.8			75.0	29.08	15.25	1.005	0.130
Stop	1.0	[illegible]	[illegible]	73.0	86	80	83	0.10	10:49		
Start		1186.000	[illegible]	73.0	[illegible]	76	[illegible]	0.10			
Average	29.16	(5) [illegible]	6.044	73.0			80.5	29.08	10.82	1.004	0.130
Stop	2.0	[illegible]	264.235	73.0	92	84	88	0.10	14:11		
Start		1192.000	[illegible]	[illegible]	86	80	83	0.10			
Average	29.24	(10) 11.000	11.167	73.0			85.5	29.08	14.18	1.003	0.128
Stop	3.0	1221.000	282.602	73.0	98	89	94	0.10	19:10		
Start		[illegible]	2[illegible]235	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
Average	29.31	(10) 18.000	18.367	73.0			90.5	29.08	19.17	1.004	0.127
Stop	4.0	[illegible]	[illegible]	[illegible]	100	90	95	0.10	11:07		
Start		[illegible]	2[illegible]	[illegible]	[illegible]	88	94	0.10			
Average	29.38	(10) [illegible]	12.272	73.0			94.0	29.08	11.12	1.006	0.126
Stop	5.0	1246.000	208.177	[illegible]	100	90	95	0.10	10:51		
Start		1233.000	294.874	73.0	100	90	95	0.10			
Average	29.46	(10) 13.000	13.304	73			95.0	29.08	10.85	1.005	0.125
									AVERAGE	1.004	0.128

$$P_w = P_b - \frac{P_w}{13.6} \qquad P_d = P_b + \frac{\Delta m}{13.6} \qquad K_m = \frac{V_w}{\theta}\sqrt{\frac{P_w}{T_w \Delta m}}$$

$$\gamma = \frac{V_w P_w (t_d + 460)}{V_d P_d (t_w + 460)}$$

Factor in isokinetic equation $= \frac{27.40}{(\overline{K}_m)^2} = \frac{27.40}{(\quad)^2} =$ 1683

Clayton Environmental Consultants, Inc.

METER AND ORIFICE CALIBRATION

Date 10/2/79 Client FROM EPA Houston Meter Box Number

Barometric Pressure Pb ("Hg) 28.98 Calibrator GEH. Gas Meter Number RAC#2

	Orifice Manometer Setting, Δm (in. H_2O)	Gas Volume Wet Test Meter V_w (ft^3)	Gas Volume Dry Gas Meter V_d (ft^3)	Temperature: Wet Test Meter t_w (°F)	Temperature: Dry Gas Meter Inlet t_{di} (°F)	Temperature: Dry Gas Meter Outlet t_{do} (°F)	Temperature: Dry Gas Meter Average t_d (°F)	Vacuum Wet Test Meter p_w (in. H_2O)	Time θ (min)	γ	K_m
Stop	0.5	1505.00	798.545		74	70	72				
Start		1500.00	793.500	66	66	66	66	.05	12:41		
Average	29.02	(5) 5.00	5.045	66			69	28.98	12.68	0.995	0.131
Stop	1.0	1510.00	803.615		80	74	77				
Start		1505.00	798.545	68	74	70	72	.05	9:10		
Average	29.05	(5) 5.00	5.070	68			74.5	28.98	9.17	0.996	0.128
Stop	2.0	1520.00	813.835		90	80	85				
Start		1510.00	803.615		80	74	77	.05	13:11		
Average	29.13	(10) 10.00	10.220	68			81	28.98	13.18	0.997	0.126
Stop	3.0	1530.00	824.183		94	80	87				
Start		1520.00	813.835	68	90	80	85	.05	10:44		
Average	29.20	(10) 10.00	10.348	68			86	28.98	10.73	0.992	0.126
Stop	4.0	1540.00	834.348		94	82	88				
Start		1530.00	824.183	68	94	80	87	.05	9:20		
Average	29.27	(10) 10.00	10.165	68			87.5	28.98	9.33	1.010	0.125
Stop	5.0	1550.00	844.600		98	84	91				
Start		1540.00	834.348	68	94	82	88	.10	8:21		
Average	29.35	(10) 10.00	10.252	68			89.5	28.97	8.35	1.002	0.125
									AVERAGE	0.999	0.127

$$P_w = P_b - \frac{p_w}{13.6} \qquad P_d = P_b + \frac{\Delta m}{13.6} \qquad K_m = \frac{V_w}{\theta}\sqrt{\frac{P_w}{T_w\,\Delta m}}$$

$$\gamma = \frac{V_w\,P_w\,(t_d + 460)}{V_d\,P_d\,(t_w + 460)}$$

Factor in isokinetic equation $= \frac{27.40}{(\bar{K}_m)^2} = \frac{27.40}{(\quad)^2} =$ 1702

METER AND ORIFICE CALIBRATION

Damaged in return shipment no post-calibration on this unit

Date 9/27/79 Client _____ Meter Box Number _____

Barometric Pressure Pb ("Hg) 29.35 Calibrator GEH Gas Meter Number KAC #3

	Orifice Manometer Setting, Δm (in. H_2O)	Gas Volume Wet Test Meter V_w (ft^3)	Gas Volume Dry Gas Meter V_d (ft^3)	Temperature: Wet Test Meter t_w (°F)	Temperature: Dry Gas Meter Inlet t_{di} (°F)	Temperature: Dry Gas Meter Outlet t_{do} (°F)	Temperature: Dry Gas Meter Average t_d (°F)	Vacuum Wet Test Meter p_w (in. H_2O)	Time θ (min)	γ	K_m
Stop	0.5	1395.00	232.808		92	84	88		11:57		
Start		1390.00	227.628	75	94	84	89	.05			
Average		(5) 5.00	5.180				88.5		11:58	0.988	0.138
Stop	1.0	1400.00	237.990		94	86	90		8:42		
Start		1395.00	232.808	75	92	84	88	.05			
Average		(5) 5.00	5.182				89		8:43	0.988	0.134
Stop	2.0	1410.00	248.335		100	90	95		12:52		
Start		1400.00	237.990	75	94	86	90	.05			
Average		(10) 10.00	10.345				92.5		12:31	0.993	0.132
Stop	3.0	1420.00	258.663		104	90	97		10:19		
Start		1410.00	248.335	75	100	90	95	.05			
Average		(10) 10.00	10.328				96		10:19	0.999	0.131
Stop	4.0	1430.00	268.992		104	92	98		9:02		
Start		1420.00	258.663	75	104	90	97	.05			
Average		(10) 10.00	10.329			91			9:01	0.999	0.130
Stop	5.0	1440.00	279.305		104	92	98		8:14		
Start		1430.00	268.992	75	104	92	98	.10			
Average		(10) 10.00	10.313				98		8:10	0.999	0.128
									AVERAGE	0.994	0.132

$$P_w = P_b - \frac{p_w}{13.6} \qquad P_d = P_b + \frac{\Delta m}{13.6} \qquad K_m = \frac{V_w}{\theta}\sqrt{\frac{p_w}{T_w\,\Delta m}}$$

$$\gamma = \frac{V_w\,P_w\,(t_d + 460)}{V_d\,P_d\,(t_w + 460)}$$

Factor in isokinetic equation $= \frac{27.40}{(\overline{K}_m)^2} = \frac{27.40}{(\quad)^2} = 1564$

Clayton Environmental Consultants, Inc.

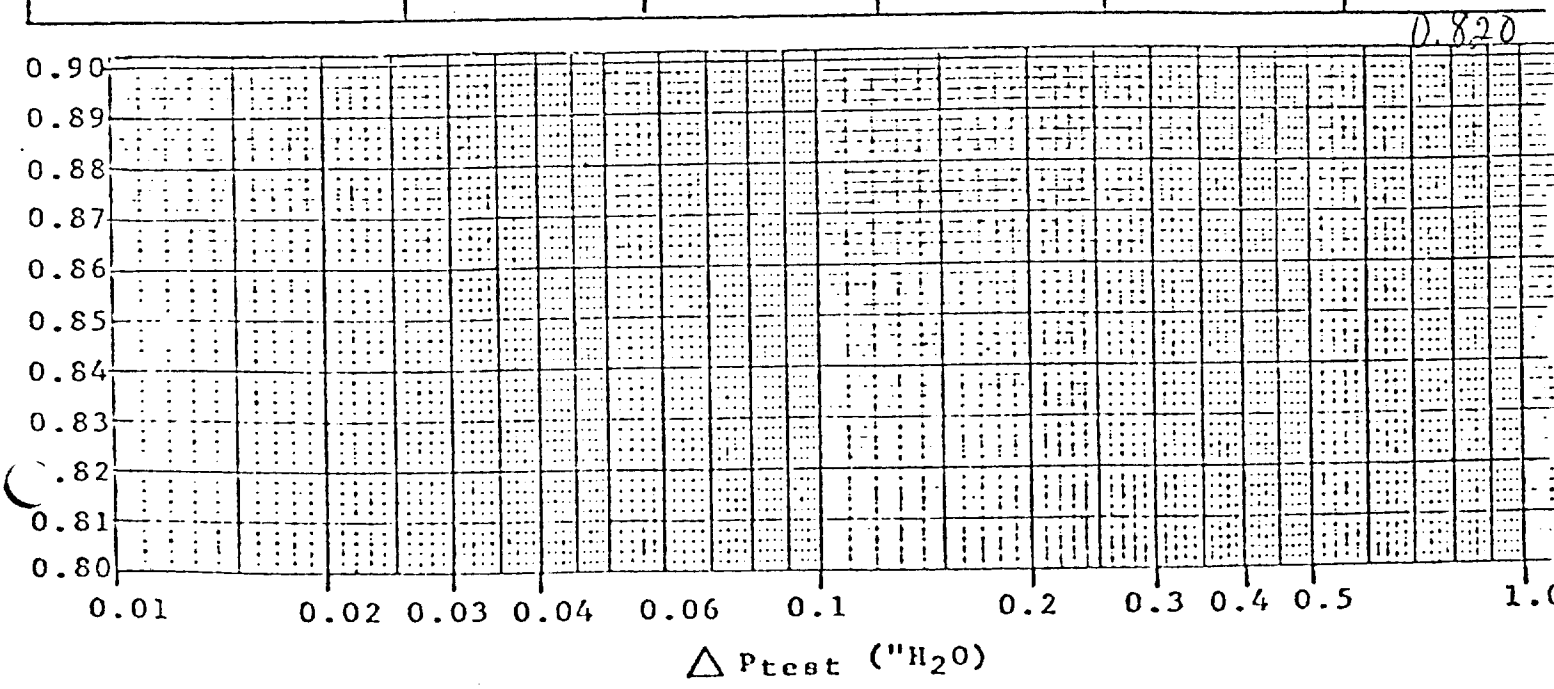
$$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$$

Pitot Tube Type S Pitot Tube No. 18

Standard Pitot Tube No. _____

alibrator: BGB Date: 10/10/79 Client: U.S. EPA - 20

Anticipated ΔP_{std}	ΔP_{std}	A		B	
		ΔP_{test}	ΔC_{ptest}	ΔP_{test}	ΔC_{ptest}
0.02	0.10	0.144	0.825	0.150	0.808
0.04	0.	0.	0.	0.	0.
0.06	0.10	0.144	0.825	0.148	0.814
0.08	0.	0.	0.	0.	0.
0.10	0.10	0.142	0.831	0.148	0.814
0.12	0.	0.	0.	0.	0.
0.16	0.	0.	0.	0.	0.
0.20	0.	0.	0.	0.	0.
0.30	0.	0.	0.	0.	0.
0.50	0.	0.	0.	0.	0.
0.70	0.	0.	0.	0.	0.
0.80	0.	0.	0.	0.	0.



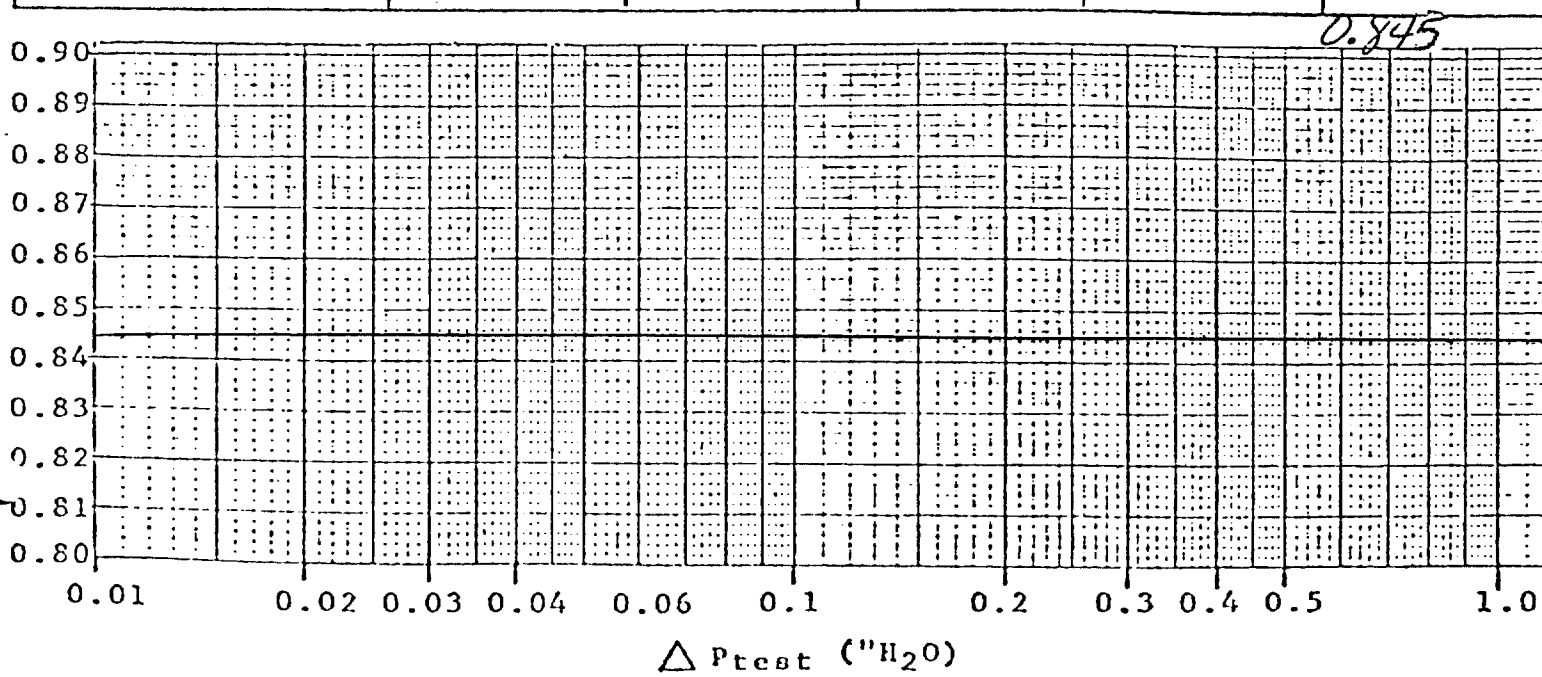
$$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$$

Pitot Tube Type S Pitot Tube No. 18

Standard Pitot Tube No. 3

Calibrator: JJB Date: 8/29/79 Client:

Anticipated ΔP_{std}	ΔP_{std}	A		B	
		ΔP_{test}	ΔC_{ptest}	ΔP_{test}	ΔC_{ptest}
0.02	0.101	0.853	0.136	0.	0.
0.04	0.101	0.	0.	0.847	0.138
0.06	0.100	0.846	0.137	0.	0.
0.08	0.100	0.	0.	0.837	0.140
0.10	0.100	0.843	0.138	0.	0.
0.12	0.101	0.	0.	0.841	0.140
0.16	0.100	0.849	0.136	0.	0.
0.20	0.100	0.	0.	0.843	0.138
0.30	0.	0.	0.	0.	0.
0.50	0.	0.	0.	0.	0.
0.70	0.	0.	0.	0.	0.
0.80	0.	0.	0.	0.	0.



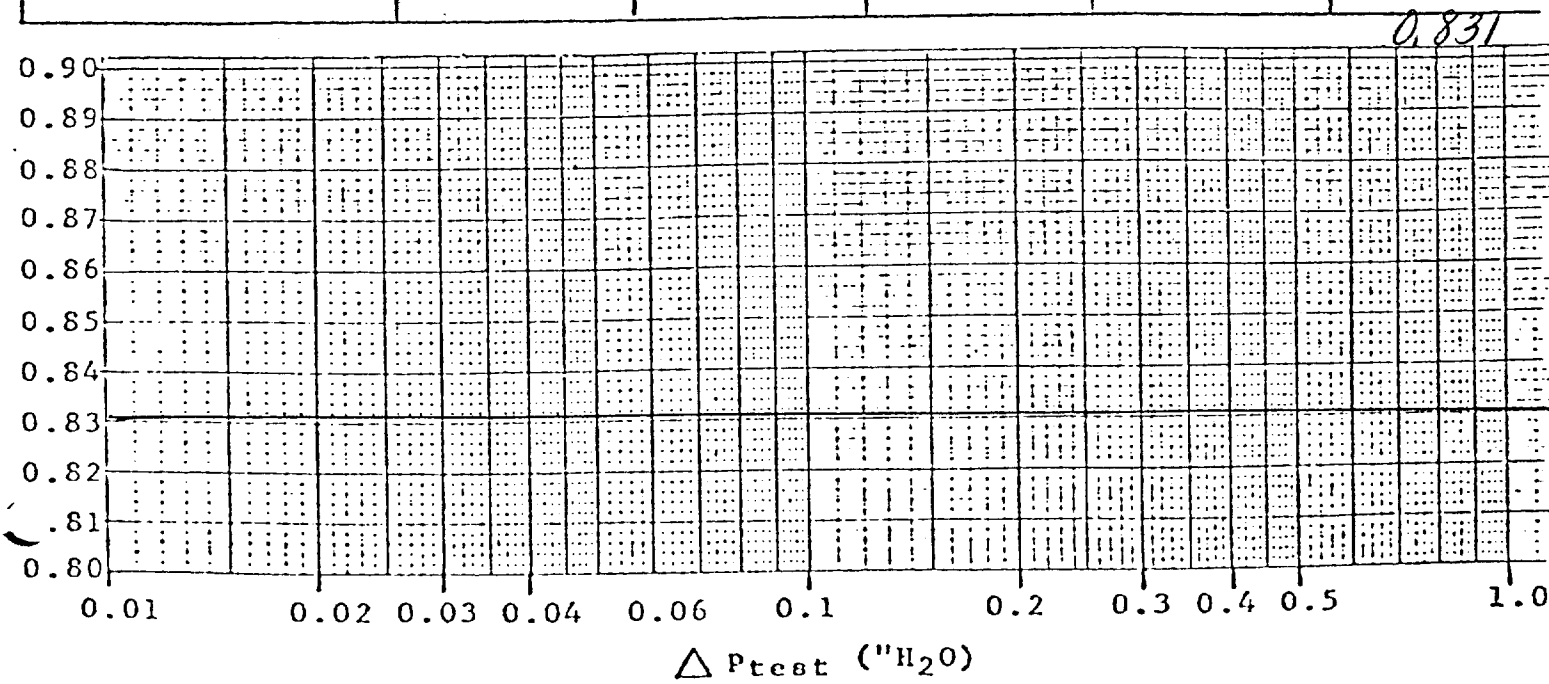
$$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$$

Pitot Tube Type S Pitot Tube No. 40

Standard Pitot Tube No. –

Calibrator: BGB Date: 8/16/79 Client:

Anticipated ΔP_{std}	ΔP_{std}	A		B	
		ΔP_{test}	ΔC_{ptest}	ΔP_{test}	ΔC_{ptest}
0.02	0.111	0.156	0.835	0.159	0.821
0.04	0.	0.	0.	0.	0.
0.06	0.	0.	0.	0.	0.
0.08	0.110	0.156	0.831	0.158	0.826
0.10	0.	0.	0.	0.	0.
0.12	0.111	0.154	0.840	0.159	0.827
0.16	0.	0.	0.	0.	0.
0.20	0.	0.	0.	0.	0.
0.30	0.	0.	0.	0.	0.
0.50	0.	0.	0.	0.	0.
0.70	0.	0.	0.	0.	0.
0.80	0.	0.	0.	0.	0.



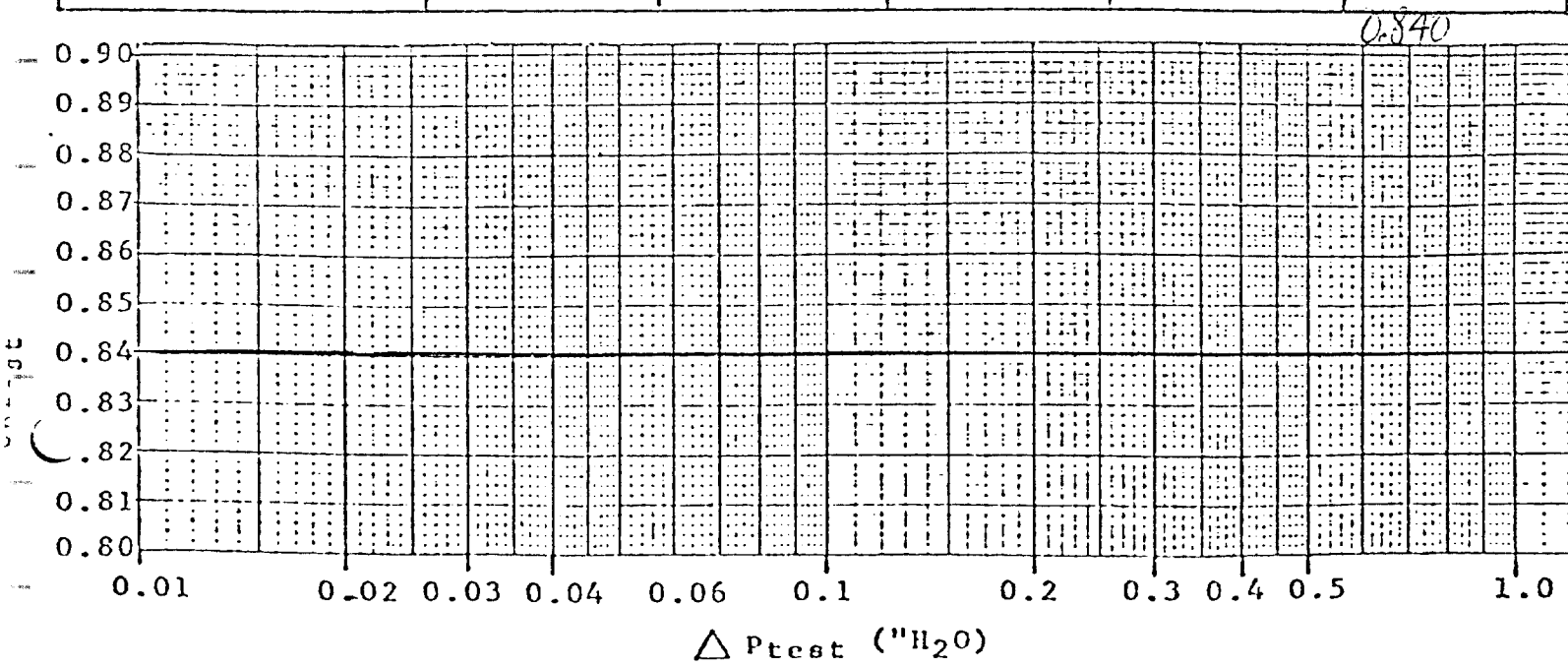
$$C_{ptest} = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_{test}}}$$

Pitot Tube Type _____ Pitot Tube No. 40

Standard Pitot Tube No. _____

Calibrator: RMK Date: 10/12/79 Client: US EPA - 20

Anticipated ΔP_{std}	ΔP_{std}	A		B	
		ΔP_{test}	ΔC_{ptest}	ΔP_{test}	ΔC_{ptest}
0.02	0.000	0.143	0.828	0.	0.
0.04	0.	0.	0.	0.	0.
0.06	0.099	0.	0.	0.138	0.839
0.08	0.	0.	0.	0.	0.
0.10	0.103	0.142	0.843	0.	0.
0.12	0.	0.	0.	0.	0.
0.16	0.102	0.	0.	0.141	0.842
0.20	0.	0.	0.	0.	0.
0.30	0.102	0.142	0.839	0.	0.
0.50	0.	0.	0.	0.	0.
0.70	0.102	0.	0.	0.138	0.851
0.80	0.	0.	0.	0.	0.



APPENDIX H

FIELD AUDIT REPORT

FIELD AUDIT REPORT

PART A - To be filled out by organization supply unit cylinders (RTI)

1. Organization supplying audit sample(s) and shipping address
   Research Triangle Institute, P.O. Box 12194
   Research Triangle Park, NC 27709

2. Audit supervisor, organization, and phone number (EMB Technical Manager)
   Dan Bivins, EPA (MD-13)

3. Shipping instructions - Name, Address, Attention
   Attention: Steve Walsh
   Clayton Environmental Consultants, 25711 S. Field Road
   S. Field, Michigan 48075

4. Guaranteed arrival date for cylinders 9/1/79

5. Planned shipping date for cylinders 8/21/79

6. Details on audit cylinders for last analysis

	Low Conc.	High Conc.
a. Date of last analysis	8/20/79	8/20/79
b. Cylinder number	B-1198	B-1159
c. Cylinder pressure, PSI	1900	1600
d. Audit gas(es)/balance gas	Benzene in N_2	Benzene in N_2
e. Audit gas(es) ppm	7.54	225
f. Cylinder construction	Steel	Steel

PART B - To be filled out by audit supervisor

1. Process sampled Coke Oven Decomposition test. Wet ESP.

2. Location of audit Pasadena, Texas.

3. Name of individual audited Clayton Environmental Consultants (John Holm)

4. Audit date 10/4-5/79

5. Audit results

	Low Conc. Cylinder	High Conc. Cylinder
a. Cylinder number	24	9
b. Cylinder pressure before audit, psi	2000	1610
c. Cylinder pressure after audit, psi ~~concentration, ppm~~	1910	1580
Injection #1*	7.5	226
Injection #2*	7.6	226
Average *	7.55	226
e. Actual audit concentration, ppm (Part A, 6~~d~~e)	7.54	225

* Results of two consecutive injections which meet the sample analysis criteria of the test method.

f. Audit accuracy*

Low Conc. Cylinder 0.13

High Conc. Cylinder 0.14

$$* \text{ Percent accuracy} = \frac{\text{Measured Conc.} - \text{Actual Conc.}}{\text{Actual Conc.}} \times 100$$

g. Problems detected (if any) Wire from detector to electronics was broken but was repaired on 10/5/79.

SECTION II - TRW REPORT

SECTION II - TRW REPORT

COKE OVEN EMISSION TESTING

Project No. 79-CKO-22
Contract No. 68-02-2812
Work Assignment No. 51

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1.0 SUMMARY

The results of the benzo(a)pyrene (B(a)P) test conducted at the Houston, Texas location of Armco Steel Corporation are presented here. The Environmental Engineering Division of TRW, Inc. tested simultaneously at this location with Clayton Environmental Consultants, Inc.

The B(a)P trains were run simultaneously with the benzene soluble organic (BSO) trains. This included stopping and starting runs to avoid sampling during a push. The inlet train sampled 44 points at three minutes a point. During the last test, only thirty-three points were sampled because the nozzle was pulled off while removing the probe from the third port. This did not affect the results of the test. The outlet train sampled twenty points at seven minutes a point. Because of interferences at the outlet, it was not possible to sample points nine and ten (see diagram on page A-27). For this reason, the nozzle remained at point eight for twenty-one minutes with readings taken every seven minutes. The results from the inlet and outlet B(a)P test are listed in Table 1.

On Test Numbers 2 and 3, the outlet B(a)P values are larger than the inlet values. A possible explanation of this involves the wet precipitator. The potential

TABLE 1. BαP TEST RESULTS

Test #	BαP-I-1	BαP-O-1	BαP-I-2	BαP-O-2	BαP-I-3	BαP-O-3
Date	10-2-79	10-2-79	10-5-79	10-5-79	10-5-79	10-5-79
Time	1420-1756	1400-1816	0946-1322	0950-1322	1655-2013	1655-2100
Meter Vol.(DSCF)	45.987	143.954	51.591	137.477	38.822	133.210
Stack Flow(DSCFM)	163,692	169,158	179,849	163,358	179,439	157,826
% Moisture	0.8	2.1	0.6	1.4	2.1	3.2
% Isokinetic	97.7	95.6	101.3	94.6	100.4	94.9
BαP(Lb/DSCF)	5.731×10^{-9}	3.583×10^{-9}	6.455×10^{-9}	1.191×10^{-8}	5.213×10^{-9}	1.834×10^{-8}
BαP (mg/DSCM)	0.0918	0.0574	0.1034	0.1908	0.0835	0.2938
BαP (lb/hr)	0.056	0.036	0.070	0.117	0.056	0.174
BαP (kg/hr)	0.026	0.016	0.032	0.053	0.025	0.079
Stack Temp (°F)	109.4	88.1	116.7	86.6	127.5	90.7

situation exists that the clarified process water used in the precipitator contains 0.0082 μg/ml B(a)P and that it is entrained by the precipitator and carried out in the outlet stream.

2.0 SAMPLING LOCATIONS AND LOCATION OF TRAVERSE POINTS

The sampling locations and traverse points are exactly the same as were used for the BSO tests. (Refer to Section 4.0 of the Clayton report).

3.0 SAMPLING PROCEDURE

The sampling procedure used at the coke oven outlet consisted of an EPA Method 5 train, modified in the following manner (using EPA's draft B(a)P Method). A Battelle trap loaded with XAD-2 resin was inserted between the heated filter, which was cut from General Metal Works No. 25 Hi-Volume filters (see appendix for typical Elemental Analysis), and the first impinger. A thermostatically controlled water bath controlled the temperature of the Battelle trap at 127F. The Battelle trap was shielded from visible and ultra-violet light by wrapping with aluminum foil. The Battelle trap was capped after sampling and remained capped until the analysis was performed. Methylene chloride was used for the recovery of the sample from the 316 stainless steel probe, glass filter holder with 316 stainless steel filter support and connecting glassware up to the Battelle trap.

The inlet train was identical to the outlet train except that a heated Teflon tube was used between the probe and the filter holder. The tube rinse was included as part of the inlet sample. Figure 1 is a schematic of the typical B(a)P train while Figure 2 shows a Battelle trap as was used in the B(a)P train. All field data sheets and analytical forms are included in the appendix.

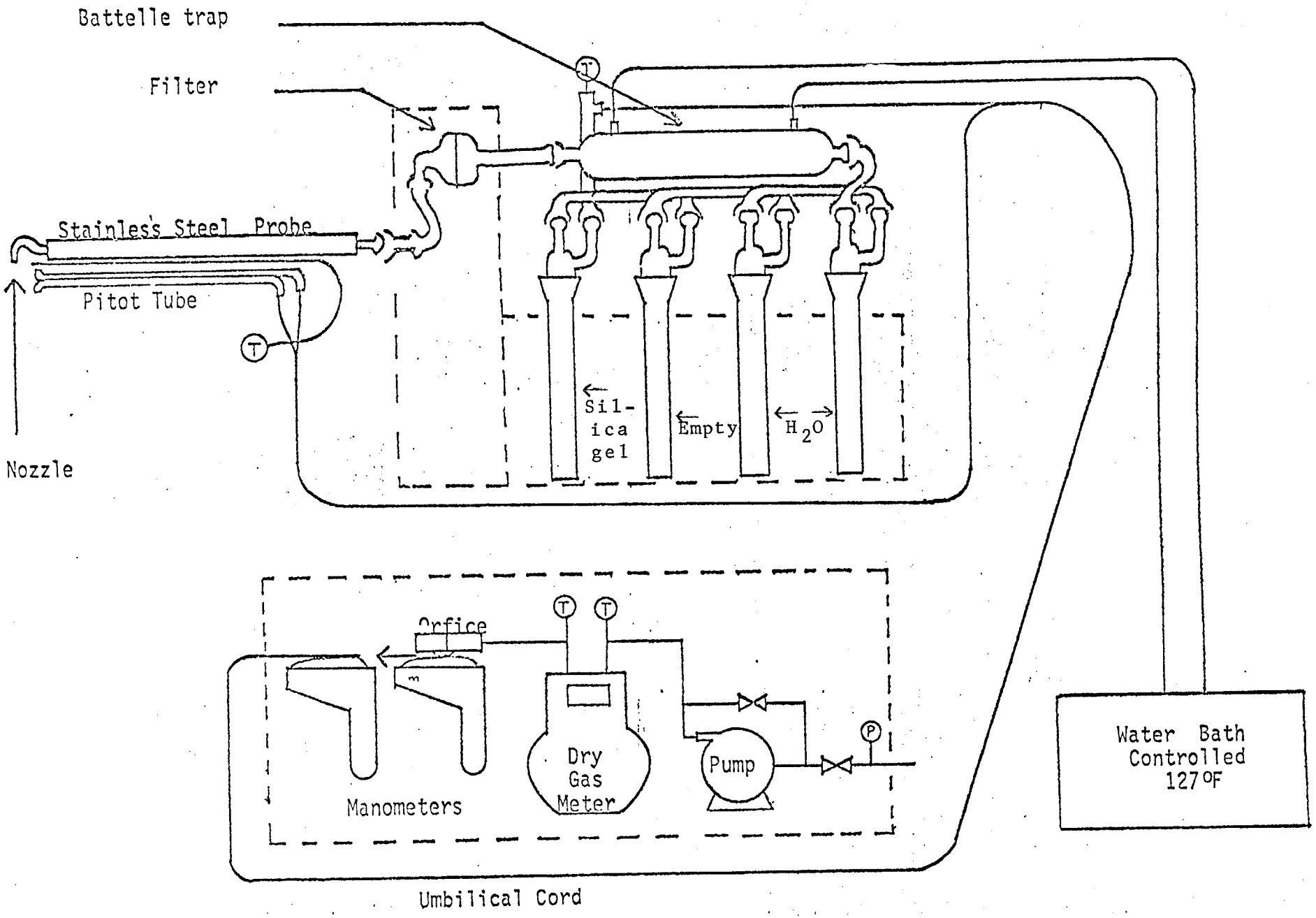


Figure 1. BαP Sample Train.

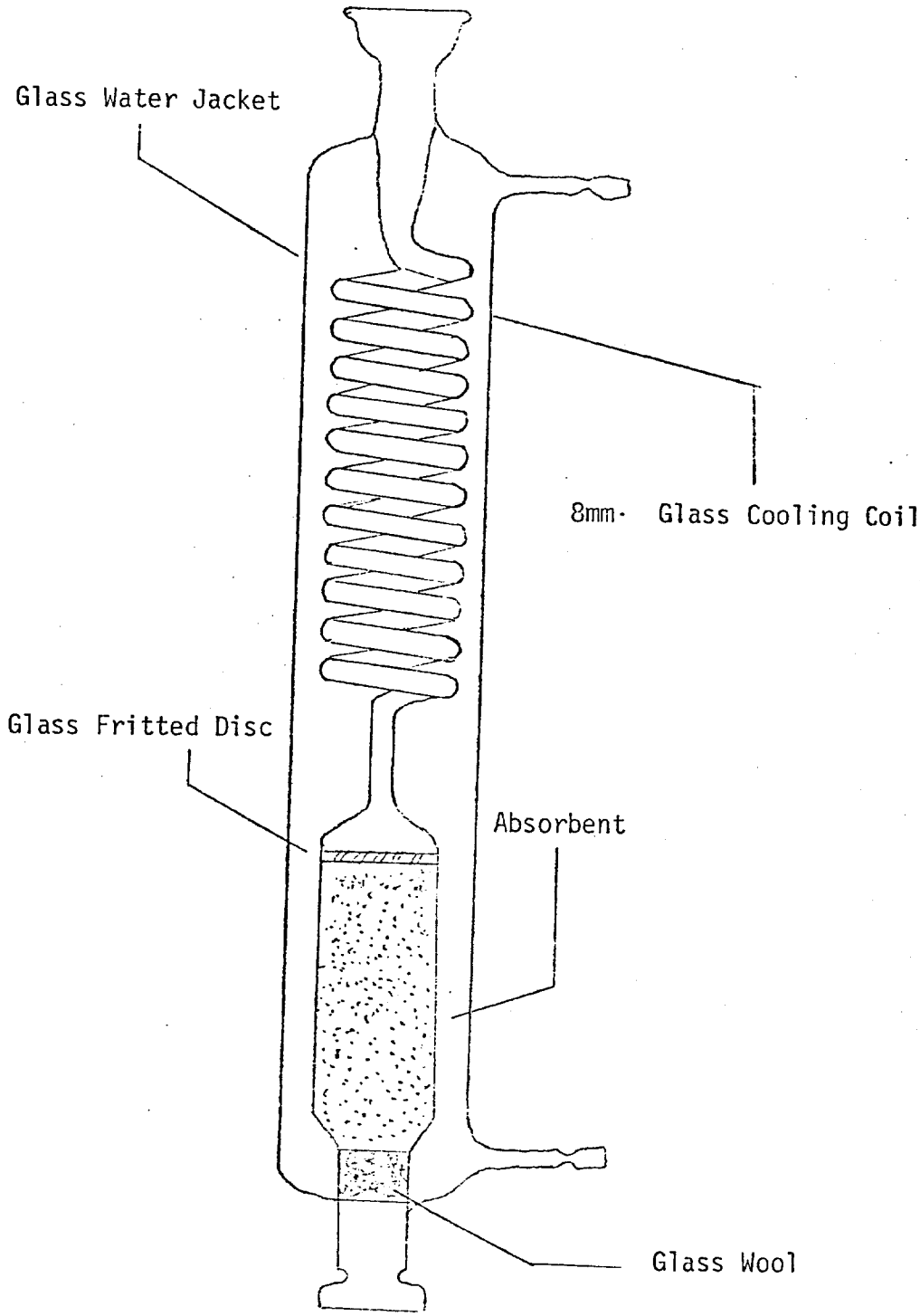


Figure 2. Battelle Trap.

4.0 LABORATORY PROCEDURES

The volume of the rinse sample was recorded and the sample was stored at 4C in an amber glass bottle until the analysis was performed. If the rinse sample was deeply colored or contained a large amount of suspended material, it was diluted ten to one with cyclohexane before it was analyzed.

The filter was extracted with 100-ml of cyclohexane while the XAD-2 resin from the Battelle trap was extracted with 250-ml of cyclohexane. The extraction procedure placed the filter or XAD-2 into a single thickness pre-extracted cellulose extraction thimble. The thimble was then placed in a soxhlet extraction apparatus and extracted for eight hours at five to six cycles per hour. All this was done either behind a yellow light-safe screen or under a yellow safe light. At the end of the extraction, the extract volume was recorded, and the extract stored in an amber bottle at 4C until the analysis was performed. The thimble was checked with a black light to confirm complete extraction.

ANALYTICAL PROCEDURE

The samples are analyzed for B(a)P using the fluorescence spectrophotometric procedure. This method is preferred over the thin layer chromatographic (TLC) method for low level B(a)P analysis, as the TLC method

has only 0.01 the sensitivity of direct liquid measurement. The benzc(a)pyrene method using the fluorescence spectrophotometry was tailored to these samples. The method originally chosen was intended to be thin layer chromatography separation and measurement by scanning in-situ with a scanning attachment for the fluorescence spectrophotometer. This method lacked the sensitivity required for the analyses.

The equipment used for this analysis was the Aminco Model SPF-125 Spectrophotofluorometer with 7-mm lightpath cell. This instrument accurately measures concentrations of B(a)P as low as 0.0001 ppm. The wavelength settings were 378-nm excitation and 403-nm emission with respective slitwidth openings of 1-mm and 5-mm. This instrument becomes extremely substance specific at very narrow slit widths, as was used in this analysis.

The spectrophotometer is equipped with a high intensity xenon lamp which provides the excitation energy. For B(a)P analysis, the best results are obtained by setting the excitation wavelength and emission wavelength to produce the maximum peak height. With a narrow slit width, the specificity of the instrument is greatly increased. The excitation wavelength is 378 nm. The minimum entrance slit width used was 1-mm. The excitation energy is re-emitted as fluorescence of a longer wavelength. For B(a)P, this wavelength is 403-nm.

The exit slit width can be narrower than the entrance slit width, as in this case, 0.5-mm. The fluorescence is expressed as a relative intensity. The relative intensity values are converted to B(a)P concentrations by analyzing a set of known standards. These standards are prepared by serial dilution of a 1000 μg/ml B(a)P stock solution. This is prepared by dissolving 10-mg of three times recrystallized B(a)P in 10-ml spectral grade cyclohexane. This is stable for several months if stored away from light at 0C.

To determine the concentration of B(a)P in unknown samples, it is necessary to plot a curve of the relative intensities from the standards. The μg/ml in the sample is then determined by the sample's relative intensity compared to the graph of the standards. The WESP clarified process water was analyzed using the same method as is used for the rinse of a B(a)P sampling train.

The results can be affected by temperature, humidity, and light. Precautions are taken during sampling, preparation, and analysis to keep the exposure to light at a minimum. The optimum relative humidity is between 35-percent and 50-percent. The instrument is equipped with a constant temperature cell compartment to avoid instability and the possible loss of sensitivity which could be caused by a change in sample temperature. All glassware with which the sample comes in contact is cleaned

by using a soapy water wash, 50-percent nitric acid rinse, and a distilled, deionized water rinse, respectively. When using fluorescence spectrophotometry, only high quality quartz cuvettes are used. No corks, rubber stoppers or lubricating agents are used and care is taken so that impurities do not contaminate the sample.

APPENDIX A

FIELD DATA SHEETS

TABLE 2. BαP CALCULATIONS

TEST#	BαP (μg)	METER (DSCF)	METER (DSCM)	STACK (DSCF)	STACK (DSCM)	BαP (lbs./DSCF)	BαP (mg/DSCM)	BαP (lb/hr)	BαP (kg/hr)
BαP-I-1	119.4	45.987	1.301	163.692	4,632	5.731×10^{-9}	0.0918	0.056	0.026
BαP-O-1	234.0	143.954	4.074	169,158	4,787	3.583×10^{-9}	0.0574	0.036	0.016
BαP-I-2	150.9	51.591	1.460	179,849	5,090	6.455×10^{-9}	0.1034	0.070	0.032
BαP-O-2	742.4	137.477	3.891	163,358	4,623	1.191×10^{-8}	0.1908	0.117	0.053
BαP-I-3	91.8	38.822	1.099	179,439	5,078	5.213×10^{-9}	0.0835	0.056	0.025
BαP-O-3	1,107.5	133.210	3.770	157,826	4,466	1.834×10^{-8}	0.2938	0.174	0.079

TABLE 3. BαP TEST RESULTS

SAMPLE	BαP µg/ml	SAMPLE VOLUME ml.	BαP Value	BLANK	TOTAL BαP
BαP-I-1 Filter	0.570	100	57.0	0.2	56.8
XAD-2	0.004	250	1.0	<0.1	1.0
Rinse	0.330	188	62.0	0.4	61.6
TOTAL					119.4
BαP-O-1 Filter	1.000	100	100.0	0.2	99.8
XAD-2	0.330	250	82.5	<0.1	82.5
Rinse	0.490	106	51.9	0.2	51.7
TOTAL					234.0
BαP-I-2 Filter	0.695	100	69.5	0.2	69.3
XAD-2	0,0248	250	6.2	<0.1	6.2
Rinse	0.440	172	75.7	0.3	75.4
TOTAL					150.9
BαP-O-2 Filter	5.000	100	500.0	0.2	499.8
XAD-2	0.510	250	127.5	<0.1	127.5
Rinse	0.660	175	115.5	0.4	115.1
TOTAL					742.4
BαP-I-3 Filter	0.530	100	53.0	0.2	52.8
XAD-2	0.0015	250	0.4	<0.1	0.4
Rinse	0.200	195	39.0	0.4	38.6
TOTAL					91.8
BαP-O-3 Filter	9.100	100	910.0	0.2	909.8
XAD-2	0.590	250	147.5	<0.1	147.5

TABLE 3. BαP TEST RESULTS (cont'd)

SAMPLE	BαP µg/ml	SAMPLE VOLUME ml.	BαP Value	BLANK	TOTAL BαP
BαP-0-3 Rinse	0.560	90	50.4	0.2	50.2
TOTAL					1,107.5
BLANK FILTER	0.002	100	0.2		
BLANK XAD-2	<.001	250	<0.1		
BLANK RINSE	0.002	250	0.5		

TABLE 4. TYPICAL ELEMENTAL ANALYSIS FOR A 8" x 10" FILTER

ELEMENT	#25 GLASS
Antimony (Sb)	ND
Arsenic (As)	ND
Benzo(a) Pyrene (BaP)	<.2
Beryllium (Be)	ND
Bismuth (Bi)	ND
Cadmium (Cd)	ND
Chromium (Cr)	<15
Cobalt (Co)	ND
Copper (Cu)	<7.5
Iron (Fe)	140
Lead (Pb)	10
Manganese (Mn)	<10
Molybdenum (Mo)	<10
Nickel (Ni)	6
Tin (Sn)	18
Titanium (Ti)	12
Vanadium (V)	ND
Zinc (Zn)	100
Extractable Ions	
Ammonium (NH_4 +)	238
Fluoride (F^-)	169
Nitrate (No_3-)	25
Phosphate (PO_4)	4.5
Sulfate (So_4=)	4250
OTHER CHARACTERISTICS	
pH	9.0
DOP	99.95%
Tensile strength*	375g
Weight (8" x 10" sheet)	4.2g
Maximum use temperature	540°C

*Expressed in grams per 20 mm wide by 50mm long strip, pulled at rate of 1/2 inch per minute.

ND = non-detectable

The above physical/chemical properties represent typical values obtained in accordance with accepted EPA test procedures as described in EPA contract #68-02-2952 dated June 16, 1978. Trace elements and extractable ions are expressed as micrograms per 25.4 x 20.3cm sheet.

LOAD SHEET

STACK TEST - PARTICULATE

Test # BAP-0-1

Part 1

Enter	(Initial	y Only)
	Value	Location
	0.0283	04
17.65	~~17.71~~	05
	0.0474	06
	1032	07
f(Min)	140	09
^{2}(in^2)	.0576	10
S(in Hg)	30.01	11
ft^3)	147.95	12
ml)	66.0	13
CO_2	0	14
2	20.0	15
N_2	80.0	16
$\sqrt{}$	105285.09	17
s(ft^2)	49.74	18
T +460)	548.1	19
	Part 2	
f (mg)		00
t (mg)		01
TD(f^3)		02
S ("Hg)		03
		04
s+460)		05
scfm)		06
M	89.8	
M	4.2	
5	30.00	

Test # BAP-0-2

Enter	Value	Location
Tf(Min)	140	09
(DN)^2(in^2)	.0576	10
PS(in Hg)	29.54	11
VM(ft^3)	141.97	12
VW(ml)	42.8	13
% CO_2	0	14
% O_2	20.0	15
% N_2	80.0	16
4350$\sqrt{}$	101,119.55	17
As(ft^2)	49.74	18
(Ts+460)	546.6	19
	Part 2	
mf (mg)		00
mt (mg)		01
VMSTD(f^3)		02
Ps ("Hg)		03
Md		04
(Ts+460)		05
Qs(scfm)		06
	88.8	
	3.8	
	29.83	

Test # BAP-0-3

Enter	Value	Location
Tf(Min)	140	09
(DN)^2(in^2)	.0576	10
PS(in Hg)	29.93	11
VM(ft^3)	135.82	12
VW(ml)	91.4	13
% CO_2	0	14
% O_2	20.0	15
% N_2	80.0	16
4350$\sqrt{}$	99680.38	17
As(ft^2)	49.74	18
(Ts+460)	550.7	19
	Part 2	
mf (mg)		00
mt (mg)		01
VMSTD(f^3)		02
Ps ("Hg)		03
Md		04
(Ts+460)		05
Qs(scfm)		06
	83.2	
	3.6	
	29.92	

RESULTS

STACK TEST - PARTICULATE

Test # BAP-O-1		Test # BAP-O-2		Test # BAP-O-3	
Value		Value		Value	
Vm (SCF)	143.954	Vm (SCF)	137.477	Vm (SCF)	133.210
Vm (SCM	4.074	Vm (SCM)	3.891	Vm (SCM)	3.770
Vw gas (CF)	3.128	Vw gas (CF)	2.029	Vw gas (CF)	4.332
% Moisture	2.127	% Moisture	1.454	% Moisture	3.150
Md	0.979	Md	0.985	Md	0.969
MWd	28.800	MWd	28.800	MWd	28.800
MW	28.571	MW	28.643	MW	28.460
Vs (fpm)	3595.616	Vs (fpm)	3458.785	Vs (fpm)	3415.364
ACFM	178845.937	ACFM	172039.981	ACFM	169880.217
Flow (SCFM)	169158.185	Flow (SCFM)	163358.339	Flow (SCFM)	157826.336
Flow (SCMM)	4787.177	Flow (SCMM)	4623.041	Flow (SCMM)	4466.485
% I	95.6	% I	94.6	% I	94.9
% EA	1562.5	% EA	1562.500	% EA	1562.500
Front gr/scf		Front gr/scf		Front gr/scf	
Front gm/scm		Front gm/scm		Front gm/scm	
Total gr/scf		Total gr/scf		Total gr/scf	
Total gm/scm		Total gm/scm		Total gm/scm	
Front gr/acf		Front gr/acf		Front gr/acf	
Front gm/acm		Front gm/acm		Front gm/acm	
Total gr/acf		Total gr/acf		Total gr/acf	
Total gm/acm		Total gm/acm		Total gm/acm	
Front lb/hr		Front lb/hr		Front lb/hr	
Front kg/hr		Front kg/hr		Front kg/hr	
Total lb/hr		Total lb/hr		Total lb/hr	
Total kg/hr		Total kg/hr		Total kg/hr	

LOAD SHEET

STACK TEST - PARTICULATE

Test # BAP-I-1

Part 1

using avg values for each point in which a push occurred

Enter	(Initial	y Only)
	Value	Location
	0.0283	04
17.65	~~17.71~~	05
	0.0474	06
	1032	07
f(Min)	132	09
^{2}(in^2)	.0156	10
S(in Hg)	29.73	11
(ft^3)	48.279	12
(ml)	7.6	13
CO_2	0	14
O_2	20.0	15
N_2	80.0	16
3 $\sqrt{}$	133,028.47	17
s(ft^2)	39.32	18
(+460)	569.4	19
	Part 2	
f (mg)		00
t (mg)		01
d TD(f^3)		02
S ("Hg)		03
d		04
Ts+460)		05
s(scfm)		06
1M	97.8	
1 M	.45	
2b	30.07	

Test # BAP-I-2

Enter	Value	Location
Tf(Min)	130	09
(DN)^2(in^2)	.0156	10
PS(in Hg)	29.66	11
VM(ft^3)	54.46	12
VW(ml)	6.9	13
% CO_2	0	14
% O_2	20.0	15
% N_2	80.0	16
4350$\sqrt{}$	148,028.55	17
As(ft^2)	39.32	18
(Ts+460)	576.7	19
	Part 2	
mf (mg)		00
mt (mg)		01
VMSTD(f^3)		02
Ps ("Hg)		03
Md		04
(Ts+460)		05
Qs(scfm)		06
	97.8	
	.52	
	29.90	

Test # BAP-I-3

Enter	Value	Location
Tf(Min)	99	09
(DN)^2(in^2)	.0156	10
PS(in Hg)	29.69	11
VM(ft^3)	41.002	12
VW(ml)	17.5	13
% CO_2	0	14
% O_2	20.0	15
% N_2	80.0	16
4350$\sqrt{}$	152,205.89	17
As(ft^2)	39.32	18
(Ts+460)	587.5	19
	Part 2	
mf (mg)		00
mt (mg)		01
VMSTD(f^3)		02
Ps ("Hg)		03
Md		04
(Ts+460)		05
Qs(scfm)		06
	99.8	
	.55	
	29.99	

RESULTS

STACK TEST - PARTICULATE using avg. values for each point in which a flush occu

Test # BAP-I-1		Test # BAP-I-2		Test # BAP-I-3	
Value		Value		Value	
Vm (SCF)	45.987	Vm (SCF)	51.591	Vm (SCF)	38.822
Vm (SCM	1.301	Vm (SCM)	1.460	Vm (SCM)	1.099
Vw gas (CF)	0.360	Vw gas (CF)	0.327	Vw gas (CF)	0.830
% Moisture	0.777	% Moisture	0.630	% Moisture	2.092
Md	0.992	Md	0.994	Md	0.979
MWd	28.800	MWd	28.800	MWd	28.800
MW	28.716	MW	28.732	MW	28.574
Vs (fpm)	4552.830	Vs (fpm)	5070.770	Vs (fpm)	5225.611
ACFM	179017.281	ACFM	199382.693	ACFM	205,471.015
Flow (SCFM)	163692.325	Flow (SCFM)	179849.331	Flow (SCFM)	179,438.612
Flow (SCMM)	4632.493	Flow (SCMM)	5089.736	Flow (SCMM)	5078.113
% I	97.7	% I	101.3	% I	100.4
% EA	1562.5	% EA	1562.5	% EA	1562.5
Front gr/scf		Front gr/scf		Front gr/scf	
Front gm/scm		Front gm/scm		Front gm/scm	
Total gr/scf		Total gr/scf		Total gr/scf	
Total gm/scm		Total gm/scm		Total gm/scm	
Front gr/acf		Front gr/acf		Front gr/acf	
Front gm/acm		Front gm/acm		Front gm/acm	
Total gr/acf		Total gr/acf		Total gr/acf	
Total gm/acm		Total gm/acm		Total gm/acm	
Front lb/hr		Front lb/hr		Front lb/hr	
Front kg/hr		Front kg/hr		Front kg/hr	
Total lb/hr		Total lb/hr		Total lb/hr	
Total kg/hr		Total kg/hr		Total kg/hr	

LOAD SHEET

STACK TEST - PARTICULATE

Test # BAP-I-1

using each recorded value

Enter	Part 1 (Initially Only) Value	Location
	0.0283	04
1.65	~~17.71~~	05
	0.0474	06
	1032	07
f(Min)	132	09
^{2}(in^2)	.0156	10
S(in Hg)	29.73	11
(ft^3)	48.279	12
ml)	7.6	13
CO_2	0	14
	20.0	15
N_2	80.0	16
$\sqrt{}$	134,904.44	17
s(ft^2)	39.32	18
-460)	569.5	19
	Part 2	
(mg)		00
(mg)		01
D(f^3)		02
S ("Hg)		03
d		04
T+460)		05
s(scfm)		06
m	97.8	
m	.45	
b	30.07	

Test # BAP-I-2

Enter	Value	Location
Tf(Min)	130	09
(DN)^2(in^2)	.0156	10
PS(in Hg)	29.66	11
VM(ft^3)	54.46	12
VW(ml)	6.9	13
% CO_2	0	14
% O_2	20.0	15
% N_2	80.0	16
4350$\sqrt{}$	147,449.63	17
As(ft^2)	39.32	18
(Ts+460)	577.0	19
	Part 2	
mf (mg)		00
mt (mg)		01
VMSTD(f^3)		02
Ps ("Hg)		03
Md		04
(Ts+460)		05
Qs(scfm)		06
	97.8	
	.52	
	29.90	

Test # BAP-I-3

Enter	Value	Location
Tf(Min)	99	09
(DN)^2(in^2)	.0156	10
PS(in Hg)	29.69	11
VM(ft^3)	41.002	12
VW(ml)	17.5	13
% CO_2	0	14
% O_2	20.0	15
% N_2	80.0	16
4350$\sqrt{}$	153,186.83	17
As(ft^2)	39.32	18
(Ts+460)	587.9	19
	Part 2	
mf (mg)		00
mt (mg)		01
VMSTD(f^3)		02
Ps ("Hg)		03
Md		04
(Ts+460)		05
Qs(scfm)		06
	99.8	
	.55	
	29.99	

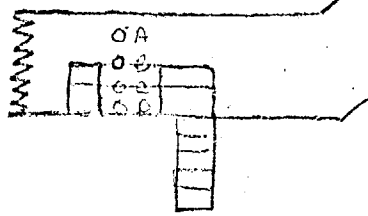
RESULTS

STACK TEST - PARTICULATE using each recorded value

Test # BAP-I-1		Test # BAP-I-2		Test # BAP-I-3	
Value		Value		Value	
Vm (SCF)	45.987	Vm (SCF)	51.591	Vm (SCF)	38.822
Vm (SCM	1.301	Vm (SCM)	1.460	Vm (SCM)	1.099
Vw gas (CF)	0.360	Vw gas (CF)	0.327	Vw gas (CF)	0.830
% Moisture	0.777	% Moisture	0.630	% Moisture	2.092
Md	0.992	Md	0.994	Md	0.979
MWd	28.800	MWd	28.800	MWd	28.800
MW	28.716	MW	28.732	MW	28.574
Vs (fpm)	4617.034	Vs (fpm)	5050.939	Vs (fpm)	5259.287
ACFM	181541.788	ACFM	198602.934	ACFM	206,795.240
Flow (SCFM)	165971.569	Flow (SCFM)	179052.821	Flow (SCFM)	180,472.182
Flow (SCMM)	4696.995	Flow (SCMM)	5067.195	Flow (SCMM)	5107.363
% I	96.4	% I	101.8	% I	99.8
% EA	1562.5	% EA	1562.5	% EA	1562.5
Front gr/scf		Front gr/scf		Front gr/scf	
Front gm/scm		Front gm/scm		Front gm/scm	
Total gr/scf		Total gr/scf		Total gr/scf	
Total gm/scm		Total gm/scm		Total gm/scm	
Front gr/acf		Front gr/acf		Front gr/acf	
Front gm/acm		Front gm/acm		Front gm/acm	
Total gr/acf		Total gr/acf		Total gr/acf	
Total gm/acm		Total gm/acm		Total gm/acm	
Front lb/hr		Front lb/hr		Front lb/hr	
Front kg/hr		Front kg/hr		Front kg/hr	
Total lb/hr		Total lb/hr		Total lb/hr	
Total kg/hr		Total kg/hr		Total kg/hr	

FIELD DATA

PLANT ARMCO
DATE 10-2-99
SAMPLING LOCATION Inlet
SAMPLE TYPE MRP
RUN NUMBER ARMCO - BAF I-1
OPERATOR Henry
AMBIENT TEMPERATURE 25
BAROMETRIC PRESSURE ~~29.88~~ 30.07
STATIC PRESSURE, (P_s) -4.5
FILTER NUMBER (s) Not Numbered



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 10' SS
NOZZLE I.D. ~~5/16~~ 1/8
ASSUMED MOISTURE, % 9
SAMPLE BOX NUMBER
METER BOX NUMBER 8E
METER ΔH@ 2.01
C FACTOR 1.15
PROBE HEATER SETTING 60 00
HEATER BOX SETTING 250°F
REFERENCE Δp ~~1.35~~ 7.3
LEAK CHECK Int. .013
" " Final .013

1 of 2

48

READ AND RECORD ALL DATA EVERY 3 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	Condens TRAP °F
	0	1420	000.031										
B-11	3	23	—	1.1	.235	.235	111	94	88	2.5	250	55°	130
STOP 10	6	36	001.77	1.8	.47	.47	159	95	90	2.5	250	55°	130
START	6	1428	001.77			PUSH							
9	9	31	002.49	1.5	.39	.39	160	95	90	5	250	55°	130
8	12	34	003.57	1.6	.42	.42	118	98	91	5	250	60°	130
7	15	37	004.67	2.3	.60	.60	118	99	91	5	250	60°	130
STOP 6	18	38	005.205	2.4	.63	.63	118	100	92	6	250	60	130
START	16	1442	005.205			PUSH							
6	18	45	006.45	1.7	.45	.45	118	99	83	5	250	60°	126
STOP 5	21	48	007.395	1.2	.31	.31	118	100	94	4.5	250	65°	126
START	21	1452	007.395			PUSH							
4	24	55	008.495	2.1	.55	.55	108	99	94	6.0	250	65°	126
3	27	58	009.75	2.2	.57	.57	108	101	94	6.0	250	65°	126
2	30	1501	010.97	1.9	.50	.50	104	102	95	6.0	250	—	123
STOP 1	33	04	012.151	1.8	.47	.47	98	103	95	5	250	—	125
START	33	1508	012.151		CHANGED	PORT							
C-11	36	11	012.975	.95	.25	.25	108	99	94	4	250	60	123
10	39	14	013.844	.96	.25	.25	108	101	96	4	250	60	129
9	42	17	014.69	.96	.25	.25	105	102	96	4	250	60	129
8	45	20	015.96	2.1	.55	.55	105	103	96	6	250	100	123
7	48	23	017.21	2.3	.60	.60	108	104	97	6	250	98	129
6	51	26	018.61	2.3	.60	.60	107	105	98	6	"	92	127
5	54	29	19.83	2.3	.60	.60	104	106	98	6	"	90	128

A-11

COMMENTS

EPA Dwg 235

26 SHIP I 1 - 2-72

	TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
	C-5	54	1524	19.835										
	4	57	32	21.10	2.1	.55	.55	108	107	98	6	250	86	130
	3	60	35	22.235	1.5	.39	.39	106	108	98	5	250	84	130
	2	63	38	23.045	.59	.15	.15	104	107	100	2	250	84	127
STOP	1	66	41	23.650	.59	.15	.15	104	105	100	2	250	84	127
START		66	56	23.650		CHANGED PORT								
STOP	D-11	69	59	24.860	1.8	.47	.47	104	97	96	5	250	86	122
START		69	1002	24.860			PUSH							
	10	72	05	25.83	1.8	.47	.47	102	97	96	6	250	76	123
	9	75	08	27.00	1.8	.47	.47	102	98	96	6	250	76	125
STOP	8	76	09	27.605	2.2	.57	.57	107	100	96	6	250	74	125
START		76	1618	27.605		SWITCHOVER								
	8	78	20	28.405	2.2	.57	.57	106	97	94	6	250	80	130
**	7	81	23	29.72	2.3	.60	.60	104	99	96	6	250	72	127
	6	84	26	31.005	2.4	.63	.63	104	100	96	6	250	72	130
STOP	5	86	28	32.095	2.3	.60	.60	112	103	97	6	250	70	130
START		86	1633	32.095		PUSH								
	5	87	34	32.40	2.5	.64	.64	108	101	97	6	250	78	129
	4	90	37	33.78	2.5	.64	.64	108	102	98	6	250	78	129
	3	93	40	35.15	2.4	.63	.63	104	104	98	6	250	70	126
STOP	2	94	41	35.60	2.2	.57	.57	102	106	100	6	250	76	126
START		94	1704	35.60		LOST POWER AT Outlet								
***	2	96	06	36.42	2.2	.57	.57	111	95	94	6	250	80	116
STOP	1	99	09	37.585	1.8	.47	.47	106	95	96	6	250	70	117
START		99	1720	37.585		CHANGED PORT								
	A-11	102	23	38.37	1.5	.39	.39	112	94	92	6	250	78	122
	10	105	26	39.42	1.4	.37	.37	114	95	94	6	250	74	123
	9	108	29	40.67	1.4	.37	.37	109	96	94	6	250	72	127
	8	111	32	41.53	1.5	.39	.39	107	100	94	6	250	70	127
	7	114	35	42.525	1.4	.37	.37	111	101	94	6	250	70	129
	6	117	38	43.575	1.4	.37	.37	105	101	94	6	250	70	128
	5	120	41	44.45	.90	.23	.23	105	102	94	2	250	70	127
	4	123	44	45.27	.80	.21	.21	103	103	95	2	250	70	128
	3	126	47	46.23	1.2	.30	.30	106	104	96	4	250	70	130
STOP	2	129	50	47.10	1.4	.37	.37	98	105	96	4	250	70	129
START	2	129	53	47.10				PUSH						
	1	132	56	48.31	1.8	.47	.47	98	103	97	5	250	70	128
	134.904.44													

126.8

EPA (Dun 236 4-72

** Lost Probe Rheostat

*** Removed Probe Heat

.45 109.5

4 9 8

ANALYTICAL DATA

PLANT ARMCO

DATE 10-2-79

SAMPLING LOCATION INLET

SAMPLE TYPE BAP

RUN NUMBER ARMCO - BAP - I - 1

SAMPLE BOX NUMBER

CLEAN-UP MAN MS. R.

COMMENTS:

FRONT HALF

		LABORATORY RESULTS
ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER _____	_____ mg
FILTER NUMBER ~~[illegible]~~ BAP-I-1	CONTAINER _____	_____ mg
_____ _____		
_____ _____		

FRONT HALF SUBTOTAL _____ mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER	CONTAINER ~~[illegible]~~	_____ mg
	ETHER-CHLOROFORM EXTRACTION	_____ mg
ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER	CONTAINER _____	_____ mg

BACK HALF SUBTOTAL _____ mg

TOTAL WEIGHT _____ mg

MOISTURE

IMPINGERS

FINAL VOLUME	196 ml
INITIAL VOLUME	200 ml
NET VOLUME	-4 ml

SILICA GEL

FINAL WEIGHT	161.6 g	_____ g	_____ g
INITIAL WEIGHT	150 g	_____ g	_____ g
NET WEIGHT	11.6 g	_____ g	_____ g

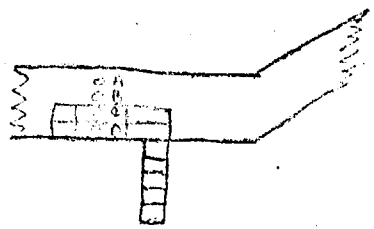
TOTAL MOISTURE 7.6 g

EPA (Dun) 231
4 72

FIELD DATA

1 2

PLANT Armco Steel
DATE 10-5-79
SAMPLING LOCATION Inlet
SAMPLE TYPE PM
RUN NUMBER BAP-I-6
OPERATOR Henry / Steve house
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 29.99
STATIC PRESSURE, (P_s) -4.5" H_2O
FILTER NUMBER (s) Not Numbered



PROBE LENGTH AND TYPE 10' SS
NOZZLE I.D. 3/8"
ASSUMED MOISTURE, % 4%
SAMPLE BOX NUMBER 2
METER BOX NUMBER 8E
METER ΔH@ 2.01
C FACTOR 1.15
PROBE HEATER SETTING 70%
HEATER BOX SETTING 250° F
REFERENCE Δp
INITIAL LEAK CK. .007
FINAL LEAK CK. .010

44 pairs
50 pairs

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

	TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	Condenser Trap Temp.
		0	946	96.400										
	B-11	3	49	97.625	2.2	.57	.57	103	82	80	5	250	68	134
STOP	10	5	51	98.75	2.2	.57	.57	103	83	80	5	250	68	134
START		5	56	98.75				PUSHED						
	10	6	57	99.23	2.3	.60	.60	104	86	81	5	250	68	130
	9	9	1000	100.50	2.3	.60	.60	108	87	81	5	250	68	130
	8	12	03	101.78	2.2	.57	.57	108	88	82	5	250	68	130
	7	15	06	103.33	2.1	.54	.54	110	90	82	5	250	70	127
	6	18	09	104.28	2.2	.57	.57	106	92	83	5	250	70	138
	5	21	12	105.60	2.2	.57	.57	106	93	84	5	250	70	135
STOP	4	24	15	106.785	2.3	.60	.60	106	95	86	5	250	76	135
START		24	20	106.785				PUSHED						
	3	27	23	108.21	2.2	.57	.57	111	94	87	5	250	70	134
	2	30	26	109.38	2.1	.54	.54	111	96	88	5	250	69	131
STOP	1	31	27	109.64	.95	.25	.25	111	97	89	5	250	69	131
START		31	32	109.64										
STOP	1	33	35	110.359	.95	.25	.25	124	95	90	5	250	68	130
START		33	58	110.359				CHANGE PORT						
	C-11	36	1101	111.66	2.3	.60	.60	117	90	88	5	250	70	127
	10	39	04	112.98	2.4	.62	.62	115	92	88	5	250	70	127
	9	42	07	114.31	2.3	.60	.60	115	94	88	5	250	68	126
	8	45	10	115.62	2.3	.60	.60	115	97	90	6	250	68	126
	7	48	13	116.92	2.3	.60	.60	113	100	90	6	250	68	128
	6	51	16	118.26	2.4	.62	.62	113	100	90	6	250	68	128

COMMENTS.

EPA Form 235

	TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
	C-6	51	1116	118.26										
	5	54	19	119.56	2.2	.57	.57	113	102	92	5	250	73	125
	4	57	23	120.85	2.2	.57	.57	113	103	93	5	250	70	126
	3	60	26	122.20	2.2	.57	.57	113	105	94	5	250	70	126
	2	63	28	123.48	2.1	.54	.54	112	105	95	5	250	80	128
STOP	1	66	31	124.575	1.5	.39	.39	112	105	96	5	250	68	130
START		66	37	124.575				CHANGE	PORT					
	D-11	69	40	125.74	1.9	.49	.49	115	101	96	5	250	68	130
STOP	10	70	41	126.225				PUSHED						
START		70	46	126.225	2.0	.52	.52	115	103	97	5	250	68	130
	10	72	48	127.030	2.1	.54	.54	117	107	97	6	250	68	130
	9	75	51	128.30	2.1	.54	.54	119	103	97	5	250	68	130
	8	78	54	129.60	2.2	.57	.57	119	104	98	5	250	68	130
	7	81	57	130.91	2.2	.57	.57	119	105	98	5	250	68	130
	6	84	1200	132.25	2.3	.60	.60	119	106	99	5	250	68	130
	5	87	03	133.59	2.4	.62	.62	120	108	100	5	250	68	130
STOP	4	89	05	134.60	2.3	.60	.60	120	109	100	5	250	68	130
START		89	09	134.60				Pushed						
	4	90	10	134.95	2.5	.65	.65	120	109	100	5	250	68	130
	3	93	13	136.27	2.4	.62	.62	122	109	102	5	250	68	129
	2	96	16	137.50	2.1	.54	.54	124	111	102	5	250	68	126
STOP	1	99	19	138.65	1.5	.39	.39	119	112	103	4	250	68	126
START		99	25	138.65				CHANGED	PORT					
	A-11	102	28	139.73	1.5	.39	.39	123	108	103	4	250	70	125
	10	105	31	140.91	1.8	.47	.47	123	109	104	4	250	70	125
	9	108	34	142.13	1.9	.49	.49	124	109	104	4	250	70	123
STOP	8	109	35	142.54	1.9	.49	.49	124	110	104	4	250	70	123
START		109	40	142.54				Pushed						
STOP	8	111	42	143.395	1.8	.47	.47	128	107	103	4	250	70	126
START		111	47	143.395				Pushed						
	7	114	50	144.40	1.5	.39	.39	129	107	102	4	250	70	130
	6	117	53	145.45	1.3	.34	.34	127	108	103	4	250	70	130
STOP	5	118	54	145.79	1.3	.34	.34	103	108	103	4	250	70	130
START		118	59	145.79				Pushed						
	4	121	1301	146.53	1.5	.39	.39	130	107	102	4	250	70	126
STOP	3	122	02	147.105	1.9	.49	.49	130	107	103	4	250	70	126
START		122	07	147.105				Pushed						
	3	124	10	148.05	2.0	.52	.52	131	106	102	4	250	70	128
STOP	EPA (Dun 2.6	127	13	149.38	2.0	.52	.52	136	107	102	4	250	70	128
START	& 72	127	19	149.32	PUSHED									
	1	130	22	150.86	1.8	.47	.47	132	106	102	4	250	70	128

ANALYTICAL DATA

PLANT ARMCO / steel

DATE 10/5/79

SAMPLING LOCATION Inlet

SAMPLE TYPE BAP

RUN NUMBER BAP - I - 2

SAMPLE BOX NUMBER

CLEAN-UP MAN STACK HOUSE

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

FILTER NUMBER Not Numbered — CONTAINER _____ _____ mg

FRONT HALF SUBTOTAL _____ mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

ETHER-CHLOROFORM EXTRACTION _____ mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

BACK HALF SUBTOTAL _____ mg

TOTAL WEIGHT _____ mg

MOISTURE

IMPINGERS

FINAL VOLUME 200 ml

INITIAL VOLUME 200 ml

NET VOLUME 0 ml

SILICA GEL

FINAL WEIGHT 306.9 g _____ g _____ g

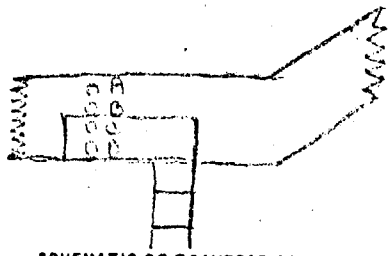
INITIAL WEIGHT 300 g _____ g _____ g

NET WEIGHT 6.9 g _____ g _____ g

TOTAL MOISTURE 6.9 g

EPA (Dur) 231
4 72

PLANT Armco/Steel
DATE 10-5-79
SAMPLING LOCATION Inlet
SAMPLE TYPE BAP
RUN NUMBER BAP-I-3
OPERATOR Henry/Slack Kohl
AMBIENT TEMPERATURE 75°
BAROMETRIC PRESSURE 29.99
STATIC PRESSURE, (P_s) 4" H_2O
FILTER NUMBER (s) Not Numbered



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 10' SS
NOZZLE I.D. 1/8
ASSUMED MOISTURE, % 4%
SAMPLE BOX NUMBER
METER BOX NUMBER 8E
METER ΔH@ 2.01
C FACTOR 1.15
PROBE HEATER SETTING 70%
HEATER BOX SETTING 250°F
REFERENCE Δp

Initial LK CK. .007
Final LK CK .005

1 of 2

33 pairs
42 pairs

READ AND RECORD ALL DATA EVERY 3 MINUTES

	TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
		0	1655	158.938										
STOP	B-11	1	56	159.475	1.8	.47	.47	129	92	90	4	250	70	129
START		1	1701	159.475		PUSHED								
	B-11	3	03	160.05	2.0	.52	.52	130	93	90	4	250	70	129
	10	6	06	161.29	2.1	.55	.55	130	93	90	4	250	70	129
	9	9	09	162.56	2.3	.59	.59	130	95	90	4	250	78	131
STOP	8	10	10	163.23	2.2	.57	.57	130	97	91	4	250	78	130
START		10	14	163.23		PUSHED								
	8	12	16	163.83	2.2	.57	.57	142	98	92	4	250	78	130
	7	15	19	165.11	2.2	.59	.59	142	99	92	4	250	78	130
	6	18	22	166.35	2.1	.55	.55	128	102	94	4	250	78	130
STOP	5	20	24	167.36	2.2	.59	.59	132	104	94	4	250	80	130
START		20	28	167.36		PUSHED								
	5	21	29	167.60	2.1	.55	.55	132	104	95	4	250	80	130
	4	24	32	168.87	2.1	.55	.55	135	104	96	4	250	70	125
	3	27	35	170.16	2.2	.57	.57	135	107	98	4	250	70	127
STOP	2	29	37	170.785	2.1	.55	.55	132	109	99	4	250	70	127
START		29	40	170.785		PUSHED								
	2	30	41	171.31	2.2	.57	.57	132	106	99	4	250	70	129
STOP	1	32	44	172.445	1.5	.39	.39	132	108	100	4	250	70	129
START		33	53	172.445		CHANGED PORT								
	C-11	36	56	173.73	2.2	.57	.57	141	104	100	4	250	80	127
STOP	10	37	57	174.36	2.2	.57	.57	140	105	100	4	250	80	127
START		37	1802	174.36		PUSHED								

COMMENTS

EPA (Dur) 235

EAP 1 3

41,07

	TRAVERSE POINT NUMBER	SAMPLING TIME min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
		37	1802	174.36										
	C-10	39	03	174.86	2.4	.62	.62	134	103	99	3	250	80	129
	9	42	06	176.36	2.4	.62	.62	134	105	100	4	250	80	129
STOP	8	43		177.68	2.3	.59	.59	128	107	100	4	250	80	127
START		43	[illegible]	177.68		PROBE HOSE CAME OFF								
	8	45		178.96	2.3	.59	.59	130	106	100	4	250	80	126
STOP	7	48		179.935	2.2	.57	.57	129	108	100	4	250	80	127
START		48		179.935		PUSHED								
	6	51	26	181.55	2.3	.59	.59	128	125	100	4	250	80	127
STOP	5	53	28	182.365	2.3	.59	.59	127	107	100	5	250	80	124
START		53	32	182.365		PUSHED								
	5	54	33	182.85	2.3	.59	.59	126	104	100	5	250	80	
	4	57	36	184.12	2.2	.57	.57	126	105	100	4	250	80	127
STOP	3	59	38	184.845	2.2	.57	.57	124	106	100	4	250	80	128
START		59	43	184.145		PUSHED								
	3	60	44	185.400	2.3	.59	.59	124	104	99	4	250	80	127
	2	63	47	186.045	1.5	.39	.39	124	105	101	4	250	80	127
STOP	1	66	50	186.845	1.5	.39	.39	124	105	101	4	250	80	127
START		66	50	186.845		CHANGED PORT								
	D-11	69	59	187.77	2.0	.52	.52	125	102	98	4	250	80	130
	10	72	1902	188.80	2.0	.52	.52	122	103	98	4	250	80	129
	9	75	05	190.07	2.1	.55	.55	122	104	98	5	250	80	129
	8	78	08	191.35	2.1	.55	.55	122	105	98	5	250	80	129
	7	81	11	192.61	2.2	.57	.57	120	107	98	5	250	80	128
	6	84	14	193.92	2.3	.59	.59	120	107	99	4	250	80	128
	5	87	17	195.25	2.3	.59	.59	119	108	99	4	250	80	128
STOP	4	88	18	195.835	2.3	.59	.59	119	105	100	4	250	80	127
START		88	2002	195.835		OUTLET PROBLEMS								
	4	90	04	196.47	2.3	.59	.59	120	92	90	5	250	80	126
	3	93	07	197.75	2.2	.57	.57	119	92	90	5	250	79	125
	2	96	10	198.91	1.7	.45	.45	118	94	90	4	250	79	126
STOP	1	99	13	199.941	1.5	.39	.39	118	96	90	4	250	78	127
START		99		199.941		CHANGED PORT								
	A-11	102			ABORTED FINAL PORT BECAUSE									
					The Nozzle Fell off the PROBE into									
					Stack with No Replacement.									

EPA (Dur) 236
4 72

41.002 0.55 127.9 99.8 128

ANALYTICAL DATA

PLANT Armco

DATE 10/5/79

SAMPLING LOCATION Inlet

SAMPLE TYPE BAP

RUN NUMBER BAP-I-3

SAMPLE BOX NUMBER

CLEAN-UP MAN Henry

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

FILTER NUMBER Not Numbered — CONTAINER _____ _____ mg

FRONT HALF SUBTOTAL _____ mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

ETHER-CHLOROFORM EXTRACTION _____ mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

BACK HALF SUBTOTAL _____ mg

TOTAL WEIGHT _____ mg

MOISTURE

IMPINGERS

FINAL VOLUME 204 ml

INITIAL VOLUME 200 ml

NET VOLUME 04 ml

SILICA GEL

FINAL WEIGHT	313.5 g	_____ g	_____ g
INITIAL WEIGHT	300 g	_____ g	_____ g
NET WEIGHT	13.5 g	_____ g	_____ g

TOTAL MOISTURE 17.5 g

EPA (Dur) 231
4 72

FIELD DATA

PLANT ARMCO
DATE 10-4-79
SAMPLING LOCATION Outlet
SAMPLE TYPE BAP
RUN NUMBER BAP-0-1
OPERATOR MSR - Magnum
AMBIENT TEMPERATURE 75
BAROMETRIC PRESSURE 30.0
STATIC PRESSURE, (P_s) ±.12" H_2O
FILTER NUMBER (s) Not #

PROBE LENGTH AND TYPE 10' SS
NOZZLE I.D. .24
ASSUMED MOISTURE, % 4
SAMPLE BOX NUMBER 4
METER BOX NUMBER 9E
METER $\Delta H_@$ 2.01
C FACTOR 1.15
PROBE HEATER SETTING 70
HEATER BOX SETTING 250
REFERENCE Δp .48

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY _____ MINUTES

Leak Check - good

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	XAD-2 TRAP
	0	1400	806.17										
A-1	7	07	813.19	.92	4.1	4.1	85	78	78		130	65	126
2	14	1415 08 1422	820.65	1.05	4.3	4.3	90	88	82		130	65	115
3	21	47	828.20	1.1	4.3	4.3	90	96	84		130	65	105
4	28	54	835.40	1.1	4.3	4.3	90	92	84		130	65	105
5	35	1503	843.30	1.1	4.2	4.2	90	96	86		130	65	105
6	42	10	850.33	1.1	4.2	4.2	87	100	86		130	65	110
7	49	17	857.00	1.1	4.2	4.2	88	100	88		130	65	110
8	56	24	867.52	1.1	4.2	4.2	90	100	88		130	65	110
9	63	31	872.50	1.1	4.2	4.2	88	98	90		135	65	110
10	70	38	879.95	1.1	4.2	4.2	87	96	90		135	65	110
	0	1630	880.46										
B-1	7	37	887.48	.92	4.1	4.1	90	82	84		185	70	105
2	14	Power outage 07	894.98	1.1	4.3	4.3	90	82	82		165	70	110
3	21	14	904.51	1.1	4.3	4.3	90	92	84		200	80	110
4	28	1739	910.20	1.1	4.3	4.3	89	92	86		230	70	120
5	35	1736	917.33	1.1	4.3	4.3	89	92	86		215	70	125
6	42	46	924.85	1.1	4.3	4.3	85	96	88		190	70	120
7	49	1753	932.58	1.05	4.1	4.1	85	100	88		247	70	126
8	56	1800	939.68	1.05	4.1	4.1	85	86	90		190	70	126
9	63	09	947.10	1.05	4.1	4.1	87	100	88		235	70	130
10	70	1816	954.63	1.05	4.1	4.1	87	102	90		255	70	125
		140	147.95			4.2	88.1		89.8				115.1

COMMENTS:

EPA (Dur) 235

105285.09

TRW

29.88

ANALYTICAL DATA

PLANT ARMCO

DATE 10-2-79

SAMPLING LOCATION OuTLeT

SAMPLE TYPE BAP

RUN NUMBER ARMCO - BAP- O-1

SAMPLE BOX NUMBER

CLEAN-UP MAN M. & R.

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

FILTER NUMBER ARMCO - BAP-O-1 — CONTAINER _____ _____ mg

FRONT HALF SUBTOTAL _____ mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

ETHER-CHLOROFORM EXTRACTION _____ mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

BACK HALF SUBTOTAL _____ mg

TOTAL WEIGHT _____ mg

MOISTURE

IMPINGERS

FINAL VOLUME	332 ml	208 ml + 124 ml = 332 ml
INITIAL VOLUME	300 ml	
NET VOLUME	32 ml	

SILICA GEL

FINAL WEIGHT	184.0 g	_____ g	_____ g
INITIAL WEIGHT	150 g	_____ g	_____ g
NET WEIGHT	34.0 g	_____ g	_____ g

TOTAL MOISTURE 66.0 g

FIELD DATA

PLANT ARMCO
DATE 10-5-79
SAMPLING LOCATION OUTLET
SAMPLE TYPE BAD
RUN NUMBER BAD-0-2
OPERATOR [illegible]
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 29.82
STATIC PRESSURE, (P_s) +.12" H_2O
FILTER NUMBER (s) —

PROBE LENGTH AND TYPE 10' SS 316
NOZZLE I.D. .24
ASSUMED MOISTURE, % 4
SAMPLE BOX NUMBER 4
METER BOX NUMBER 9E
METER $\Delta H_@$ 2.01
C FACTOR 1.15
PROBE HEATER SETTING 70
HEATER BOX SETTING 250
REFERENCE Δp .48

SCHEMATIC OF TRAVERSE POINT LAYOUT

Leak Check Good

READ AND RECORD ALL DATA EVERY _____ MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	XAD-2 TMP
B-	0 0950	962.89										
B-1	7 off 57	969.40	.89	3.4	3.4	82	76	76	12	250	65	125
2	14 1009	976.60	1.05	4.1	4.1	83	86	78	15	222	65	123
3	21 off 16	984.97	1.1	4.3	4.1	83	96	82	15	220	71	126
4	28 1020 27	992.03	1.05	4.1	4.1	87	98	84	15	218	70	125
5	35 34	999.30	1.0	3.9	3.9	87	96	86	15	205	70	130
6	42 off 1045	1006.50	.98	3.8	3.8	90	100	88	14	210	70	127
7	49 off 1050	1013.36	.90	3.5	3.5	90	90	86	13	210	70	125
8	56 off 1105	1019.60	.80	3.1	3.1	88	96	88	12	213	70	125
9	63 1112	1026.57	.83	3.2	3.2	90	100	90	12	210	70	128
10	70 1119	1033.12	.83	3.2	3.2	90	102	90	12	215	70	127
	Leak Check	1034.15										
A-1	7 1155	1040.47	.76	3.0	3.0	90	84	84	12	200	70	110
2	14 off 1210	1047.23	1.1	4.2	4.0	90	88	84	15	224	70	131
3	21 1220	1054.45	1.05	4.1	3.9	87	92	86	15	255	70	131
4	28 27	1060.65	1.1	4.2	3.9	85	98	88	15	252	70	140
5	35 34	1068.90	1.05	4.1	3.9	85	94	88	15	263	70	131
6	42 off 1247	1076.15	1.05	4.1	4.0	85	94	88	15	280	70	110
7	49 off 1308	1083.45	1.1	4.2	4.0	85	90	86	15	262	70	133
8	56 off 1320	1090.97	1.05	4.1	4.1	85	86	84	15	265	70	120
9	63 off 1331	1098.39	1.05	4.1	4.1	85	88	86	15	265	70	120
10	70 End 1340	1105.89	1.05	4.1	4.1	85	92	86	15	285	70	135
												126.2

COMMENTS:

141.97 3.8 86.6 88.8

EPA (Dur) 235 101,119.55

A-22

TRW

ANALYTICAL DATA

PLANT Armco

DATE 10-5-79

SAMPLING LOCATION Outlet

SAMPLE TYPE BAP

RUN NUMBER BAP-O-2

SAMPLE BOX NUMBER

CLEAN-UP MAN M.S.R.

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

FILTER NUMBER Not Numbered — CONTAINER _____ _____ mg

FRONT HALF SUBTOTAL _____ mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

ETHER-CHLOROFORM EXTRACTION _____ mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ _____ mg

BACK HALF SUBTOTAL _____ mg

TOTAL WEIGHT _____ mg

MOISTURE

IMPINGERS

FINAL VOLUME 214 ml

INITIAL VOLUME 200 ml

NET VOLUME 14 ml

SILICA GEL

FINAL WEIGHT	328.8 g	_____ g	_____ g
INITIAL WEIGHT	300 g	_____ g	_____ g
NET WEIGHT	28.8 g	_____ g	_____ g

TOTAL MOISTURE 42.8 g

FIELD DATA

PLANT Armco
DATE 10-5-79
SAMPLING LOCATION Outlet
SAMPLE TYPE RAP
RUN NUMBER RAP-O-3
OPERATOR Mc. R
AMBIENT TEMPERATURE 75
BAROMETRIC PRESSURE 29.83
STATIC PRESSURE, (P_s) 7.12 " H_2O
FILTER NUMBER (s) Not Numbered

PROBE LENGTH AND TYPE 10' SS
NOZZLE I.D. .24
ASSUMED MOISTURE, % 4
SAMPLE BOX NUMBER 4
METER BOX NUMBER 9E
METER $\Delta H_@$ 2.01
C FACTOR 1.15
PROBE HEATER SETTING 60
HEATER BOX SETTING 250
REFERENCE Δp .48

Final Leak rate .013

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY _____ MINUTES

XAD-2

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
	0	1655	107.62										
A-1	7 off	1703	114.62	.85	3.3	3.3	100	82	82	14	300	70	122
2	14 off	1715	120.98	1.05	4.1	3.8	95	86	84	15	225	70	120
3	21 off		128.00	1.0	3.8	3.7	97	90	84	15	240	70	120
4	28		135.27	.98	3.7	3.6	95	94	86	15	260	70	126
5	35 off	1746	142.25	.96	3.7	3.6	97	90	86	15	270	70	126
6	42 off	1753	148.96	1.05	4.1	3.6	95	88	84	15	270	70	120
7	49		155.20	1.0	3.9	3.6	95	86	84	15	270	70	128
8	56		162.66	.98	3.7	3.6	95	88	84	15	245	70	128
9	63		169.80	.96	3.7	3.6	95	92	86	15	265	70	127
10	70	1836	176.73	.94	3.6	3.6	95	86	84	15	235	70	115
	1915 Leak Check		177.92										
B-1	7	1922	185.09	.90	3.5	3.5	85	76	76	13	230	70	120
2	14 off	1933	192.05	1.05	4.1	3.8	85	78	78	15	250	70	130
3	21 off		199.01	1.05	4.1	3.8	85	50	78	15	240	70	125
4	28		206.05	1.05	4.1	3.7	85	80	78	15	265	70	130
5	35		213.05	1.05	4.1	3.7	85	86	78	15	270	70	132
6	42 off		220.20	.94	3.7	3.7	85	86	78	15	260	70	120
7	49	2035	227.08	.90	3.6	3.6	85	78	78	15	260	70	127
8	56	2040	234.05	.80	3.1	3.1	90	84	78	14	270	70	130
9	63		238.35	.80	3.1	3.1	85	86	80	14	260	70	130
10	70	2100	244.63	.80	3.1	3.1	85	86	78	14	265	70	132
													125.4
			135.82			3.6	90.7		83.2				

COMMENTS:

EPA (Dur) 235 99680.38

ANALYTICAL DATA

PLANT Armco

DATE 10-5-79

SAMPLING LOCATION Outlet

SAMPLE TYPE BAP

RUN NUMBER BAP-O-3

SAMPLE BOX NUMBER

CLEAN UP MAN MKA

COMMENTS:

FRONT HALF

		LABORATORY RESULTS
ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER	mg
FILTER NUMBER Not Numbered	CONTAINER	mg
	FRONT HALF SUBTOTAL	mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER	CONTAINER	mg
	ETHER-CHLOROFORM EXTRACTION	mg
ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER	CONTAINER	mg
	BACK HALF SUBTOTAL	mg
	TOTAL WEIGHT	mg

MOISTURE

IMPINGERS

FINAL VOLUME	[illegible]	ml
INITIAL VOLUME	200	ml
NET VOLUME	40	ml

SILICA GEL

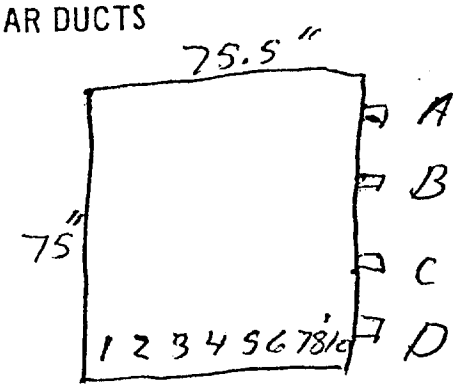
FINAL WEIGHT	351.4 g	g	g
INITIAL WEIGHT	300 g	g	g
NET WEIGHT	51.4 g	g	g

TOTAL MOISTURE 91.4 g

EPA (Dun 231
4 72

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

.ANT ARMCO
ATE 10-2-79
SAMPLING LOCATION Inlet
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) Nipple + 3.5"
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B)
TACK I.D., (DISTANCE A - DISTANCE B)
..EAREST UPSTREAM DISTURBANCE 20
NEAREST DOWNSTREAM DISTURBANCE 2/0
ALCULATOR MSR



SCHEMATIC OF SAMPLING LOCATION

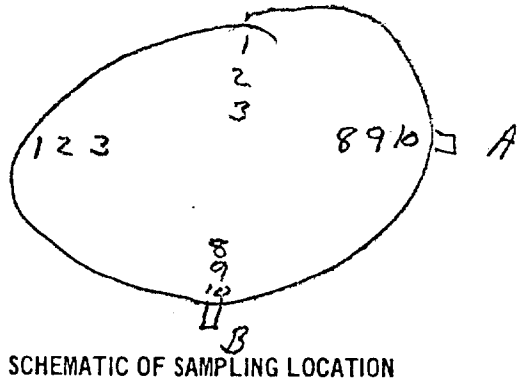
TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1		75.5x75	3		6.6
2			3		12.9
3			3		19.2
4			3		25.5
5			3		31.8
6			3		38.1
7			3		44.4
8			3		50.7
9			3		57.0
10			3		63.3
11			3		69.6

EPA (Dur) 232
4/72

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

95.5" I.D.

.ANT ARMCO
..ATE 10-2-79
SAMPLING LOCATION Outlet
SIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) 99
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) 3.5
ACK I.D., (DISTANCE A - DISTANCE B) 95.5
NEAREST UPSTREAM DISTURBANCE 60
NEAREST DOWNSTREAM DISTURBANCE 30
ALCULATOR MC. R



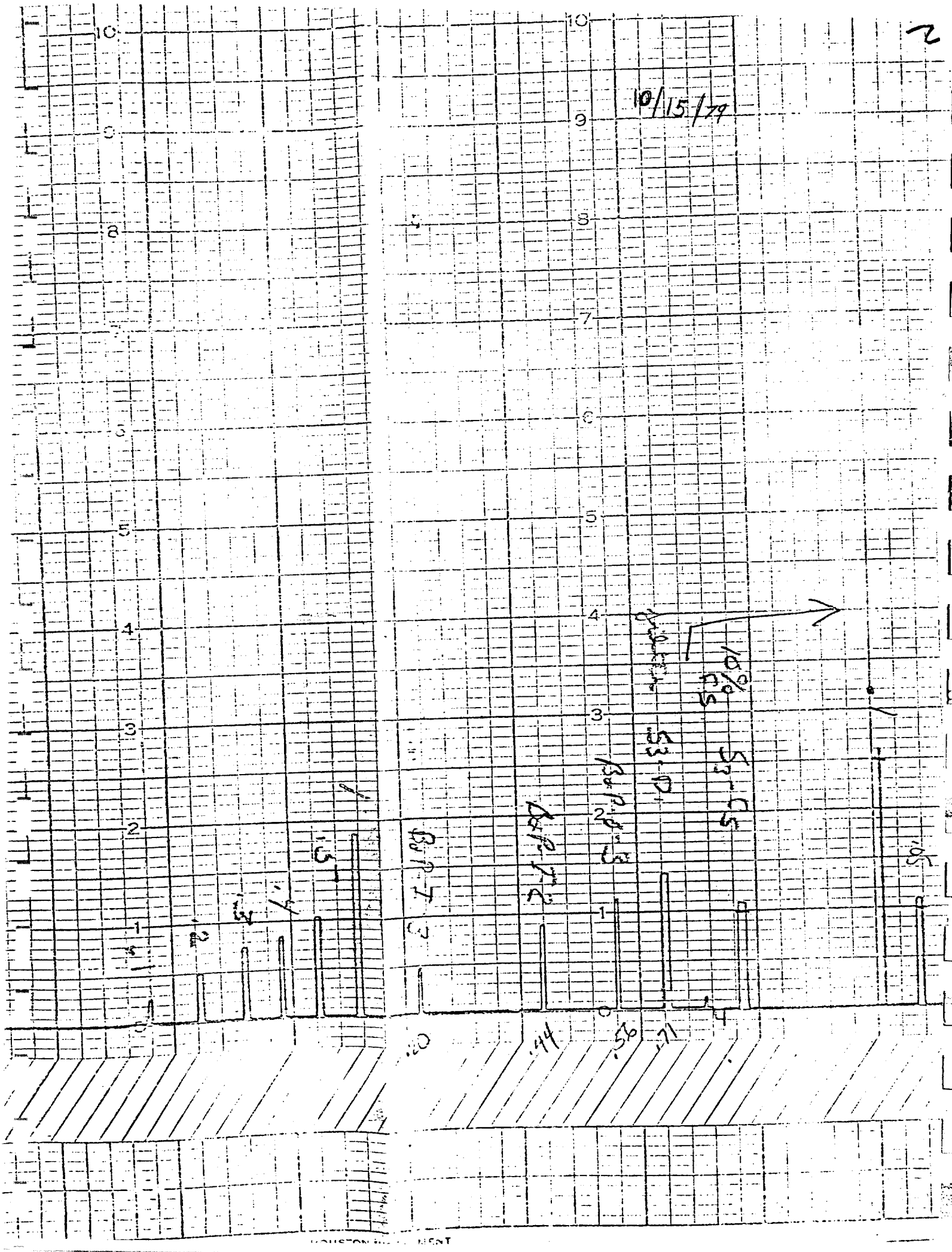
SCHEMATIC OF SAMPLING LOCATION

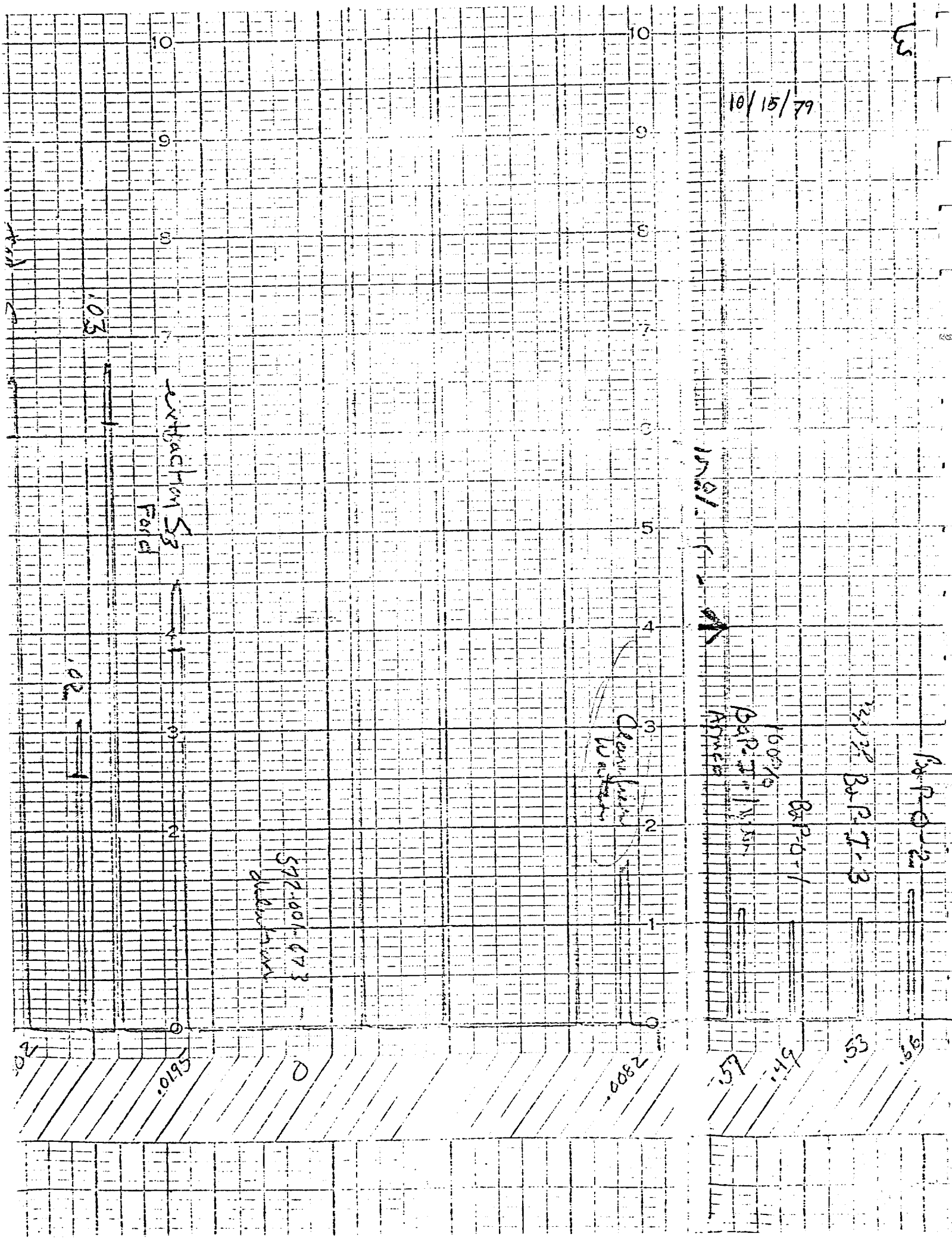
TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM ~~OUTSIDE~~ INSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	.025	95.5			2.4
2	.092				7.8
3	.146				13.9
4	.226				21.6
5	.342				32.7
6	.658				62.8
7	.774				73.9
8	.854				81.6
9	.918				87.7
10	.975				93.1

(Dur) 232
4, 72

APPENDIX B

ANALYTICAL RESULTS


2
10/15/79
10%
.20
.44
.56
.71


10/15/79
extraction S3
Ford
.03
.02
577-001-673
dilution
Clearfield Water
Bap-I-1
Armco
100%
Bap-O-1
Bap-I-3
Bap-O-2
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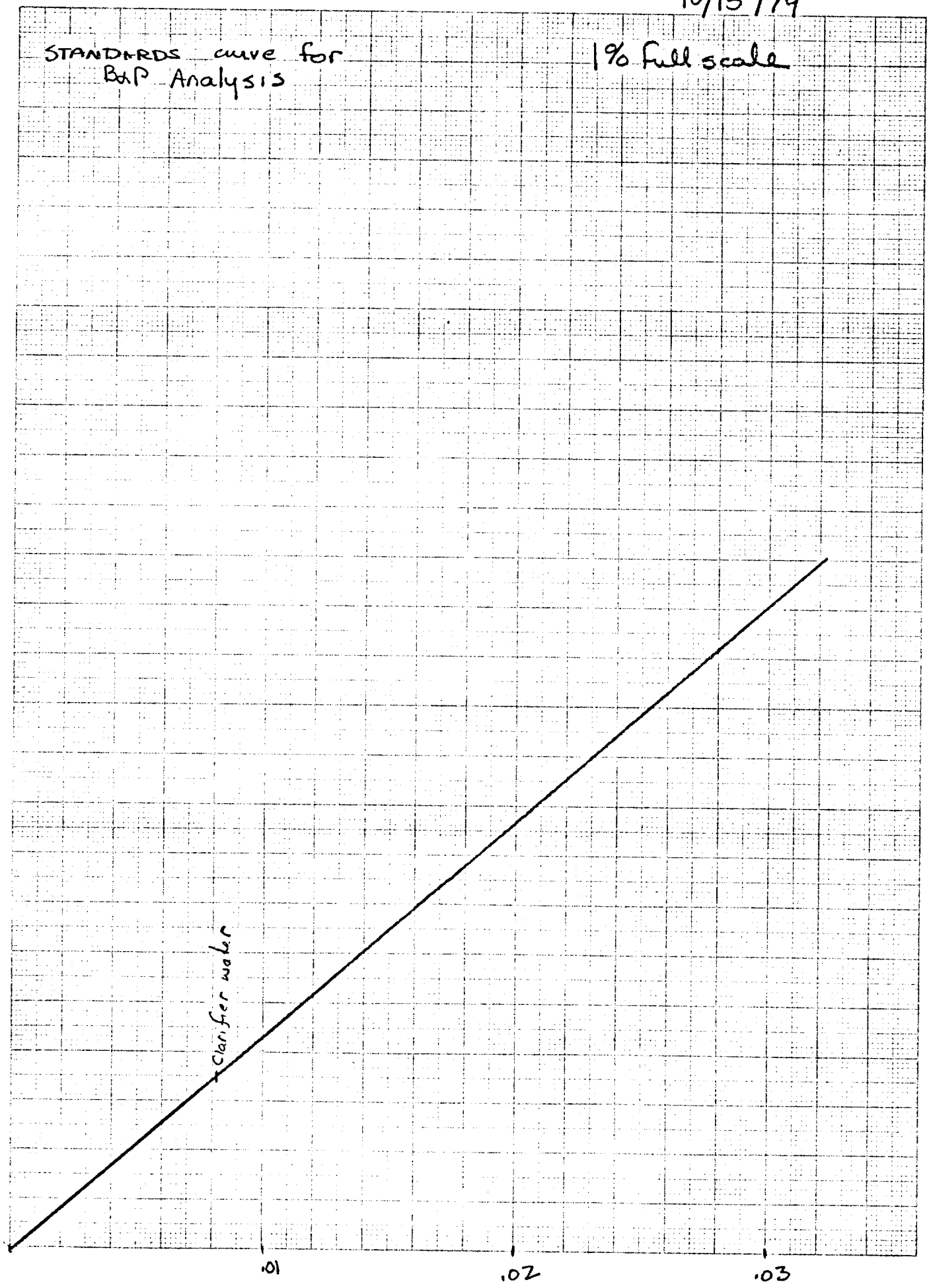
0
.0082
.57
.49
.53
.66

10/15/79

STANDARDS curve for B&P Analysis

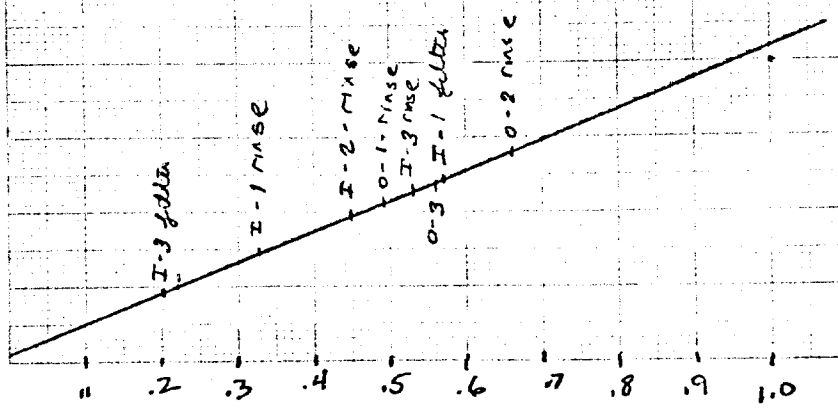
1% full scale

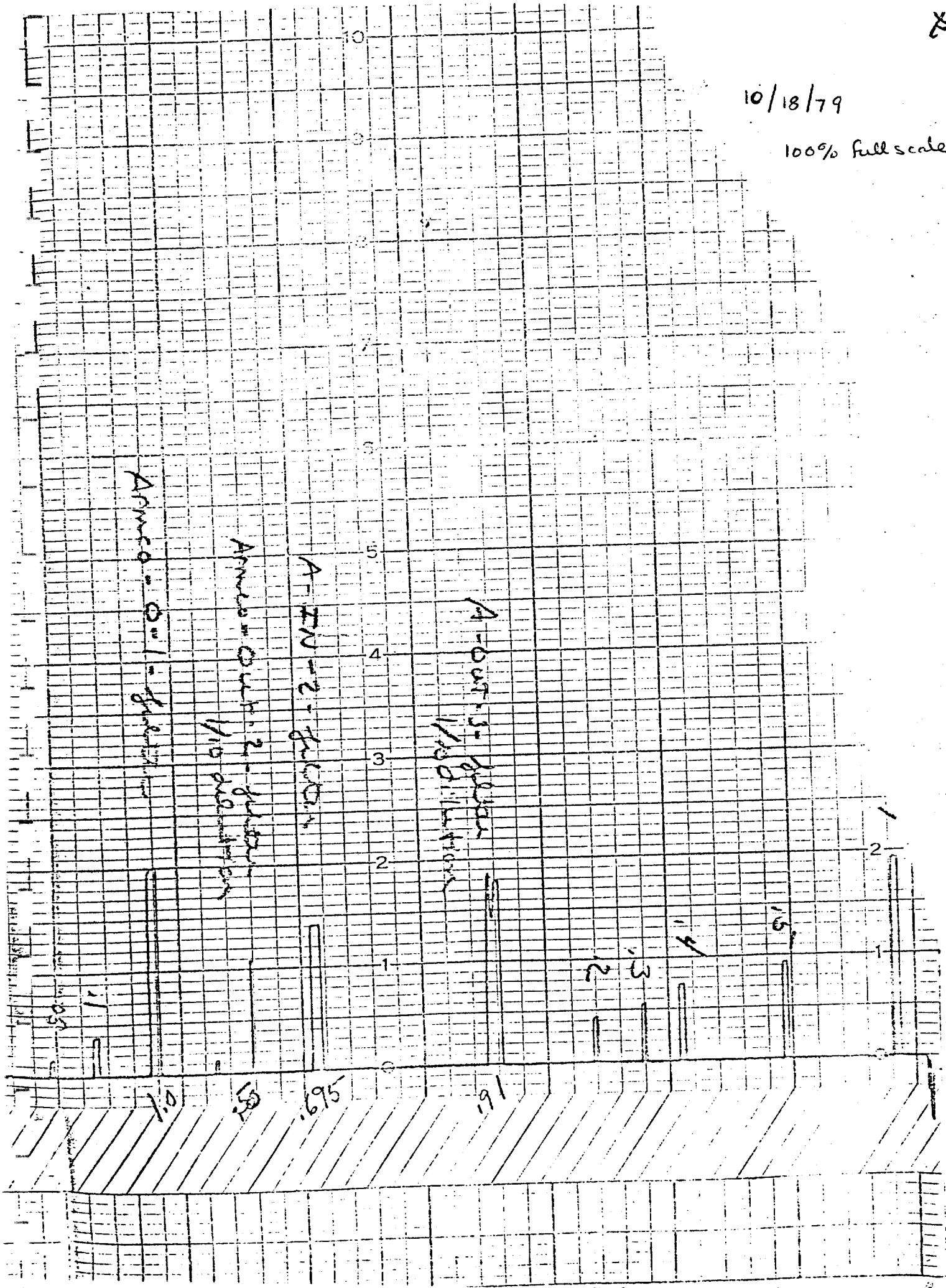


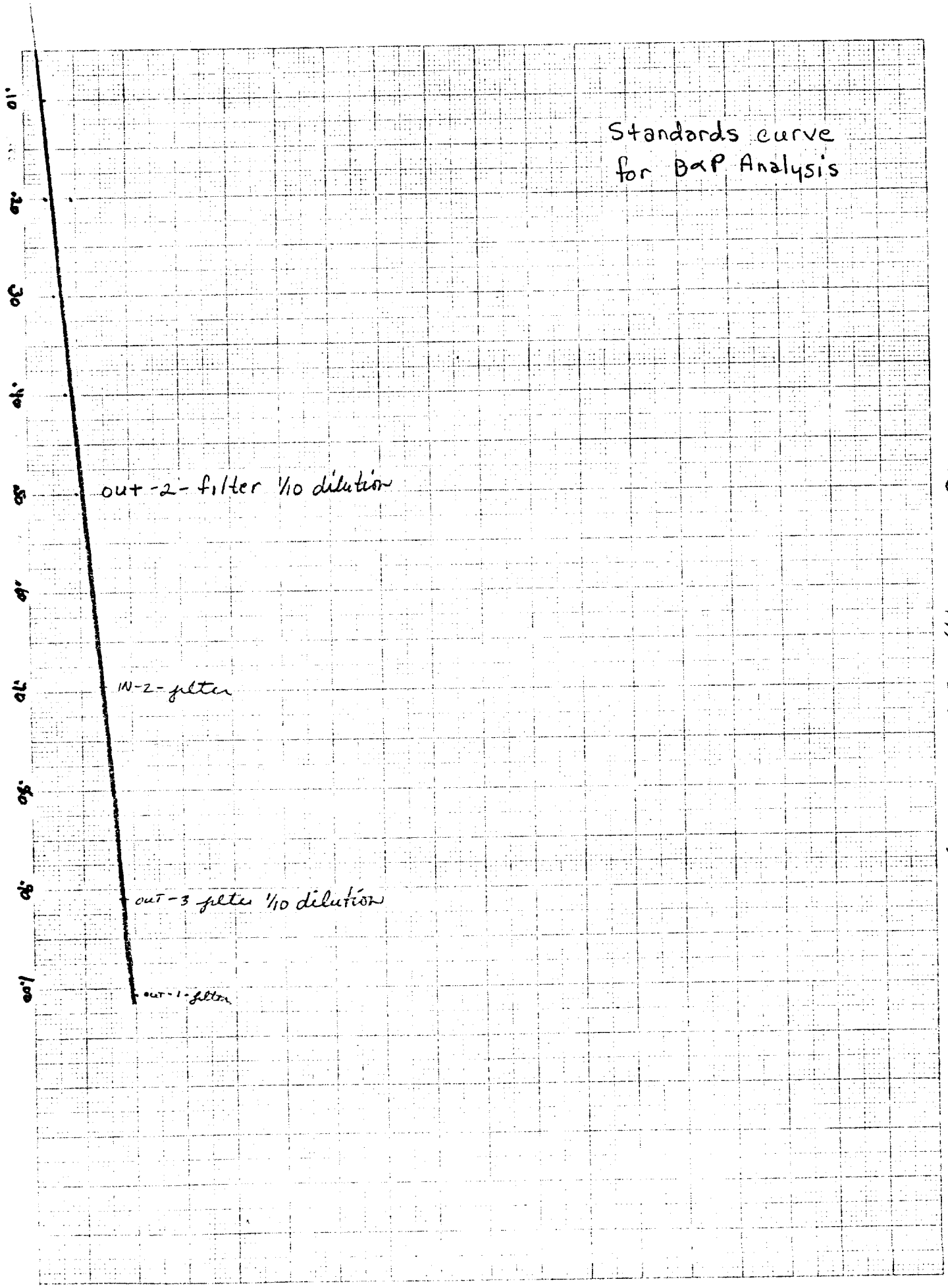
10/15/79

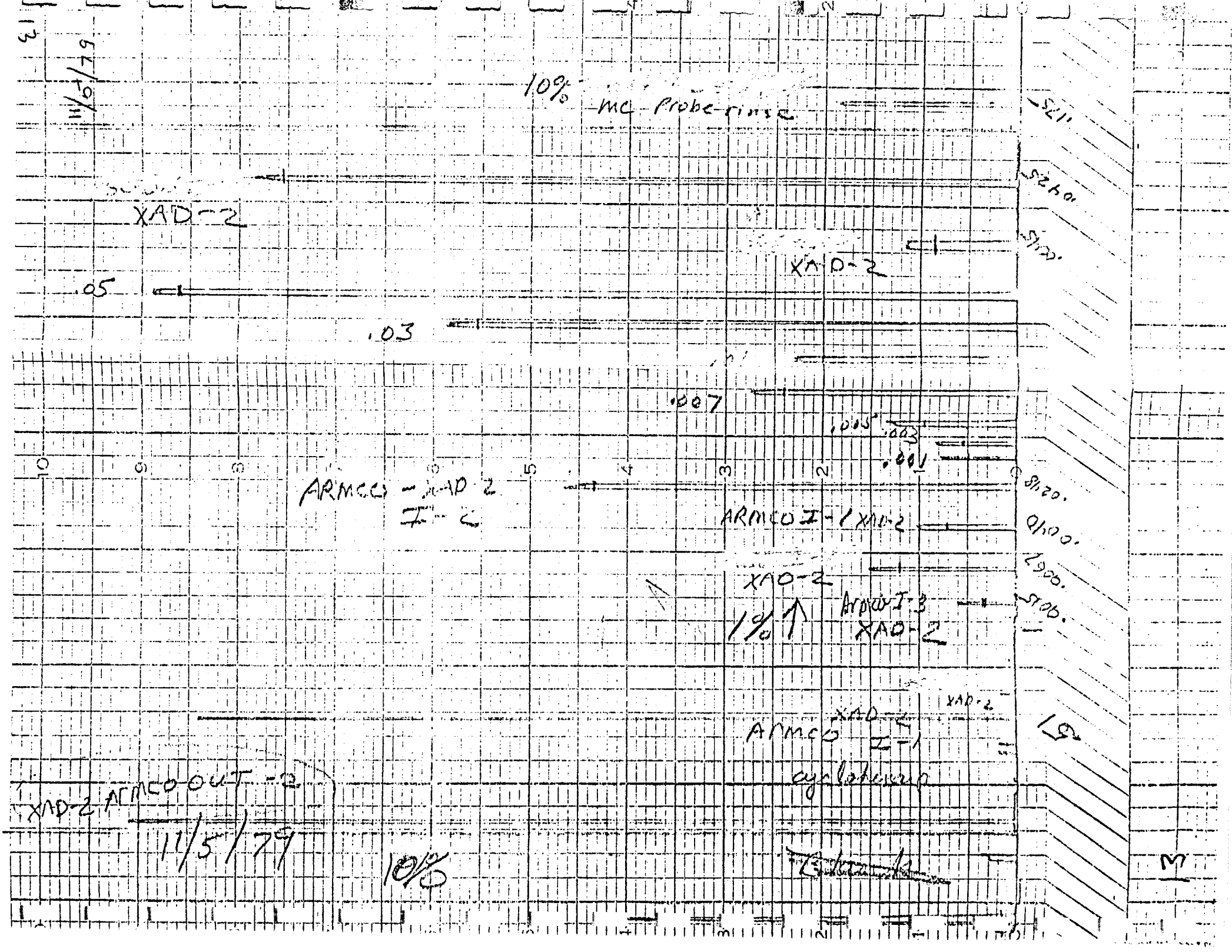
100% full scale

STANDARDS CURVE FOR
BaP ANALYSIS




10/18/79
100% full scale
Armco - 0 - 1 - filter
Armco - Out - 2 - filter
1/10 dilution
A - IN - 2 - filter
A - Out - 3 - filter
1/10 dilution
1.0
.50
.695
.91
.2
.3
.4
.5


Standards curve
for B&P Analysis
out-2-filter 1/10 dilution
IN-2-filter
out-3 filter 1/10 dilution
out-1-filter
1.0
.95
.90
.85
.80
.75
.70
.65
.60

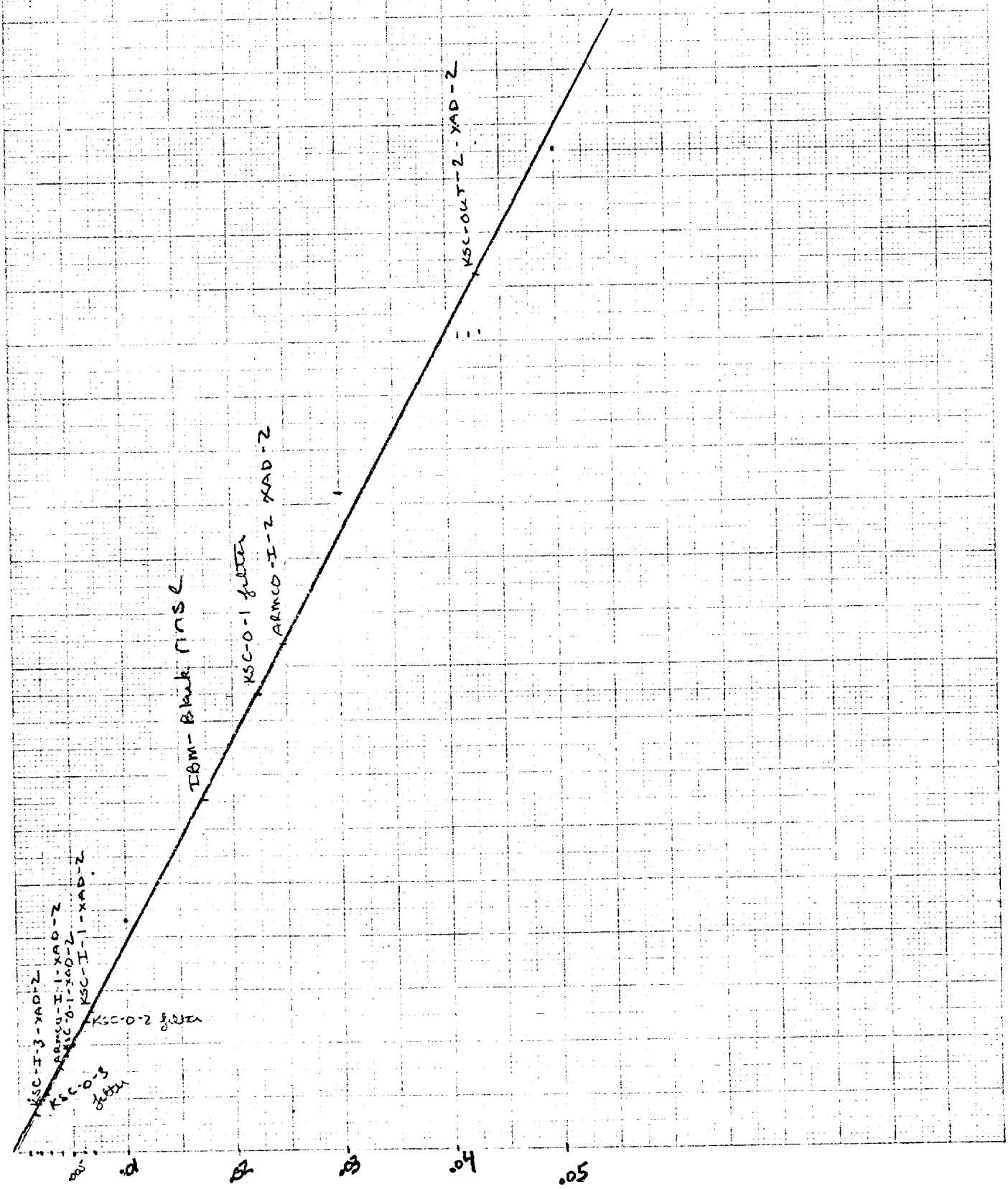


11/5/79
10%
MC Probe rinse
XAD-2
XAD-2
.05
.03
.007
.005
.003
.001
ARMCO - XAD 2
I-2
ARMCO I-1 XAD-2
XAD-2
1%
ARMCO I-3
XAD-2
XAD-2
ARMCO I-1
cyclohexane
XAD-2 ARMCO OUT-2
11/5/79
10%

11/5/79

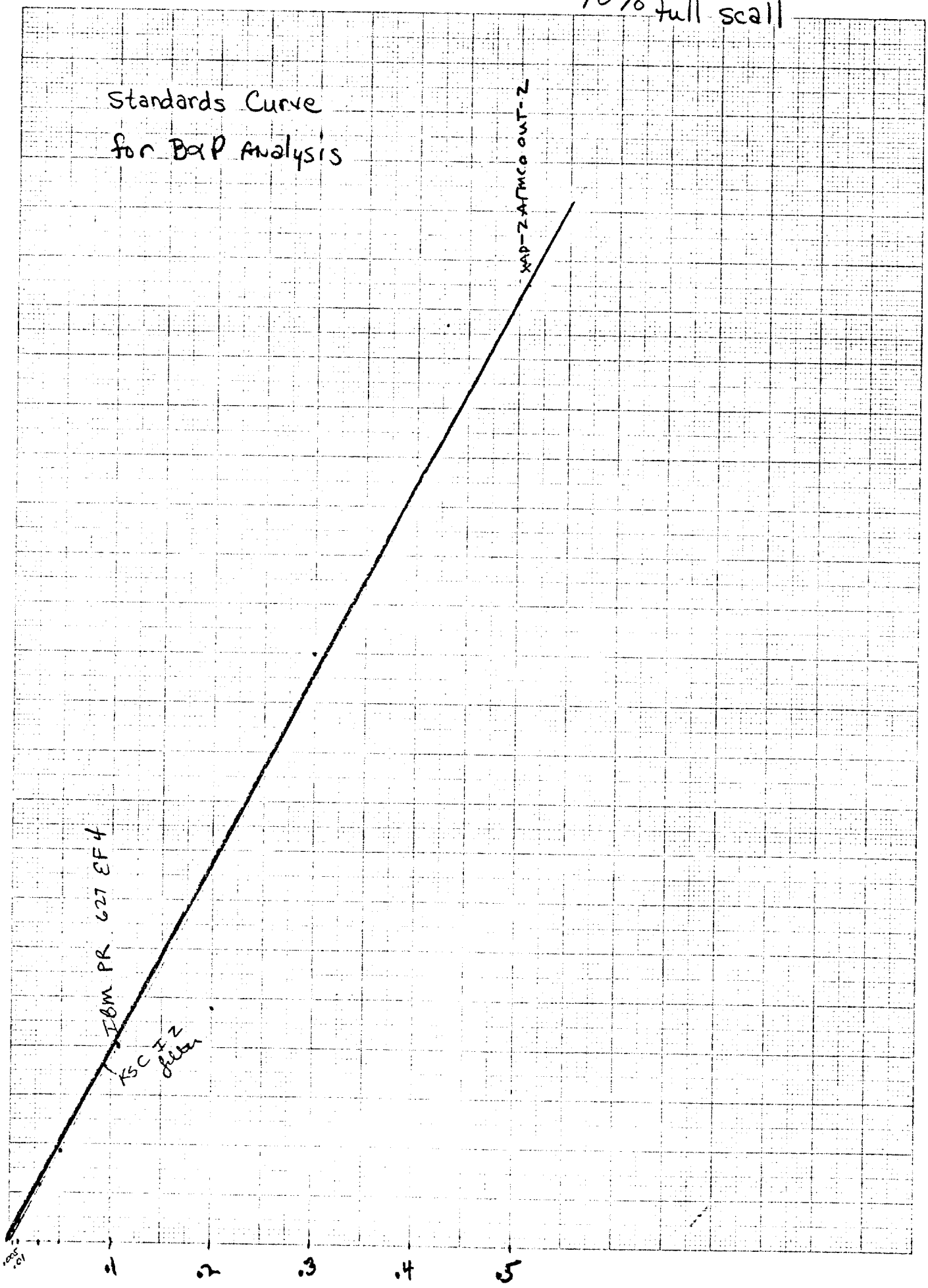
1% full scale

STANDARDS CURVE
FOR BOP ANALYSIS.

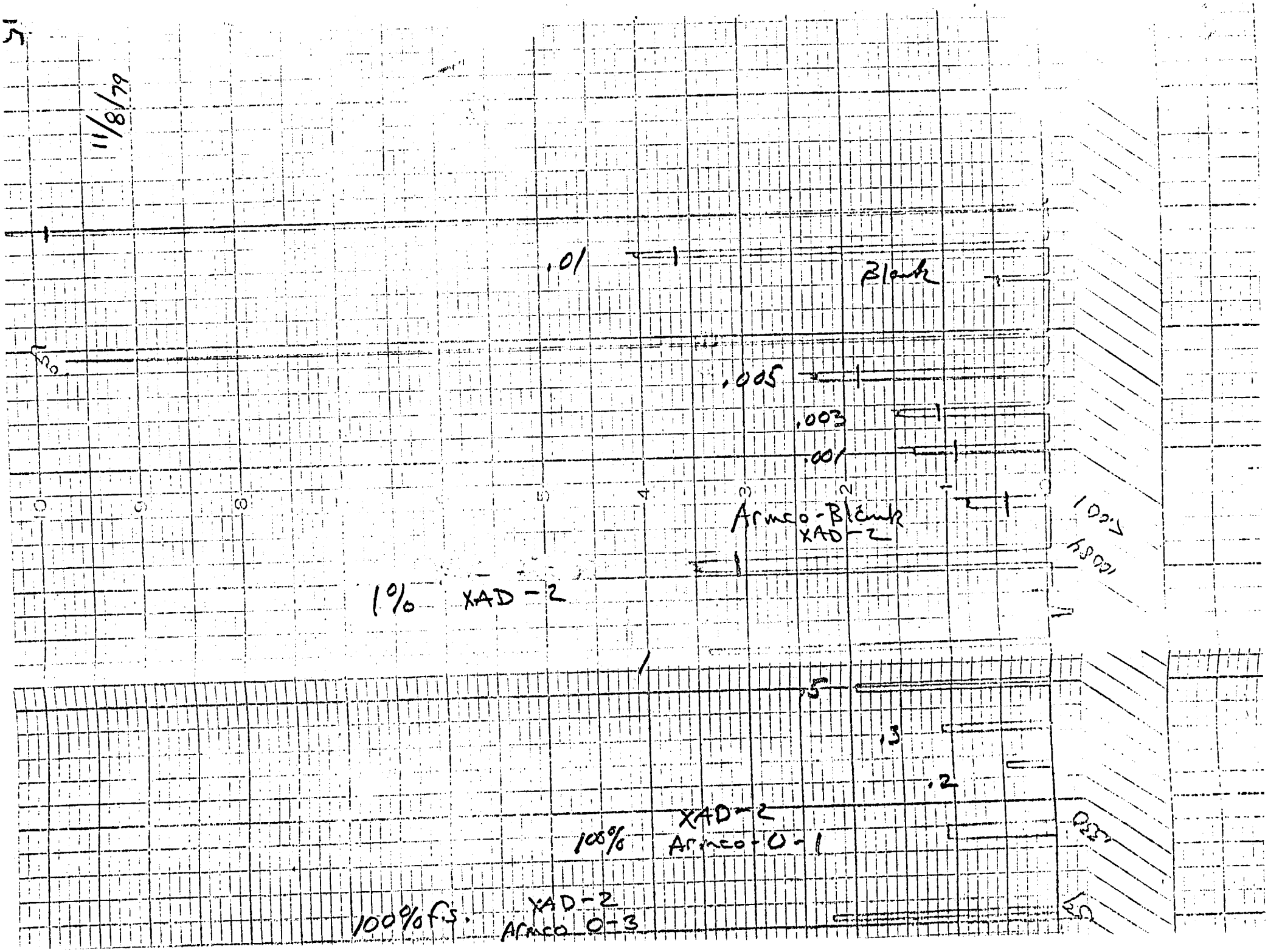


10% full scall 11/5/79

Standards Curve
for BaP Analysis



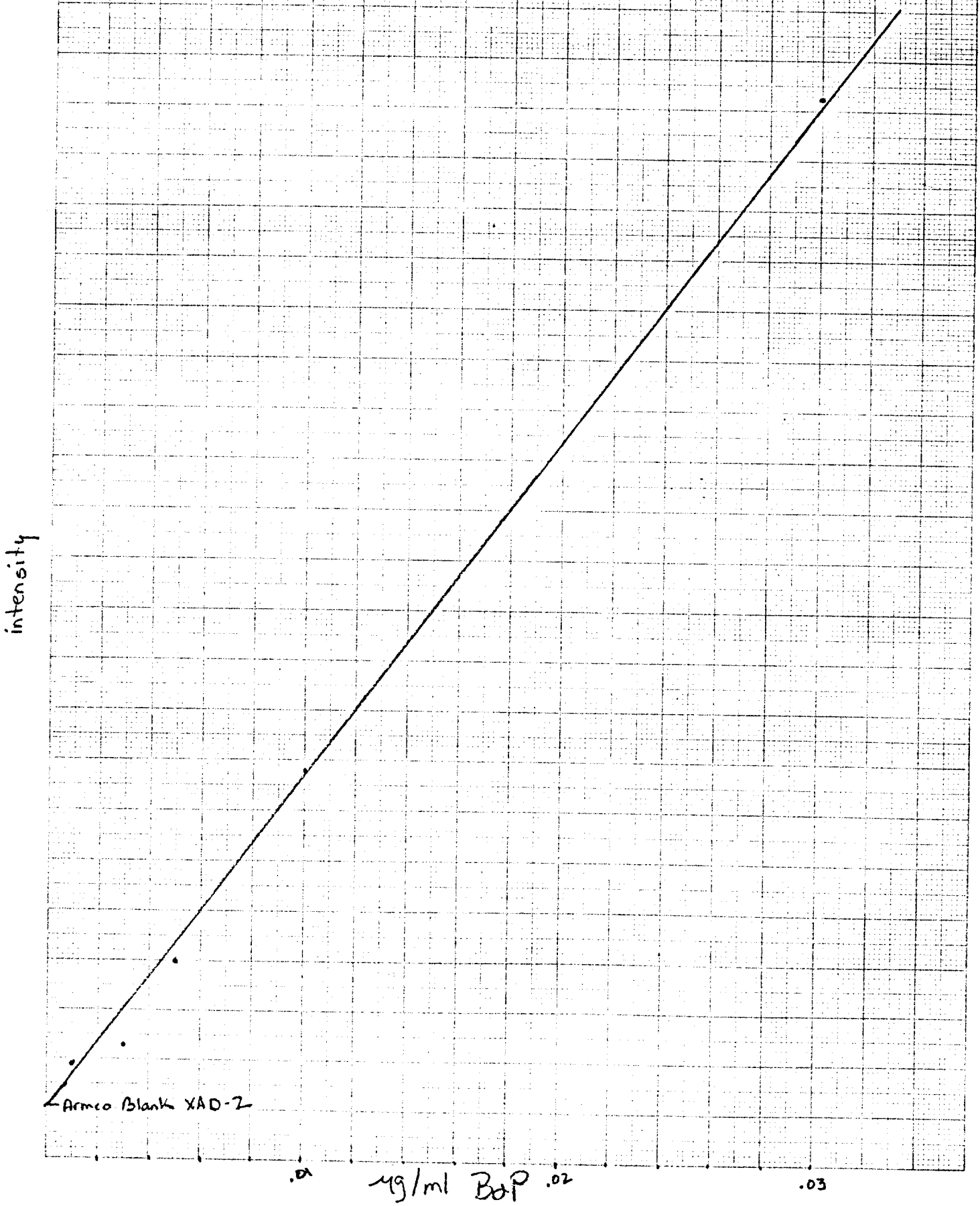
11


11/8/79
.01
Blank
.005
.003
.001
Armco-Blank
XAD-2
1% XAD-2
.5
.3
.2
XAD-2
100% Armco-0-1
XAD-2
100% f.s. Armco 0-3

11/8/79

STANDARDS CURVE
FOR ARMCO BAP ANALYSIS

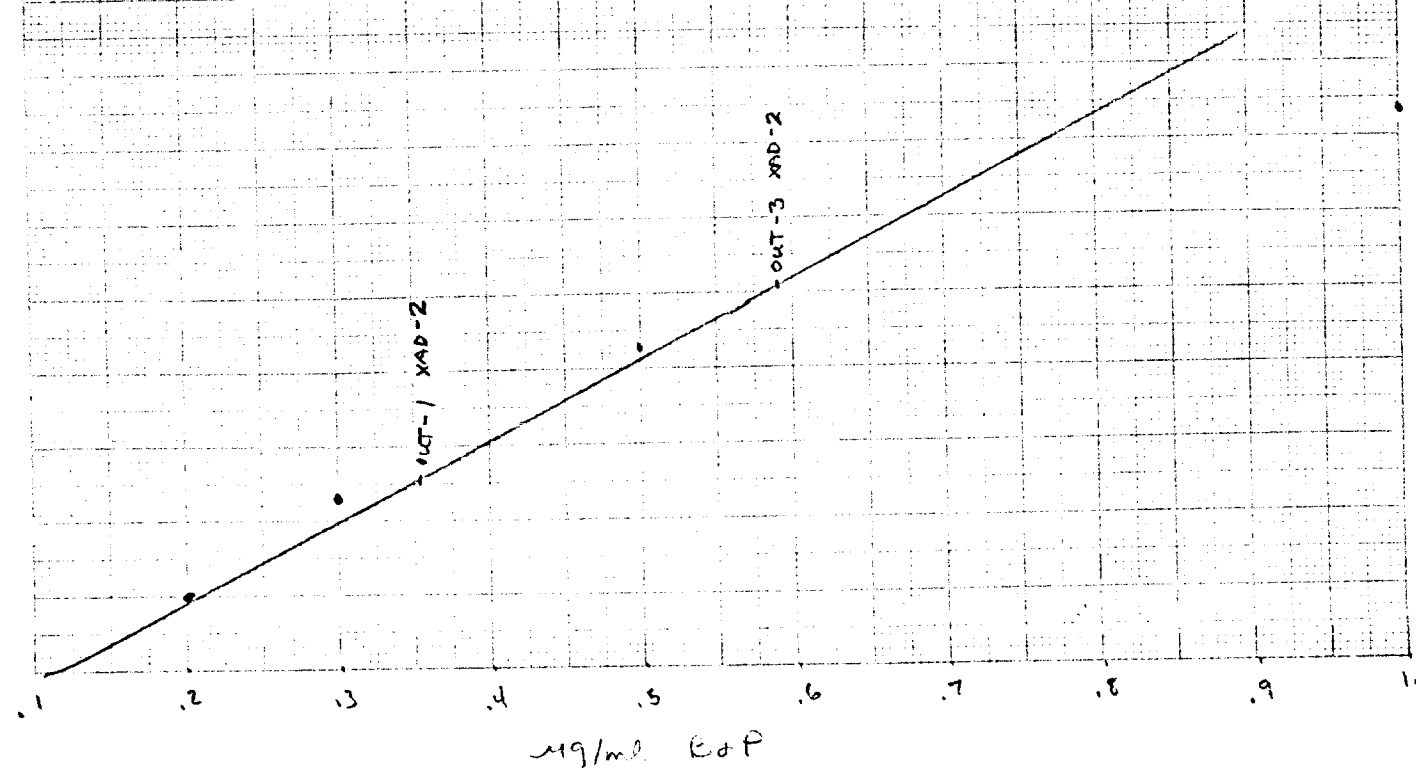
1% full scale



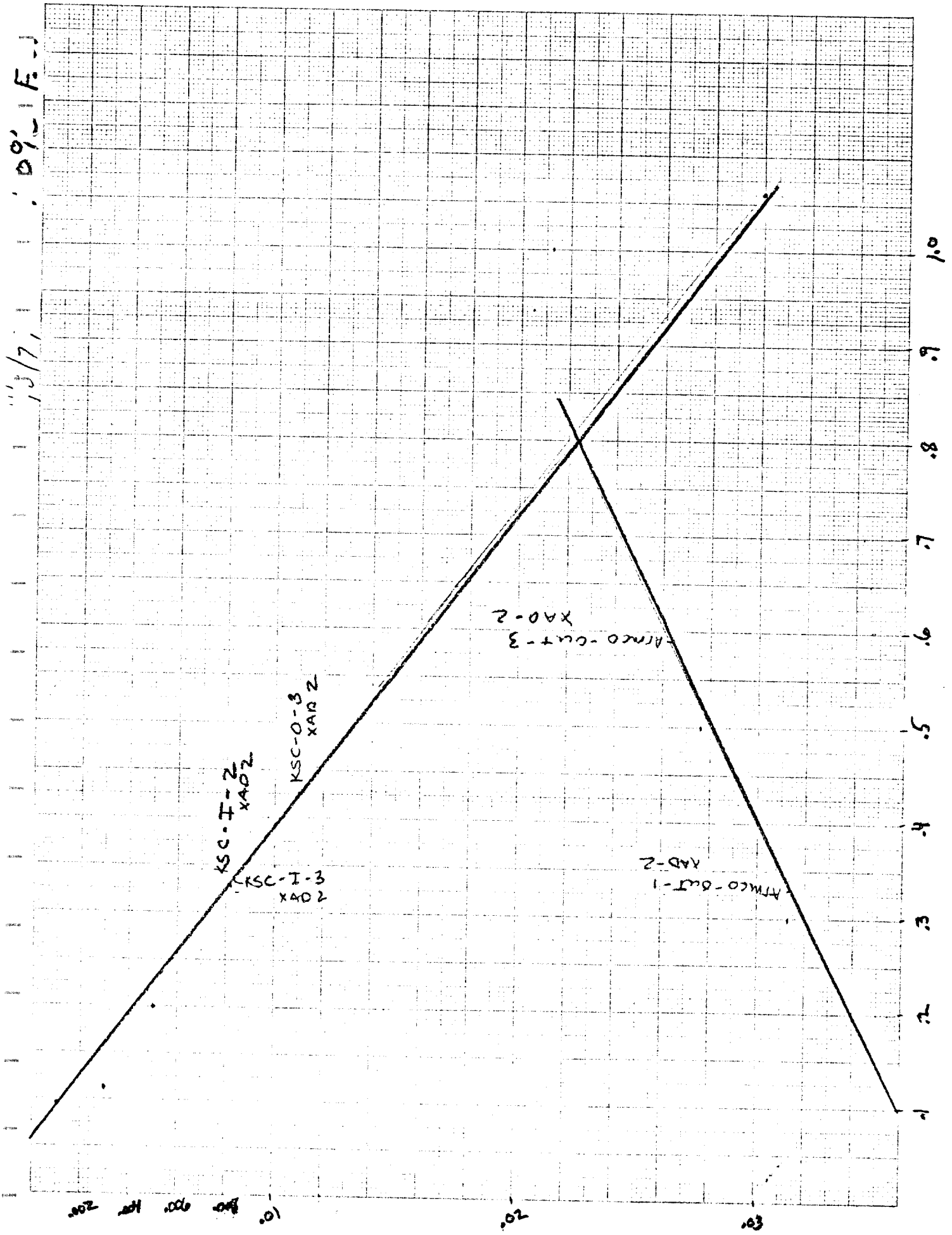
11/8/79

STANDARDS CURVE
FOR B&P ANALYSIS (ARMCO)

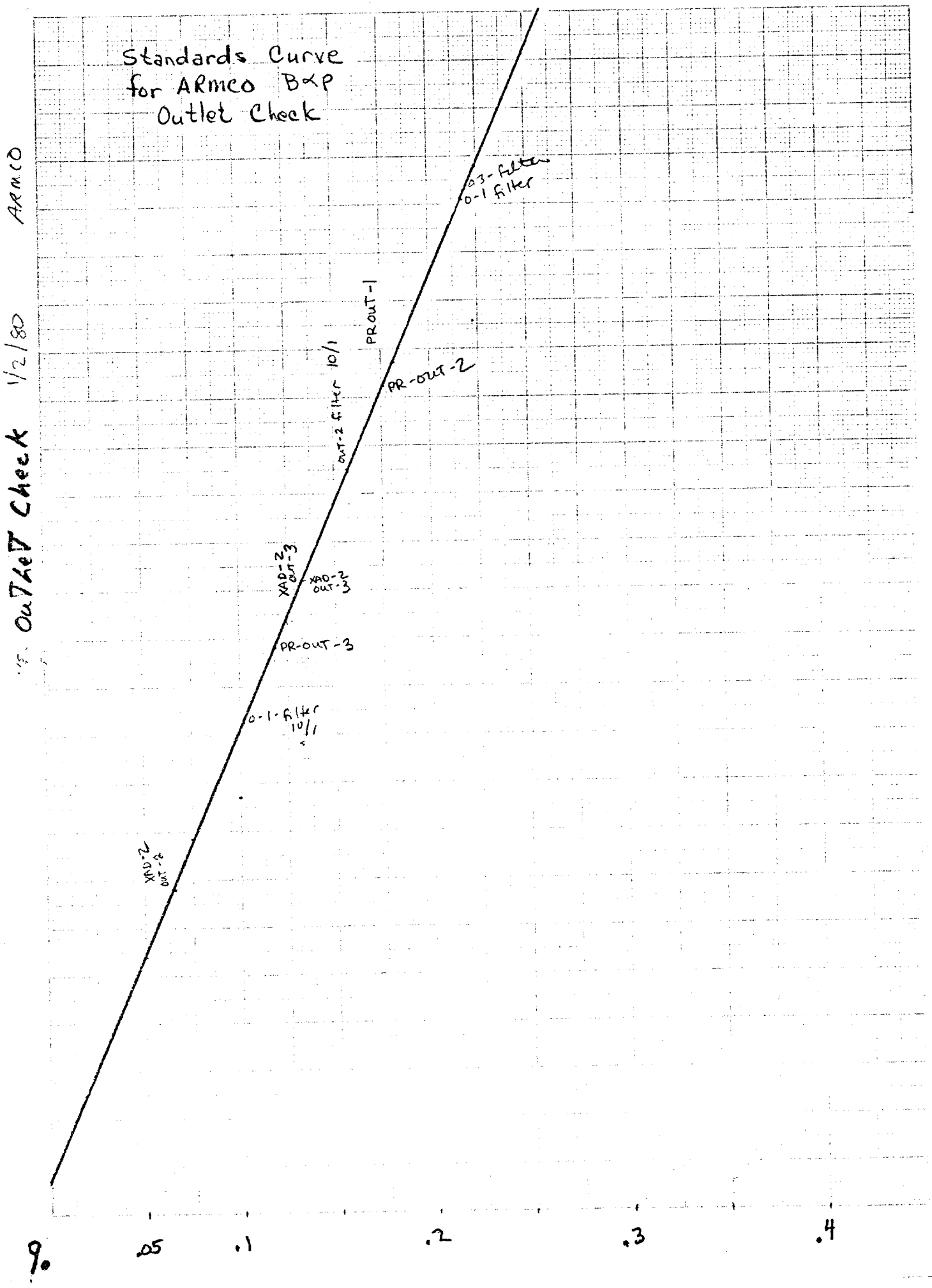
100% full scale



1% f.s. 11/8/79


KSC-I-2
XAD2
KSC-I-3
XAD2
KSC-O-3
XAR2
ATMCO-OUT-3
XAO-2
ATMCO-OUT-1
XAD-2
.01
.02
.03
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0

10% f.s.


Standards Curve
for ARMCO B&P
Outlet Check
ARMCO
1/2/80
OUTLET Check
03-filter
0-1 filter
PR-OUT-1
PR-OUT-2
OUT-2 filter 10/1
XAD-2
OUT-3
XAD-2
OUT-3
PR-OUT-3
0-1 filter
10/1
XAD-2
OUT-3
%
.05
.1
.2
.3
.4