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.

BCM

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PARTICULATE EVALUATION

OF

COKE OVEN BATTERY NO. 4 COMBUSTION STACK

AT

SHENANGO INCORPORATED
NEVILLE ISLAND PLANT
PITTSBURGH, PENNSYLVANIA 15225

BCM NO. 00-4810-11

DECEMBER 27, 1984

PREPARED BY:

PAUL JADLOWIEC
SCIENTIST II

REVIEWED BY:

RICHARD G. BEER, P.E.
SECTION MANAGER

BCM EASTERN INC.
5777 BAUM BOULEVARD
PITTSBURGH, PENNSYLVANIA 15206

BCM

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1.0 EXECUTIVE SUMMARY

Shenango Incorporated retained BCM Eastern Inc. (BCM) to perform a particulate emission tests on the Coke Oven Battery No. 4 Combustion Stack. Testing and analyses were conducted according to EPA Methods 1 through 5 and 9 of the Federal Register, Volume 42, August 1977, latest revision, with the exception of the use of a heated flexible probe extension. The test results are to be used to demonstrate compliance with limitations set forth by the Allegheny County Health Department. The compliance limits and measured particulate emissions were as follows:

Test No.	Compliance Limit	Measured Concentration
1	0.03 gr/dscf	0.0147 gr/dscf
2	0.03 gr/dscf	0.0139 gr/dscf
3	0.03 gr/dscf	0.0151 gr/dscf

2.0 SCOPE AND OBJECTIVES

The scope of this proposal was outlined in BCM Proposal No. 10-8000-06-47 which is contained in Appendix A. The following parameters were determined for each test:

- Gas Flow DSCFM
- Gas Temperature ^{o}F
- Gas Moisture % by Volume
- Particuate Concentration gr/dscf
- Opacity %

3.0 PROCEDURES

The field sampling program was performed on December 11, and 12, 1984. The BCM test personnel consisted of Messrs. Richard G. Beer, P.E., Paul Jadlowiec, and Ms. Maria Buss. Messrs. James Schlaegle and George Manown served as plant coordinators. The tests were witnessed by Messrs. John Logan and Shanker Banninthaya, of the Allegheny County Health Department.

TJM → JDG

Shenango
INCORPORATED

PLANTS
NEVILLE ISLAND, PA
SHARPSVILLE, PA
COKE PLANS
NEVILLE ISLAND, PA

January 4, 1985

Allegheny County Health Department
Bureau of Air Pollution Control
301 - 39th Street
Pittsburgh, PA 15201-1891

Attention: Mr. Ronald J. Chleboski
Deputy Director

Dear Mr. Chleboski:

Enclosed is one (1) copy of the BCM Eastern Inc. final report on the "Particulate Evaluation of Coke Oven Battery #4 Combustion Stack".

Should you have any questions regarding this report, please call me at (412) 777-6654.

Very truly yours,

James R. Zwikl
Director of Environmental Control

JRZ/bsl
Enclosure

Copy to: S. Copeland, EPA

3.1 FIELD WORK

All test and analytical procedures and field data sheets, including visual emissions data, are contained in Appendix B.

3.2 ANALYSIS

All analytical data sheets and calculations are contained in Appendix C.

3.3 CALIBRATIONS

Field equipment calibrations are contained in Appendix D.

3.4 PROCESS DATA

All process data are contained in Appendix E.

4.0 SUMMARY OF RESULTS

Table 1 presents a summary of the results of the particulate testing. The opacity observations are contained in Appendix B. The particulate grain loading ranged from 0.0137 gr/dscf to 0.0151 gr/dscf. The average of the three test runs was 0.0146 gr/dscf. The compliance limit was 0.03 gr/dscf.

TABLE 1

SUMMARY OF RESULTS

COKE OVEN BATTERY NO. 4 COMBUSTION STACK

Parameter	Test #1	Test #2	Test #3
Gas Flow (DSCFM)	22,338	23,624	26,420
Gas Temp. (^{o}F)	429	421	445
Gas Moisture (%)	12.5	11.7	13.5
Isokinetic (%)	98	94	98
Part. Emission (gr/dscf)	0.0147	0.0139	0.0151

BCM

APPENDIX A

BCM PROPOSAL

PROPOSAL

TO

SHENANGO INCORPORATED

FOR

BATTERY NO. 4
COMBUSTION STACK

BCM PROPOSAL NO. 10-8000-06-47

NOVEMBER 8, 1984

PREPARED BY

RICHARD G. BEER
SECTION MANAGER

BCM EASTERN INC.
5777 BAUM BOULEVARD
PITTSBURGH, PENNSYLVANIA 15206

TECHNICAL PROPOSAL

Shenango Incorporated requires testing on their coke oven battery at their Neville Island plant. The data collected will be used for compliance with County regulations. BCM Eastern Inc. (BCM) will evaluate the particulate loading and opacity during the sampling program. The following proposal presents BCM's approach to fulfilling Shenango's needs.

1.0 PROJECT PLANNING

BCM will contact Shenango's personnel upon bid approval to:

- Establish lines of communication
- Finalize the project objectives
- Ensure that requirements for sampling will be completed by the scheduled testing

2.0 FIELD TESTING PROGRAM

BCM will supply three (3) men for up to two (2) days to conduct the sampling program. A total of three (3) particulate samples will be collected. Opacities will be determined simultaneously during each particulate test run.

This program will yield the following data:

- Gas flow rates - ACFM & SCFM
- Gas temperature - ^{o}F
- Gas moisture content - % by volume
- Gas analysis - % by volume CO_2, O_2, CO, and N_2
- Particulate emissions - grains/dscf and lbs/hr
- Opacities - %

3.0 DATA EVALUATION AND REPORT PREPARATION

BCM personnel will review and will incorporate into their written report all pertinent operating data. This report will include, but will not be limited to, the following:

- Description of work undertaken
- Discussion of the sampling and analytical techniques employed
- Tabulation of field and laboratory data
- All calibration sheets for each apparatus used in the program

Shenango will receive five (5) copies of the final report.

4.0 SAFETY

BCM personnel always endeavor to conduct field activities in such a manner as to protect themselves and others from accidents and injury. When special safety equipment is required, the client should so specify. BCM personnel use their own safety equipment (hard hats, goggles, etc.) unless otherwise instructed.

BUSINESS PROPOSAL

5.0 COMPENSATION

We propose that the outlined project scope be performed on a lump sum basis. This fee is firm and cannot be changed unless it is mutually agreed that the scope of work has changed from that outlined in this proposal.

LUMP SUM COST

Coke Oven Battery Sampling Program . . . .

Each additional hour (as per delays/overtime paragraph) will be billed at . for a three-man crew.

6.0 INVOICES

Invoices will be submitted on a monthly basis for work completed. Terms are net thirty (30) days with past-due balances subject to interest at the rate of one-and-one-half percent (1-1/2%) interest charge per month, effective forty-five (45) days after date of invoice. This represents an annual interest charge of eighteen percent (18%).

7.0 WORK SCHEDULE

Upon receipt of your notification that BCM has been selected, we will meet with personnel from your company to finalize the project scope (if necessary) and determine a performance schedule and a target completion date which meet your needs.

8.0 DELAYS/OVERTIME

Delays caused by conditions beyond BCM's control, such as partial or complete process shutdowns or irregularities, strikes, floods or fires which delay the project's completion, constitute a Change-of-Scope. Also, unfavorable weather conditions which BCM's Field Project Engineer considers a threat to crew safety and/or sample quality constitute a Change-of-Scope and will be charged at the delay/overtime rate. In addition, the field work is based on a 10-hour day (excluding travel). Any hours necessary for the successful completion of the project in excess of 10 per day will be charged at the delay/overtime rate described in the compensation section. Any expenses incurred as a result of project delays/overtime will be billed at cost plus 10%. The BCM Field Project Engineer will notify you of such Changes of Scope. At your request, BCM will outline the type of shelter, as required, to minimize weather delays. If the project is postponed within 72 hours of the scheduled start date, you may be subject to a change not to exceed the mobilization fee.

9.0 VALIDITY

This proposal is valid for 60 days. Subsequent to that date, BCM may review the basis of payment to allow for changing costs and adjust starting and completion dates to conform to our workload.

10.0 INSURANCE

BCM will maintain insurance coverage in the following amounts and, upon request of the client, will provide a Certificate of Insurance so indicating:

Type of Policy	Limits of Liability
(a) Standard Workers' Compensation	Statutory
Employer's Liability	$100,000
(b) General Liability	
Bodily Injury	$500,000 Each Occurrence and Aggregate
Property Damage	$500,000 Each Occurrence and Aggregate
(c) Automobile Liability	
Combined Single Limit (Bodily Injury and Property Damage)	$1,000,000 Each Occurrence

PROJECT MANAGEMENT

BCM will assign key personnel to the project who are experienced in conducting similar studies. Their duties are briefly described below.

PROJECT MANAGER

Mr. Richard Beer, Section Manager, is responsible for all field testing activities involving the Air Quality Section. Mr. Beer will be the primary plant contact.

CLIENT RESPONSIBILITY

To ensure that the proposed project is completed successfully, it will be the responsibility of Shenango Incorporated to provide the following:

1. Plant liaison for the BCM field team for the duration of the program

2. Safe access to the sampling locations and electric power (110V, 20-amp service) to within 50 feet of the sampling location

BCM

APPENDIX B

FIELD DATA

BCM

1.0 SAMPLING PROCEDURES

1.1 Testing Station and Traverse Locations

The following is an explanation of the sampling points to be utilized during the project.

The test location is situated on the Number 8 stack of the Number 4 coke oven battery. The internal diameter as obtained from Shenango is 9.19'. The test station is 7 diameters downstream and approximately 20 diameters upstream from the nearest flow disturbance, which yields a requirement of 20 traverse points. We choose to use 28 points, 7 traverse points per each of 4 test ports.

1.2 Gas Flow and Gas Temperature Measurements

The flow rate and temperature profiles for the gas streams is measured by conducting simultaneous velocity and temperature traverses. Gas velocity head is measured with a calibrated "S"-type Pitot tube which is connected to an inclined manometer. The static pressure is measured using the same Pitot tube and manometer. The static pressure is measured using the same Pitot tube and manometer. A Chrome-Alumel thermocouple attached to a THERMO-ELECTRIC CORPORATION digital potentiometer is used to measure the gas temperature at each of the traverse points. The gas flow and gas temperature measurements follow Method Two of the Federal Register*.

1.3 Molecular Weight Determination

A Fisher-type B, No. 10-605 Orsat analyzer is used to determine the molecular weight of the flue gas. The following parameters are measured in order to calculate molecular weight: volume percent carbon dioxide (CO_2), volume percent oxygen (O_2), and volume percent carbon monoxide (CO); the volume percentage of nitrogen (N_2) is determined by difference. These parameters are measured using the principle of gas absorption in specific absorbing solutions. A 100 ml flue gas sample is drawn through the glass manifold to the sample chamber by the use of the leveling bottle following aspiration of the sampling line. The system is then closed by adjusting the stopcock at the inlet of the manifold.

The sample is bubbled through three absorbing solutions which selectively collect different gaseous components of the stack gas in the following manner: carbon dioxide is collected in a potassium hydroxide solution in the first absorber, oxygen is collected in a potassium pyrogallate solution in the second absorber, and carbon monoxide is collected in a saturated cupric chloride solution in the third absorber. The volume of a specific gaseous component collected

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

in an individual absorbing solution is determined by the change in volume of sample gas in the sample chamber after the bubbling process is complete. Since the original sample volume was 100 ml, any change in volume is also the percentage of the specific gaseous component found in the stack gas stream. Temperature effects in the sample chamber are minimized by a water jacket which surrounds it, maintaining the temperature at a constant level throughout the duration of the Orsat analysis.

1.4 Moisture Content Sampling

Moisture sampling is conducted employing the principles presented in EPA Method Four and concurrently with particulate sampling. Parameters evaluated in order to determine the gas stream moisture content are: sample gas volume, sample gas temperature, sample gas pressure, impinger moisture gain, and silica gel moisture gain. Some minor modifications are made to the Method Four train to allow concurrent particulate and moisture content sampling; these modifications involve no deviations from sampling principles. Modifications such as the substitution of a glass fiber filter for Pyrex wool as a filtering medium and the substitution of a calibrated orifice for a rotameter as a flow metering device are incorporated.

1.5 Determination of Particulate Emission

The following method will be used in this test program. Sampling procedures follow those described in Method Five of the Federal Register*. Due to space constraints, one exception to the method will exist. A heated teflon flex line will be used to connect the rigid stainless steel-lined probe with the heated filter box.

Approximately 200 grams of silica gel are weighed in a sealed impinger prior to each test. Glass fiber filters** (3-inch diameter) are desiccated for at least 24 hours and weighed to the nearest 0.1 mg on an analytical balance. One hundred ml of distilled water is placed in each of the first two impingers; the third impinger is initially empty; and the impinger containing the silica gel is placed next in series. The train is set up with the probe as shown in Figure A-1. The sampling train is leak checked at the sampling site prior to each test run by plugging the inlet to the nozzle and pulling a 15-inch Hg vacuum, and at the conclusion of the test by plugging the inlet to the nozzle and pulling a vacuum equal to the highest vacuum reached during the test run.

The Pitot tube and lines are leak checked at the test site prior to and following the initial velocity traverse. The check is made by blowing into the impact opening of the Pitot tube until 3 or more inches of water are recorded on the manometer and then capping the impact opening and holding it for 15 seconds to assure it is leak

* Federal Register, Vol. 42, No. 160, August 18, 1977
** Whatman Type 934 AH

free. The static pressure side of the Pitot tube is leak checked using the same procedure, except suction is used to obtain the 3-inch H_2O manometer reading. Crushed ice is placed around the impingers to keep the temperature of the gases leaving the last impinger at 68°F or less.

During sampling, stack gas and sampling train data are recorded at each sampling point and when significant changes in stack flow conditions occur. Isokinetic sampling rates are set throughout the sampling period with the aid of a nomograph or calculator. All sampling data are recorded on the Particulate Field Data Sheet.

1.5.1 Sample Recovery Procedure

The sampling train is moved carefully from the test site to the cleanup area. Samples of the acetone and distilled water used in the sample recovery are taken for use as blanks. The volume of water from the first three impingers is measured. Sample fractions are recovered as follows:

Container No. 1 - The filter is removed from its holder and placed in a petri dish and sealed.

Container No. 2 - Loose particulate and acetone washings from all sample-exposed surfaces prior to the filter are placed in a glass jar, and sealed and labeled. Particulate is removed from the probe with the aid of a brush and acetone rinsing. The liquid level is marked after the container is sealed.

Container No. 3 - A minimum of 200 ml of acetone is taken for the blank analysis. The blank is obtained and treated in a similar manner as the acetone washing.

The silica gel from the fourth impinger is weighed and recorded on the Sample Recovery and Integrity Data Sheet with other pertinent data.

1.5.2 Analytical Procedures

Container No. 1 - The filter and any loose particulate matter from this sample container are placed into a tared glass weighing dish, desiccated for 24 hours to a constant weight, and weighed to the nearest 0.1 mg.

Container No. 2 - The acetone washings are transferred to a tared beaker and evaporated to dryness at ambient temperature and pressures, desiccated for 24 hours to a constant weight, and weighed to the nearest 0.1 mg.

Container No. 3 - The acetone blank is transferred to a tared beaker and evaporated to dryness at ambient temperature and pressure. The blank is then desiccated for 24 hours to a constant weight and weighed to the nearest 0.1 mg.

The term "constant weight" means a difference of no more than 0.5 mg or 1 percent of total weight less tare weight, whichever is greater, between two consecutive readings, with no less than 6 hours of desiccation between weighings. All analytical data are recorded on the Analytical Particulate Data Sheet. Acetone blank data are recorded on the Acetone Blank Data Sheet.

1.6 Visible Emissions

During compliance testing, visible emission observations will be made simultaneously by a certified observer using EPA Method 9.

1.7 Process Data

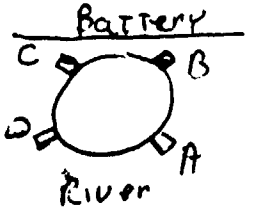
The following operational data will be gathered and inserted into the final report.

- Stack smoke density chart
- Waste heat pusher side chart
- Waste heat coke side chart
- Stack draft pusher side chart
- Stack draft coke side chart
- Crossover coke side pressure chart
- Crossover pusher side pressure chart
- Fuel gas pusher side pressure chart
- Fuel gas coke side pressure chart
- Fuel gas flow to battery chart
- Waste heat oxygen level chart
- Offtake main temperature chart
- Pusher's report

EPA METHOD 5
FIELD DATA

PLANT Shenango
DATE Dec 11, 1984
SAMPLING LOCATION No 4 Bot - No 8 Stack
SAMPLE TYPE EPA-5
RUN NUMBER 1
OPERATOR Paul Jablonec
AMBIENT TEMPERATURE ~38°F
BAROMETRIC PRESSURE 29.37
STATIC PRESSURE, (P_s) -1.1" H_2O
FILTER NUMBER (s) 347
PITOT TUBE No. & Cp. 7-1, 0.84

1,2 - CO
12,0 - CO_2
7.0 - O_2



PROBE LENGTH AND TYPE 7FT Glass
NOZZLE I.D. 0.520
ASSUMED MOISTURE, % 15
SAMPLE BOX NUMBER —
METER BOX NUMBER 552-128 Y = 1.001
METER ΔH@ 2.00
K FACTOR
PRE-TEST LEAK CHECK RATE .010 CFM @ 15 "Hg
POST TEST LEAK CHECK RATE .004 CFM @ 10 "Hg
REFERENCE Δp Pitot @ 450°F

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 6 MINUTES

TRAVERSE POINT NUMBER	ELAPSED 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		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	PROBE TEMPERATURE, °F
					DESIRED	ACTUAL		INLET, °F	OUTLET, °F				
A5 ↑	0	0837	849.234										
4 ↑	6	0843	853.11	.04	1.6	1.6	461	51	43	6	257	~32°F	223
3 ↑	12	0849	856.80	.035	1.4	1.4	469	65	43	6	261	↓	224
2 ↑	18	0855	860.39	.035	1.4	1.4	471	71	45	6	263		223
1 ↑	24	0901	863.19	.03	1.2	1.2	444	77	49	6	259		224
	30	0907	866.55	.02	0.8	0.8	311	77	53	5	255		226
	0	0911											
B5 ↑	6	0917	869.93	.03	1.2	1.2	451	73	55	5	263		223
4 ↑	12	092B	872.76	.02	0.8	0.8	485	79	57	5	263		223
3 ↑	18	0929	874.82	.01	0.4	0.4	459	79	59	3	255		223
2 ↑	24	0935	876.91	.01	0.4	0.4	417	79	61	3	253		223
1 ↑	30	0941	878.97	.01	0.4	0.4	299	83	63	2	251		225

PLANT Shenango — DATE Dec 11, 1984 — RUN NO. 1

No 4 Bat – No 8 Stack

TRAVERSE POINT NUMBER	ELAPSED 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)		STACK TEMPERATURE (T_s, °F)	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	PROBE TEMPERATURE, °F
					DESIRED	ACTUAL		INLET ($T_{m_{in}}$, °F)	OUTLET ($T_{m_{out}}$, °F)				
C 5	6	0956	~~881.90~~	.02	0.8	0.8	473	71	61	4	237	↓	223
4	12	1002	884.37	~~.02~~ .015	0.6	0.6	455	85	61	4	247		223
3	18	1008	886.87	~~.015~~ .015	0.6	0.6	455	87	63	4	253		223
2	24	1014	889.37	.015	0.6	0.6	453	89	65	4	254		223
1	30	1020	891.48	.01	0.4	0.4	361	87	67	3	205		231
	0	1024											
D 5	6	1030	~~875.38~~ 895.75	.04	1.5	1.5	443	83	69	6	251		223
4	12	1036	898.88	.03	1.2	1.2	453	93	67	6	253		227
3	18	1042	902.34	.03	1.2	1.2	461	93	69	6	254		235
2	24	1048	905.79	.03	1.2	1.2	447	95	69	6	261		243
1	30	1054	908.69	.02	0.8	0.8	303	91	71	5	263		241

EPA METHOD 5
FIELD DATA

PLANT Shenango
DATE Dec 11, 1984
SAMPLING LOCATION Unit Bat - No 8 Stack
SAMPLE TYPE EPA-5
RUN NUMBER 2
OPERATOR Paul Jadlowiec
AMBIENT TEMPERATURE ~38°F
BAROMETRIC PRESSURE 29.37
STATIC PRESSURE, (P_s) -41
FILTER NUMBER (s) 345
PITOT TUBE No. & Cp. 7-2 - 0.84

1.1 - CO
12.5 - CO_2
7.0 - O_2

PROBE LENGTH AND TYPE 7Ft Glass
NOZZLE I.D. .525
ASSUMED MOISTURE, % 15
SAMPLE BOX NUMBER
METER BOX NUMBER 552-128
METER ΔH@ 2.00
K FACTOR 0.9
PRE-TEST LEAK CHECK RATE .003 CFM @ 15 "Hg
POST TEST LEAK CHECK RATE .001 CFM @ 10 "Hg
REFERENCE Δp .046 @ 450°F

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 6 MINUTES

TRAVERSE POINT NUMBER	ELAPSED 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)		STACK TEMPERATURE (T_s, °F)	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	PROBE TEMPERATURE, °F
					DESIRED	ACTUAL		INLET ($T_{m_{in}}$, °F)	OUTLET ($T_{m_{out}}$, °F)				
	0	1141	909.000										
D 5	6	1147	912.00	.04	1.6	1.6	435	61	57	6	261	~32°F	255
4	12	1153	917.34	.05	2.0	2.0	473	83	57	8	269	↓	273
3	18	~~1159~~	920.84	.03	1.2	1.2	451	85	59	5	273		263
2	24	~~1206~~ 1203	924.73	.035	1.4	1.4	430	87	61	6	273		253
1	30	~~1212~~ 1211	928.59	.02	1.2	1.2	403	91	63	6	283		247
	0	1216					~~443~~						
C 5	6	1222	931.63	.03	1.2	1.2	~~443~~	75	65	5	259		245
4	12	1228	935.37	.035	1.4	1.4	459	89	65	5	253		249
3	18	1234	938.87	.03	1.2	1.2	439	93	65	5	249		255
2	24	1240	942.00	.025	1.0	1.0	427	91	67	5	247		259
1	30	1246	943.30	.005	0.2	02	253	79	67	2	251		259

(2)

ANT Shenango DATE Dec 11, 1984 RUN NO. No 4 Butt - No 8 Stack

TRAVERSE POINT NUMBER	ELAPSED 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		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	PROBE TEMPERATURE °F
					DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F				
5	0	1252											
5	6	1258	946.99	.035	1.4	1.4	457	73	67	5	255	↓	223
4	12	1304	950.50	.03	1.2	1.2	459	89	67	5	255		224
3	18	1310	—	.02	0.8	0.8	457	89	67	4	257		217
2	24	1316	956.27	.02	0.8	0.8	441	89	69	4	257		237
1	30	1322	958.73	.015	0.6	0.6	293	89	69	3	259		255
	0	1330											
6	6	1336	962.48	.035	1.4	1.4	449	63	65	5	257		259
4	12	1342	965.97	.03	1.2	1.2	453	91	67	6	249		243
3	18	1348	969.48	.03	1.2	1.2	447	93	67	6	261		243
2	24	1354	973.00	.03	1.2	1.2	427	93	69	6	263		235
1	30	1400	975.882	.02	0.8	0.8	329	93	71	4	265		235

EPA METHOD 5
FIELD DATA

PLANT [illegible]
DATE [illegible]
SAMPLING LOCATION [illegible]
SAMPLE TYPE [illegible]
RUN NUMBER [illegible]
OPERATOR [illegible]
AMBIENT TEMPERATURE [illegible]
BAROMETRIC PRESSURE [illegible]
STATIC PRESSURE, (P_s) -1.1" H_2O
FILTER NUMBER (s) 240
PITOT TUBE No. & Cp. [illegible]

PROBE LENGTH AND TYPE [illegible] S.S.
NOZZLE I.D. .5[illegible]
ASSUMED MOISTURE, % [illegible]
SAMPLE BOX NUMBER [illegible]
METER BOX NUMBER [illegible]
METER ΔH@ 2.00
K FACTOR 0.95
PRE-TEST LEAK CHECK RATE [illegible] CFM @ [illegible] "Hg
POST TEST LEAK CHECK RATE .010 CFM @ 12 "Hg
REFERENCE Δp [illegible]

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY [illegible] MINUTES

TRAVERSE POINT NUMBER	ELAPSED SAMPLING TIME, min	CLOCK TIME (24 hr. CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD ($\sqrt{\Delta p_s}$), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	PROBE TEMPERATURE, °F
					DESIRED	ACTUAL		INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F				
		1211	976.156										
		1217	980.80	.05	2.2	2.2	469	63	55	10	275	~32	223
		1223	985.10	.045	1.9	1.9	473	77	55	[illegible]	271	"	231
		1229	988.87	.03	1.3	1.3	453	85	59	7	275		237
		1235	992.62	.035	1.5	1.5	447	91	61	8	265		237
		1241	995.66	.02	0.86	0.86	401	93	65	5	261		241
		1245											
		1251	1000.35	.055	2.4	2.4	475	97	67	12	259		223
		1257	1005.25	.05	2.2	2.2	461	105	69	12	255		224
		1303	1008.72	.025	1.1	1.1	457	103	73	6	253		223
		1309	1011.74	.02	0.86	0.86	453	99	75	5	251		233
		1315	1013.24	.005	0.21	0.21	369	93	75	2	251		247

ANT _____ DATE _____ RUN NO. 3

TRAVERSE INT NUMBER	ELAPSED 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)		STACK TEMPERATURE (T_s, °F)	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	PROBE TEMPERATURE °F
					DESIRED	ACTUAL		INLET ($T_{m_{in}}$, °F)	OUTLET ($T_{m_{out}}$, °F)				
		1321											
		1327	1017.42	.04	1.7	1.7	427	91	77	7	245	↓	223
2		1333	1021.08	.03	1.3	1.3	449	99	77	6	243		237
		1339	1024.80	.03	1.3	1.3	453	107	77	6	245		241
		1345	1028.18	.025	1.1	1.1	453	107	79	5	241		251
		1351	1030.84	.015	.64	.64	387	101	81	4	241		255
		~~1357~~											
		1357											
		1403	1035.12	.045	1.9	1.9	445	97	77	9	245		263
		1409	—	.045	1.9	1.9	457	105	79	9	249		267
		1415	1043.67	.04	1.7	1.7	465	107	79	9	259		273
		1421	1047.63	.035	1.5	1.5	459	109	83	8	257		267
		1427	1051.220	.03	1.3	1.3	439	109	83	6	259		265

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant Shenango Sample date 12/11/84

Sample location Coke Bat No. 4 - Stack No. 8 Recovery date 12/11/84

Run number 1 Recovered by Paul Jadlowiec & R. Beer

Filter number(s) 341

MOISTURE

Impingers			Silica gel		
Final volume (wt)	360	ml(g)	Final wt	266.9	g
Initial volume (wt)	200	ml(g)	Initial wt	250	g
Net volume (wt)	160	ml(g)	Net wt	16.9	g
Description of impinger water	Clear		75	% spent	

Total moisture 176.9 g

RECOVERED SAMPLE

Filter container number(s) 341 Sealed Yes

Description of particulate on filter Blank

Probe rinse container no.	1	Liquid level marked	Yes
____ blank container no.		Liquid level marked	
Impinger contents container no.		Liquid level marked	
____ blank container no.		Liquid level marked	

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by Date

Remarks

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant Shenango Sample date 12/11/84

Sample location Coke Bat No.4 - Stack No.8 Recovery date 12/11/84

Run number 2 Recovered by

Filter number(s) 375

MOISTURE

Impingers			Silica gel		
Final volume (wt)	366	ml(g)	Final wt	277.8	g
Initial volume (wt)	200	ml(g)	Initial wt	250	g
Net volume (wt)	166	ml(g)	Net wt	17.8	g
Description of impinger water	Clear			75	% spent

Total moisture 183.8 g

RECOVERED SAMPLE

Filter container number(s) R Sealed Yes

Description of particulate on filter Black

Probe rinse container no.		Liquid level marked	Yes
____ blank container no.		Liquid level marked	
Impinger contents container no.		Liquid level marked	
____ blank container no.		Liquid level marked	

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by Date

Remarks

PARTICULATE SAMPLE RECOVERY AND INTEGRITY SHEET

Plant Sherrango Sample date 12/12/84

Sample location [illegible] Stack Recovery date 12/12/84

Run number 3 Recovered by [illegible]

Filter number(s) 340

MOISTURE

Impingers			Silica gel		
Final volume (wt)	407	ml(g)	Final wt	278	g
Initial volume (wt)	200	ml(g)	Initial wt	250	g
Net volume (wt)	207	ml(g)	Net wt	28.4	g

Description of impinger water Clear 90 % spent

Total moisture 235.4 g

RECOVERED SAMPLE

Filter container number(s) 3 Sealed Yes

Description of particulate on filter Black

Probe rinse container no. 3 Liquid level marked Yes

_____ blank container no. _____ Liquid level marked _____

Impinger contents container no. _____ Liquid level marked _____

_____ blank container no. _____ Liquid level marked _____

Samples stored and locked _____

Remarks _____

LABORATORY CUSTODY

Received by _____ Date _____

Remarks _____

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Shenango

DATE 12/12/84

SAMPLING TIME (24-hr CLOCK) 1245

SAMPLING LOCATION No 8 Coke Bat STACK

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) 2 GRABS

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE 68 °F

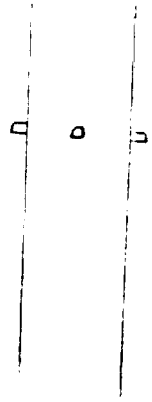
OPERATOR Paul Vadlowiec

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	4.0	4.0						44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	16.0	12.0						32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	16.0	0.0						28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Shenango
DATE 10/08/82
SAMPLING LOCATION SH #3 Battery #4
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) _____
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) 40"
STACK I.D., (DISTANCE A - DISTANCE B) 9.2' = 110"
NEAREST UPSTREAM DISTURBANCE _____
NEAREST DOWNSTREAM DISTURBANCE _____
CALCULATOR _____



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)
A-1	.026	110"	2.86 → 2 7/8"	40"	42 7/8"
-2	.082	110"	9.02 → 9"	↓	49"
-3	.146	↓	16.06 → 16"		56"
-4	.226		24.86 → 24 7/8"		64 7/8"
-5	.342	↓	37.62 → 37 5/8"	↓	77 5/8"

EA (Dur) 232

VISIBLE EMISSIONS OBSERVATION FORM

1ST TEST

OBSERVER MARIA BUSS

DATE 12/11/84

FACILITY SHENANGO - 4 BATTERY STACK

OBSERVATION PERIOD: START: 0836

FINISH: 0936

OBSERVATION POINT: PARKING LOT NORTH OF PLANT NEAR USS CHEM (1st port)

SOURCE:

DISTANCE FROM: 350'

DIRECTION FROM: NW

HEIGHT: 100'

WIND:

SPEED: 0-5 MPH

DIRECTION: WEST

TEMPERATURE: 38°F

SKY CONDITION: CLOUDY

BACKGROUND: SKY

READING CONDITIONS: FAIR

COLOR OF EMISSIONS: BLACK

COMMENTS:

NO. OF READINGS ≥ 20%: 18

NO. OF READINGS ≥ 60%: 0

MAX OPACITY: 45%

STATUS:

SIGNATURE: Maria Buss

	0	15	30	45
0	0	0	0	0
1	0	0	0	0
2	10	10	10	10
3	10	10	10	10
4	10	10	10	10
5	10	15	15	15
6	15	15	15	15
7	15	15	15	15
8	15	15	15	15
9	15	10	10	15
10	15	15	15	15
11	15	15	15	15
12	15	10	10	10
13	10	10	10	10
14	10	10	10	10
15	10	10	10	10
16	10	10	10	10
17	5	5	5	5
18	5	5	5	5
19	5	5	5	5
20	0	0	0	5
21	5	5	5	5
22	5	5	5	5
23	5	5	5	5
24	5	5	5	5
25	5	5	5	0
26	0	0	0	0
27	0	0	5	5
28	5	5	5	5
29	5	5	5	5

	0	15	30	45
30	5	5	5	5
31	5	5	5	5
32	5	15	25	45
33	45	45	30	30
34	20	20	15	15
35	15	15	15	15
36	15	15	15	15
37	15	15	15	15
38	15	10	10	10
39	10	10	10	10
40	10	10	5	5
41	5	5	5	5
42	5	5	5	5
43	5	0	0	0
44	0	0	0	0
45	0	0	5	5
46	5	5	5	15
47	15	15	10	10
48	10	5	5	5
49	5	5	5	5
50	5	5	10	10
51	10	10	15	15
52	15	15	15	15
53	20	20	15	15
54	15	15	15	15
55	15	15	15	15
56	15	20	25	25
57	20	20	15	15
58	15	15	20	20
59	20	15	15	15

VISIBLE EMISSIONS OBSERVATION FORM

OBSERVER MARIA BUSS

DATE 12/11/84

FACILITY SHENANGO - 4 BATTERY STACK

OBSERVATION PERIOD: START: 0937

FINISH: 1037

OBSERVATION POINT: PARKING LOT NORTH OF PLANT, WEST OF USS

SOURCE:

DISTANCE FROM: 350'

DIRECTION FROM: NW

HEIGHT: 100'

WIND:

SPEED: 0-5 MPH

DIRECTION: WEST

TEMPERATURE: 43°F

SKY CONDITION: CLOUDY

BACKGROUND: SKY

READING CONDITIONS: FAIR

COLOR OF EMISSIONS: BLACK

COMMENTS:

NO. OF READINGS ≥ 20%: 35

NO. OF READINGS ≥ 60%: 1

MAX OPACITY: 75%

STATUS:

SIGNATURE: Maria Buss

	0	15	30	45
0	15	15	15	15
1	15	15	15	15
2	15	15	15	15
3	15	20	20	15
4	15	15	15	15
5	15	15	15	15
6	20	20	15	15
7	15	15	15	15
8	15	10	10	10
9	10	5	5	5
10	10	10	10	10
11	10	10	10	10
12	10	10	10	10
13	10	15	25	40
14	50	35	35	15
15	15	15	15	15
16	40	75	55	50
17	35	35	30	30
18	20	20	15	15
19	15	10	10	10
20	10	10	10	10
21	5	5	5	5
22	5	5	5	5
23	5	5	5	5
24	5	0	0	0
25	0	0	0	0
26	0	0	0	0
27	0	0	0	0
28	0	0	0	0
29	0	0	0	0

	0	15	30	45
30	0	0	0	0
31	0	0	0	0
32	0	0	0	0
33	0	0	0	0
34	0	0	0	0
35	0	0	0	0
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
41	0	0	0	0
42	0	0	0	0
43	0	0	0	0
44	0	0	0	0
45	0	0	0	0
46	0	5	10	10
47	10	5	5	5
48	0	0	0	0
49	0	0	0	0
50	0	0	5	5
51	10	10	10	10
52	10	10	10	10
53	10	10	10	15
54	15	15	15	15
55	15	15	15	15
56	20	20	20	20
57	20	20	20	20
58	25	25	20	20
59	20	20	20	20

VISIBLE EMISSIONS OBSERVATION FORM

OBSERVER MARIA BUSS

DATE 12/11/84

FACILITY SHENANGO - 4 BATTERY STACK

OBSERVATION PERIOD: START: 1038

FINISH: 1055

OBSERVATION POINT: PARKING LOT NORTH OF PLANT, WEST OF USS

SOURCE:

DISTANCE FROM: 350'

DIRECTION FROM: NW

HEIGHT: 100'

WIND:

SPEED: 0-5 MPH

DIRECTION: WEST

TEMPERATURE: 43°F

SKY CONDITION: CLOUDY

BACKGROUND: SKY

READING CONDITIONS: FAIR

COLOR OF EMISSIONS: BLACK

COMMENTS:

% OF READINGS ≥ 20%:

% OF READINGS ≥ 60%:

MAX OPACITY:

STATUS:

SIGNATURE: Maria Buss

	0	15	30	45
0	20	20	20	20
1	20	15	15	15
2	15	15	15	20
3	20	20	15	15
4	15	15	15	15
5	20	20	20	20
6	20	20	20	20
7	15	15	15	15
8	20	20	20	20
9	20	15	15	15
10	15	15	15	20
11	20	20	20	20
12	20	20	20	20
13	20	15	15	20
14	15	15	15	15
15	15	15	10	5
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				

	0	15	30	45
30				
31				
32				
33				
34				
35				
36				
37				
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58				
59				

VISIBLE EMISSIONS OBSERVATION FORM

2ND TEST

OBSERVER MARIA BUSS

DATE 12/11/84

FACILITY SHENANGO - 4 BATTERY STACK

OBSERVATION PERIOD: START: 1140

FINISH: 1240

OBSERVATION POINT: PARKING LOT NORTH OF PLANT, WEST OF USS

SOURCE:

DISTANCE FROM: 350'

DIRECTION FROM: NW

HEIGHT: 100'

WIND:

SPEED: 0-5 MPH

DIRECTION: WEST

TEMPERATURE: 45°F

SKY CONDITION: CLOUDY

BACKGROUND: SKY

READING CONDITIONS: FAIR

COLOR OF EMISSIONS: BLACK

COMMENTS:

% OF READINGS ≥ 20%: 28

% OF READINGS ≥ 60%: 0

MAX OPACITY: 45%

STATUS:

SIGNATURE: Maria Buss

	0	15	30	45
0	15	15	15	15
1	15	15	15	15
2	15	15	10	10
3	10	10	10	10
4	10	10	10	10
5	10	15	15	15
6	15	15	15	15
7	15	15	15	15
8	15	15	15	15
9	5	5	5	0
10	0	0	0	0
11	0	5	5	5
12	5	5	5	5
13	5	5	5	5
14	5	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
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
23	0	0	0	0
24	0	0	0	0
25	0	0	0	0
26	0	0	0	0
27	0	0	0	0
28	0	0	0	5
29	10	25	25	25

	0	15	30	45
30	25	25	40	45
31	40	40	40	45
32	40	30	20	20
33	20	20	20	20
34	20	20	20	20
35	20	20	20	20
36	20	15	15	15
37	15	15	15	15
38	10	10	10	10
39	10	10	5	5
40	5	10	10	10
41	10	10	5	5
42	5	5	10	10
43	5	5	10	10
44	5	5	5	0
45	0	0	0	0
46	0	0	0	0
47	0	0	0	0
48	0	0	0	5
49	5	10	10	10
50	10	10	15	15
51	15	15	15	15
52	10	10	10	10
53	5	0	0	0
54	0	0	0	0
55	0	0	0	0
56	0	5	5	5
57	5	5	5	10
58	10	10	15	15
59	15	15	15	15

VISIBLE EMISSIONS OBSERVATION FORM

OBSERVER MARIA BUSS

DATE 12/11/84

FACILITY SHENANGO 4 BATTERY STACK

OBSERVATION PERIOD: START: 1241

FINISH: 1341

OBSERVATION POINT: PARKING LOT NORTH OF PLANT, WEST OF USS

SOURCE:

DISTANCE FROM: 350'

DIRECTION FROM: NW

HEIGHT: 100'

WIND:

SPEED: 0-5 MPH

DIRECTION: WEST

TEMPERATURE: 45°F

SKY CONDITION: CLOUDY

BACKGROUND: SKY

READING CONDITIONS: FAIR

COLOR OF EMISSIONS: BLACK

COMMENTS:

OF READINGS ≥ 20%: 53

OF READINGS ≥ 60%: 4

MAX OPACITY: 65%

STATUS:

SIGNATURE: Maria Buss

	0	15	30	45
0	15	15	15	15
1	15	15	20	20
2	25	25	20	20
3	20	20	20	25
4	35	45	40	40
5	40	30	45	55
6	65	60	60	45
7	30	25	20	20
8	15	15	15	15
9	10	10	10	10
10	10	15	15	15
11	15	15	15	15
12	15	15	10	10
13	10	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
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
23	0	0	0	0
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
29	0	0	0	0

	0	15	30	45
30	0	0	0	0
31	0	0	0	0
32	0	0	0	0
33	0	0	0	0
34	0	0	0	0
35	0	0	0	0
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
41	0	0	0	0
42	0	0	0	0
43	0	5	5	5
44	5	5	5	5
45	10	10	10	10
46	10	10	10	10
47	10	10	15	15
48	15	15	30	55
49	60	55	55	55
50	50	35	35	35
51	35	35	25	25
52	25	25	25	25
53	25	25	25	20
54	20	20	15	15
55	15	15	15	20
56	20	15	15	15
57	10	15	15	15
58	15	15	15	15
59	15	15	15	20

VISIBLE EMISSIONS OBSERVATION FORM

OBSERVER MARIA BUSS

DATE 12/11/84

FACILITY SHENANGO - 4 BATTERY STACK

OBSERVATION PERIOD: START: 1342

FINISH: 1403

OBSERVATION POINT: PARKING LOT NORTH OF PLANT, WEST OF USS

SOURCE:

DISTANCE FROM: 350'

DIRECTION FROM: NW

HEIGHT: 100'

WIND:

SPEED: 0 - 5 MPH

DIRECTION: WEST

TEMPERATURE: 43° F

SKY CONDITION: CLOUDY

BACKGROUND: SKY

READING CONDITIONS: FAIR

COLOR OF EMISSIONS: BLACK

COMMENTS:

NO. OF READINGS ≥ 20%: 13

NO. OF READINGS ≥ 60%: 0

MAX OPACITY: 20%

STATUS:

SIGNATURE: Maria Buss

	0	15	30	45
0	20	20	20	20
1	20	20	20	20
2	20	20	20	15
3	5	0	0	0
4	0	0	0	0
5	0	0	0	5
6	0	0	0	0
7	0	0	0	0
8	0	0	10	10
9	15	15	15	15
10	20	20	10	10
11	10	10	10	10
12	5	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0
21				
22				
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29				

	0	15	30	45
30				
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59				

3rd Run

BSERVER MARIA BUSS

ATE 12/12/84

ACILITY SHENANGO - 4 BATTERY STACK

BSERVATION PERIOD: START: 1210

FINISH: 1310

BSERVATION POINT: PARKING LOT

RTH OF PLANT, WEST OF USS

OURCE:

DISTANCE FROM: 350'

DIRECTION FROM: NW

HEIGHT: 100'

IND:

SPEED: 0-5 MPH

DIRECTION: WEST

EMPERATURE: 44°F

KY CONDITION: CLOUDY

ACKGROUND: SKY

EADING CONDITIONS: FAIR

OLOR OF EMISSIONS: BLACK

OMMENTS:

. OF READINGS ≥ 20%: 51

. OF READINGS ≥ 60%: 0

MAX OPACITY: 55%

TUS:

GNATURE: Maria Buss

X	0	15	30	45
0	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	10
13	15	15	15	15
14	15	15	15	15
15	15	15	15	15
16	10	10	15	15
17	15	15	15	15
18	15	15	15	20
19	20	20	15	15
20	15	15	15	15
21	15	15	20	20
22	20	20	20	20
23	20	20	20	20
24	20	20	20	20
25	20	10	10	5
26	5	5	5	0
27	0	0	5	5
28	5	5	10	10
29	10	15	15	15

1241

X	0	15	30	45
30	15	15	15	10
31	10	10	10	15
32	25	40	50	50
33	35	30	20	30
34	40	55	55	50
35	25	20	20	20
36	20	20	20	20
37	20	20	20	20
38	20	20	20	20
39	20	15	15	15
40	15	15	15	15
41	15	20	20	20
42	20	10	10	10
43	10	15	15	10
44	5	5	0	0
45	0	0	0	0
46	0	0	0	0
47	0	0	0	0
48	0	0	0	0
49	0	0	0	0
50	0	0	0	0
51	0	0	0	0
52	0	0	0	0
53	0	0	0	0
54	0	0	0	0
55	0	0	0	0
56	0	0	0	0
57	0	0	0	0
58	0	0	0	0
59	0	0	0	0

VISIBLE EMISSIONS OBSERVATION FORM

OBSERVER MARIA BUSS

DATE 12/12/84

FACILITY SHENANGO - 4 BATTERY STACK

OBSERVATION PERIOD: START: 1311

FINISH: 1411

OBSERVATION POINT: PARKING LOT NORTH OF PLANT, WEST OF USS

SOURCE:

DISTANCE FROM: 350'

DIRECTION FROM: N W

HEIGHT: 100'

WIND:

SPEED: 0 - 5 MPH

DIRECTION: WEST

TEMPERATURE: 45°F

SKY CONDITION: CLOUDY

BACKGROUND: SKY

READING CONDITIONS: FAIR

COLOR OF EMISSIONS: BLACK

COMMENTS:

NO. OF READINGS ≥ 20%:

NO. OF READINGS ≥ 60%:

MAX OPACITY: 70%

STATUS:

SIGNATURE: Maria Buss

	0	15	30	45
0	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	10	20
5	15	15	15	15
6	15	20	40	60
REV → 7	65	70	60	35
8	30	20	20	20
9	20	20	15	15
10	15	10	10	10
11	10	10	10	10
12	10	10	10	5
13	15	25	25	25
14	25	25	20	20
15	25	25	20	20
16	20	20	20	20
17	20	20	20	20
18	20	20	20	25
19	25	25	25	25
20	25	25	25	25
21	25	25	25	25
22	25	25	25	25
23	20	20	20	25
24	25	25	25	25
25	25	25	25	20
26	20	20	20	15
27	5	5	5	5
28	5	5	5	5
29	5	5	10	10

	0	15	30	45
30	15	15	20	20
31	20	20	20	15
32	10	10	10	10
33	10	10	10	10
34	10	10	10	10
35	10	10	10	15
36	15	15	15	15
37	15	20	20	20
38	20	20	25	25
39	25	25	25	30
40	30	30	35	35
41	35	50	65	60
REV → 42	40	40	45	70
43	70	60	40	40
44	30	25	25	25
45	15	10	10	10
46	10	10	5	5
47	5	5	0	0
48	0	0	0	0
49	0	0	0	0
50	0	0	0	0
51	0	0	0	0
52	0	0	0	0
53	0	0	0	0
54	0	0	0	0
55	0	0	0	0
56	0	0	0	0
57	0	0	0	0
58	0	0	0	0
59	0	0	0	0

VISIBLE EMISSIONS OBSERVATION FORM

OBSERVER MARIA BUSS
DATE 12/12/84
FACILITY SHENANGO – 4 BATTERY STACK
OBSERVATION PERIOD: START: 1412
FINISH: 1426

OBSERVATION POINT: PARKING LOT NORTH OF PLANT, WEST OF USS
SOURCE:
DISTANCE FROM: 350'
DIRECTION FROM: NW
HEIGHT: 100'
WIND:
SPEED: 0-5 MPH
DIRECTION: WEST
TEMPERATURE: 45°F
SKY CONDITION: CLOUDY

BACKGROUND: SKY

READING CONDITIONS: FAIR

COLOR OF EMISSIONS: BLACK

COMMENTS:

OF READINGS ≥ 20%: 0
OF READINGS ≥ 60%: 0
MAX OPACITY: 10%
STATUS:

SIGNATURE: Maria Buss

	0	15	30	45
0	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	5	10
13	10	5	0	0
14	0	0	0	0
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	0	15	30	45
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BCM

APPENDIX C

CALCULATIONS

BCM

EPA METHOD 5 CALCULATIONS

$$Vm(std) = 17.64(\gamma)(Vm)\ \frac{Pb + (0.07355)(\Delta H)}{Tm + 460}$$

$$Vw(std) = 0.0471\ Vwc$$

$$Bws = \frac{Vw(std)}{Vw(std) + Vm(std)}$$

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

$$Ms = Md(1 - Bws) + 18(Bws)$$

$$Vs = 85.49\ Cp\sqrt{\Delta P}\sqrt{\frac{Ts + 460}{Ps\ \ Ms}}$$

$$As = \frac{\pi (Ds)^2}{(4)(144)}$$

$$Qs = 60\ Vs\ As$$

$$Qs(std) = Qs(1 - Bws)17.64\ \frac{Ps}{Ts + 460}$$

$$An = \frac{\pi (Dn)^2}{(4)(144)}$$

$$I = \frac{1.667(Ts + 460)\left[(0.00267\ Vwc) + \left(\left(\frac{Vm}{Tm + 460}\right)(Pb + 0.07355\Delta H)\right)\right]}{\Theta\ Vs\ Ps\ An}$$

$$C's = 0.0154\ \frac{Wt}{Vm(std)}$$

$$E = 0.00857\ C's\ Qs(std)$$

$$lb/mmBTU = \frac{lb/hr}{mmBTU}$$

BCM

Plant Shenango

Location N. 4 Bat., No 8 Stack

Test Date Dec 11, 1984

Run No. 1

Calculator Paul Jadlowiec

Date Dec 11, 1984

SUMMARIZED DATA

Y	= 1.001		Vm (std)	= 58.312	dscf
Vm	= 59.456	cf	Vw (std)	= 8.332	scf
Pb	= 29.37	in. Hg	Bws	= 0.125	
ΔH	= 0.925	in. H_2O	Md	= 29.28	wet-lb/lb-mole
Tm	= 70.0	^oF	Ms	= 27.87	dry-lb/lb-mole
Vwc	= 176.9	mlH_2O	Vs	= 11.090	fps
%CO_2	= 4.0		As	= 66.00	ft^2
%O_2	= 16.0		Qs	= 43,916	acfm
%CO	= —		Q_s(std)	= 22,338	dscfm
%N_2	= 80.0		An	= .00[illegible]	ft^2
Cp	= 0.84		I	= 97.6	
$\sqrt{\Delta p}$	= .148	H_2O	C's	= [illegible]	gr/dscf
Ts	= 428.8	^oF	E	=	lbs/hr
Ps	= 29.29	in. Hg	lb/mmBTU	=	lb/mmBTU
Ds	= 110	in.			
Dn	= 0.520	in.			
Θ	= 120	min.			
Wt	= 55.[illegible]	mg.			

BCM

Plant- Shenango
Location- N.4 Bat., No 8 Stack
Test date- Dec 11, 1984
Run No.- 1

Calculator- Paul Jadlowiec
Date- Dec 11, 1984

EPA METHOD 5 CALCULATIONS

$Vm(std) = 17.64(1.001)(59.456)\frac{29.37+(0.07355)(0.925)}{70.0+460} = 58.312$ dscf

$Vw(std) = 0.0471(176.9) = 8.332$ scf

$Bws = \frac{8.332}{8.332+58.312} = .125$

$Md = 0.44(40)+0.32(16.0)+0.28(\text{—}+800) = 29.28$ lb/lb/mole

$Ms = (29.28)(1-.125)+18(.125) = 27.87$ lb/lb-mole

$Vs = 85.49(0.84)(0.148)\sqrt{\frac{428.8+460}{(29.29)(27.87)}} = 11.090$ ft/sec

$As = \frac{(\pi)(110)^2}{(4)(144)} = 66.00$ ft^2

$Qs = 60(11.090)(66.00) = 43,916$ acfm

$Qs(std) = (43,916)(1-0.125)17.64\frac{29.29}{428.8+460} = 22,338$ dscfm

$An = \frac{(\pi)(.520)^2}{(4)(144)} = .00147$ ft^2

$I = \frac{1.667(428.8+460)\left[(0.00267(176.9))+\left(\frac{59.456}{70.0+460}(29.37)+(0.07355)(0.925)\right)\right]}{(120)(11.09)(29.29)(.00147)} = 97.6\%$

$C's = 0.0154\frac{\text{[illegible]}}{58.312} = \text{[illegible]}$ gr/dscf

$E = 0.00857(\quad)(\quad) = \quad$ lb/hr

$\text{lb/mmBTU} = \frac{\text{lb/hr}}{\text{mmBTU}} = \quad$ lb/mmBTU

BCM

Plant _____ Calculator _____

Location _____ Date _____

Test Date _____

Run No. _____

SUMMARIZED DATA

Y	=		Vm (std)	=	dscf
Vm	=	cf	Vw (std)	=	scf
Pb	=	in. Hg	Bws	=	
ΔH	=	in. H_2O	Md	=	wet-lb/lb-mole
Tm	=	^oF	Ms	=	dry-lb/lb-mole
Vwc	=	$ml H_2O$	Vs	=	fps
$\%CO_2$	=		As	=	ft^2
$\%O_2$	=		Qs	=	acfm
%CO	=		Q_s(std)	=	dscfm
$\%N_2$	=		An	=	ft^2
Cp	=		I	=	
$\sqrt{\Delta p}$	=	H_2O	C's	=	gr/dscf
Ts	=	^oF	E	=	lbs/hr
Ps	=	in. Hg	lb/mmBTU	=	lb/mmBTU
Ds	=	in.			
Dn	=	in.			
Θ	=	min.			
Wt	=	mg.			

BCM

Plant-
Location-
Test date-
Run No.-

Calculator-
Date-

EPA METHOD 5 CALCULATIONS

$$Vm(std)= 17.64(\quad)(\quad)\frac{\quad+(0.07355)(\quad)}{\quad+460}=\quad dscf$$

$$Vw(std)=0.0471(\quad)=\quad scf$$

$$Bws=\frac{\quad}{\quad+\quad}=\quad$$

$$Md=0.44(\quad)+0.32(\quad)+0.28(\quad+\quad)=\quad lb/lb/mole$$

$$Ms=(\quad)(1-\quad)+18(\quad)=\quad lb/lb\text{-}mole$$

$$Vs=85.49(\quad)(\quad)\sqrt{\frac{\quad+460}{(\quad)(\quad)}}=\quad ft/sec$$

$$As=\frac{(\pi)(\quad)^2}{(4)(144)}=\quad ft^2$$

$$Qs=60(\quad)(\quad)=\quad acfm$$

$$Qs(std)=(\quad)(1-\quad)17.64\frac{\quad}{\quad+460}=\quad dscfm$$

$$An=\frac{(\pi)(\quad)^2}{(4)(144)}=\quad ft^2$$

$$I=1.667(\quad+460)\frac{\left[0.00267(\quad)\right)+\left(\frac{\quad}{\quad+460}(\quad)+(0.07355(\quad)\right]}{(\quad)(\quad)(\quad)(\quad)}=\quad$$

$$C's=0.0154\frac{\quad}{\quad}=\quad gr/dscf$$

$$E=0.00857(\quad)(\quad)=\quad lb/hr$$

$$lb/mmBTU=\frac{\quad lb/hr}{mmBTU}=\quad lb/mmBTU$$

BCM

Plant- [illegible]
Location- [illegible]
Test date- [illegible]
Run No.- 3

Calculator- [illegible]
Date- [illegible]

EPA METHOD 5 CALCULATIONS

Vm(std)= 17.64( )( ) / (84.6 +460) +(0.07355)( )= dscf

Vw(std)=0.0471( )= scf

Bws= / + = 0.135

Md=0.44( )+0.32( )+0.28(+)= 29.28 lb/lb/mole

Ms=(29.28)(1-0.135)+18(0.135)= 27.67 lb/lb-mole

Vs=85.49( )( ) $\sqrt{\quad / (\quad)(\quad)}$ = 13.65 ft/sec

As= $\frac{(\pi)(\quad)^2}{(4)(144)}$ = ft^2

Qs=60(13.65)( )= acfm

Qs(std)= ( )(1-)17.64 / +460 = dscfm

An= $\frac{(\pi)(\quad)^2}{(4)(144)}$ = ft^2

I=1.667(+460) [(0.00267( ))+(/ +460)(29.04)+(0.07355( )] / ( )( )( )( ) =

C's=0.0154 / = gr/dscf

E=0.00857( )( )= lb/hr

lb/mmBTU= lb/hr / mmBTU = lb/mmBTU

BLANK ANALYTICAL DATA

Plant Shenango

Sample location [illegible] stack

Relative humidity ≤ 10%

Type of blank 0.7852

Liquid level at mark and container sealed Yes

Density of blank (ρa) 0.7852 g/ml

Blank volume (Va) 200 ml 11.0

Date and time of wt. 12-17-84 1646 Gross wt. 109575.5 mg

Date and time of wt. 12-20-84 0836 Gross wt. 109575.0 mg

Average gross wt. 109575.25 mg

Tare wt. 109575.7 mg

Weight of blank (ma) — .55 mg

$$Ca = \frac{ma}{Va\ \rho a} = \frac{(\quad)}{(\quad)(\quad)} = 0 \text{ mg/g}$$

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

Remarks: — .55 acceptable error

Signature of analyst Paul Fallowie

Signature of reviewer

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

ACETONE RINSE

Plant Shenango Run No. 1

Sample location No. 4 Bat No. 8 Stack

Relative humidity <10%

Density of acetone (ρa) 0.7852 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone rinse	Yes	Yes
filter(s)	Yes	Yes

Acetone rinse container no. 11 M

Acetone rinse volume (Vaw) 218 ml

Acetone blank residue concentration (Ca) _____ mg/g

Wa = Ca Vaw ρa = ( )( )( ) = 0 mg

Date and time of wt 12-20-84 0818 Gross wt 108364.8 mg

Date and time of wt 12-20-84 1830 Gross wt 108364.9 mg

Average gross wt 108364.85 mg

Tare wt 108336.8 mg

Less acetone blank wt (Wa) 0 mg

Weight of particulate in acetone rinse 33.05 mg

Filter(s) container no. 241

Date and time of wt 12-20-84 0830 Gross wt 425.3 mg

Date and time of wt 12-20-84 1834 Gross wt 425.3 mg

Average gross wt 425.55 mg

Tare wt 402.75 mg

Weight of particulate on filter(s) 22.80 mg

Weight of particulate in acetone rinse 33.05 mg

Total weight of particulate 55.85 mg

Note: In no case shall a blank residue greater than (.01 mg/g) or .001% of the weight of acetone used be subtracted from the sample weight.

Remarks: _____

Signature of analyst [illegible]

Signature of reviewer _____

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

ACETONE RINSE

Plant Shenango Run No. 2

Sample location N. 4 Bat. No. 8 Stack

Relative humidity < 10%

Density of acetone (ρa) 0.7852 g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone rinse	Yes	Yes
filter(s)	Yes	Yes

Acetone rinse container no. 11 N

Acetone rinse volume (Vaw) 182 ml

Acetone blank residue concentration (Ca) _____ mg/g

Wa = Ca Vaw ρa = ( )( )( ) = 0 mg

Date and time of wt 12-17-84 0814 Gross wt 112406.1 mg

Date and time of wt 12-17-84 1645 Gross wt 112406.4 mg

Average gross wt 112406.65 mg

Tare wt 112382.35 mg

Less acetone blank wt (Wa) 0 mg

Weight of particulate in acetone rinse 24.3 mg

Filter(s) container no. 345

Date and time of wt 12-14-84 0827 Gross wt 438.3 mg

Date and time of wt 12-14-84 1532 Gross wt 438.3 mg

Average gross wt 438.3 mg

Tare wt 403.85 mg

Weight of particulate on filter(s) 34.45 mg

Weight of particulate in acetone rinse 24.3 mg

Total weight of particulate 58.75 mg

Note: In no case shall a blank residue greater than (.01 mg/g) or .001% of the weight of acetone used be subtracted from the sample weight.

Remarks: _____

Signature of analyst [signature]

Signature of reviewer _____

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

ACETONE RINSE

Plant Sherango Run No. 3

Sample location No. 4 Bat [illegible] Stack

Relative humidity [illegible]

Density of acetone (ρa) [illegible] g/ml

Sample type	Sample identifiable	Liquid level at mark and/or container sealed
Acetone rinse	Yes	Yes
filter(s)	Yes	Yes

Acetone rinse container no. 110

Acetone rinse volume (Vaw) 250 ml

Acetone blank residue concentration (Ca) _____ mg/g

Wa = Ca Vaw ρa = ( )( )( ) = _____ mg

Date and time of wt 12-20-84 0817 Gross wt 105556.1 mg

Date and time of wt 12-20-84 1531 Gross wt 105556.8 mg

Average gross wt 105556.85 mg

Tare wt 105515.55 mg

Less acetone blank wt (Wa) 0 mg

Weight of particulate in acetone rinse 41.3 mg

Filter(s) container no. 340

Date and time of wt 12-17-84 0735 Gross wt 433.2 mg

Date and time of wt 12-17-84 1511 Gross wt 433.4 mg

Average gross wt 433.3 mg

Tare wt 405.05 mg

Weight of particulate on filter(s) 28.25 mg

Weight of particulate in acetone rinse 41.3 mg

Total weight of particulate 69.55 mg

Note: In no case shall a blank residue greater than (.01 mg/g) or .001% of the weight of acetone used be subtracted from the sample weight.

Remarks: _____

Signature of analyst [illegible]

Signature of reviewer _____

DRY GAS METER AND ORIFICE SYSTEM CALIBRATION

DATE Sept 18, 1984 OPERATOR Paul Judlowiec CONSOLE NUMBER 582-128

* Orifice Manometer Setting In. H_2O ΔH	Minimum Volume of Gas ft^3	WET TEST METER GAS VOLUMES AND TEMPERATURES: Initial ft^3 V_{w_i}	Initial Temp. °F T_{w_i}	Final ft^3 V_{w_f}	Final Temp. °F T_{w_f}	Net Volume ft^3 V_w	Avg. Temp. °F T_w	DRY TEST METER GAS VOLUMES AND TEMPERATURES: Initial ft^3 V_{d_i}	Final ft^3 V_{d_o}	Temp. °F T_{d_i}	Temp. °F T_{d_o}	Net Volume ft^3 V_d	Avg. Temp. °F T_d	Total Test Time Minutes θ	Barometer Reading, Inches Hg P_b
0.5	5	4.251	68.0	9.502	68.0	5.251	68.0	[illegible]	405.[illegible]	107	89	5.549	98	14.203	29.56
0.75	5	3.000	68.5	8.254	68.0	5.254	68.25	370.137	375.[illegible]	85	67	5.313	76	11.552	29.56
1.00	5	8.499	68.0	13.253	68.0	4.754	68.0	375.488	380.371	101	73	4.883	87	9.175	29.56
1.50	10	3.749	68.0	13.752	68.0	10.003	68.0	381.134	391.586	113	83	10.462	98	15.582	29.56
2.00	10	4.001	68.0	14.004	68.0	10.003	68.0	371.850	402.471	119	87	10.[illegible]	103	13.843	29.56
2.50	10														

* Check at least every 2 minutes and adjust if needed.

(1) Adjusted dry gas meter
(2) Increased orifice size

CALCULATIONS

$$\gamma = \frac{(V_w)(P_b)(T_d + 460)}{(V_d)\left(P_b + \frac{\Delta H}{13.6}\right)(T_w + 460)}$$

$$\Delta H@ = \frac{0.0317\ (\Delta H)}{(P_b)(T_{d_o} + 460)}\left[\frac{(T_w + 460)\ \theta}{(V_w)}\right]^2$$

Calc. By:

Checked By:

Date:

ΔH	GAMMA CALCULATIONS	γ	$\Delta H@$ CALCULATIONS	$\Delta H@$
0.5	$\frac{(5.25)(29.56)(98.0 + 460)}{(5.549)(29.56 + \frac{0.5}{13.6})(68.0 + 460)}$	.999	$\frac{0.0317\ (0.5)}{(29.56)(98.0 + 460)}\left[\frac{(68.0 + 460)(14.203)}{(5.25)}\right]^2$	1.96
0.75	$\frac{(5.254)(29.56)(76.0 + 460)}{(5.313)(29.56 + \frac{0.75}{13.6})(68.25 + 460)}$	.996	$\frac{0.0317\ (0.75)}{(29.56)(76.0 + 460)}\left[\frac{(68.25 + 460)(11.552)}{(5.254)}\right]^2$	2.02
1.00	$\frac{(4.754)(29.56)(87.0 + 460)}{(4.883)(29.56 + \frac{1.0}{13.6})(68.0 + 460)}$	1.006	$\frac{0.0317\ (1.0)}{(29.56)(87.0 + 460)}\left[\frac{(68.0 + 460)(9.175)}{(4.754)}\right]^2$	2.04
1.50	$\frac{(10.003)(29.56)(98.0 + 460)}{(10.462)(29.56 + \frac{1.5}{13.6})(68.0 + 460)}$	1.007	$\frac{0.0317\ (1.5)}{(29.56)(98.0 + 460)}\left[\frac{(68.0 + 460)(15.582)}{(10.003)}\right]^2$	1.95
2.00	$\frac{(10.003)(29.56)(103.0 + 460)}{(10.[illegible])(29.56 + \frac{2.0}{13.6})(68.0 + 460)}$	.999	$\frac{0.0317\ (2.0)}{(29.56)(103.0 + 460)}\left[\frac{(68.0 + 460)(13.843)}{(10.003)}\right]^2$	2.03
2.50	$\frac{(\quad)(\quad)(\quad + 460)}{(\quad)(\quad + \frac{\quad}{13.6})(\quad + 460)}$		$\frac{0.0317\ (\quad)}{(\quad)(\quad + 460)}\left[\frac{(68.0 + 460)(\quad)}{(\quad)}\right]^2$	
	AVERAGE	1.001	AVERAGE	2.00

(γ) Gamma = ratio W_t to D_t

Tol. = ±.01

$\Delta H@$ = orifice pressure differential that gives 0.75 cfm of air at 68°F and 29.92" Hg. Average $\Delta H@$ value between 1.59-2.09 is acceptable. In addition, the $\Delta H@$ must not vary by more than ±0.15 over the ΔH range of calibration of 0.5-2.50" H_2O.

THERMOCOUPLE CALIBRATION DATA SHEET

Date: 9/26/84 Thermocouple No.: T-1

Ambient Temperature: 77.5 °F Barometric pressure: 29.48 " Hg

Calibrator: Paul Jadlowiec Reference: Mercury-in-glass: Yes

Other: _____

Reference point No.	Source*, (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature, °F	Difference, %
1	②	77.6	79.1	2.1
2	③	212	221	4.2
3	④	352	351	0.3
			Average % difference	2.2

* Source: 1) Ice bath 3) Boiling water bath
2) Ambient 4) Heated oil bath

Percent difference

$$\frac{\text{Ref. temp. °F} - \text{thermocouple temp. °F}}{\text{Ref. temp. °F}} \times 100$$

THERMOCOUPLE CALIBRATION DATA SHEET

Date: 9/26/84 Thermocouple No.: 7-2

Ambient Temperature: 77.5 °F Barometric pressure: 29.48 " Hg

Calibrator: Paul Jadlowiec Reference: Mercury-in-glass: Yes

Other: _____

Reference point No.	Source*, (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature, °F	Difference, %
1	②	77.5	78.8	1.7
2	③	212	219	3.3
3	④	365	367	0.5
			Average % difference	1.8

* Source: 1) Ice bath 2) Ambient 3) Boiling water bath 4) Heated oil bath

Percent difference

$$\frac{\text{Ref. temp. °F} - \text{thermocouple temp. °F}}{\text{Ref. temp. °F}} \times 100$$

TYPE S [illegible] TUBE INSPECTION DATA FORM

DATE: 9/7/84
TECH.: P JADLOWIEC

Pitot tube assembly level? ✓ yes ___ no

Pitot tube openings damaged? ___ yes (explain below) ✓ no

α_1 = 0.0 ° (<10°), α_2 = 0.0 ° (<10°), β_1 = 0.0 ° (<5°),
β_2 = 0.0 ° (<5°)

γ = 10 °, θ = 10 °, A = .95 cm (in.)

z = A sin γ = .017 cm (in.); <0.32 cm (<1/8 in.),
w = A sin θ = .017 cm (in.); <.08 cm (<1/32 in.)

P_A 1.48 cm (in.) P_b 1.53 cm (in.)

D_t = 3.01 cm (in.)

Comments: _____

Calibration required? ___ yes ✓ no

N. [illegible]
DATE: 9/7/[illegible]
TECH.: P JADOWSKI

TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot tube assembly level? ✓ yes ____ no

Pitot tube openings damaged? ____ yes (explain below) ✓ no

α_1 = 0.0 ° (<10°), α_2 = 0.0 ° (<10°), β_1 = 0.5° (<5°),

f_2 = 1.0 ° (<5°)

γ = 0.0 °, θ = 0.0 °, A = .95 cm (in.)

z = A sin γ = 0 cm (in.); <0.32 cm (<1/8 in.),

w = A sin θ = 0 cm (in.); <.08 cm (<1/32 in.)

P_A 1.20 cm (in.) P_b 1.21 cm (in.)

D_t = 2.41 cm (in.)

Comments: ____

Calibration required? ____ yes ✓ no

BALANCE CALIBRATION CHECK LOG

Standard Weights (mg)

Date	10	50	100	200	500	1,000	10,000	50,000
9/24/84	9.7	49.7	99.5	199.6	499.4	1,000.5	10,000.0	50,000.0
11/5/84	9.9	49.7	99.5	199.7	499.4	1,000.4	10,000.2	50,000.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

BAROMETER CALIBRATION LOG

DATE	MERCURY BAROMETER	TEST BAROMETER	ADJUSTED (YES/NO)
8/16/84	29.70	29.68	YES
9/7/84	29.55	29.66	YES
9/19/84	29.64	29.64	No
9/25/84	29.26	29.25	YES

NOZZLE CALIBRATION

Date 12/11/84 Calibrated by Paul Jedlowiec

Nozzle identification number	D_1, in.	D_2, in.	D_3, in.	ΔD, in.	D_{avg}
	Shenango Coke Oven Battery No. 4, Stack No. 8 - Test of 12/84				
Probe 7-1	.518	.520	.522	.004	.520
Probe 7-2	.524	.525	.526	.002	.525

where:

$D_{1,2,3}$ = nozzle diameter measured on a different diameter, in. Tolerance = measure within 0.001 in.

ΔD = maximum difference in any two measurements, in. Tolerance = 0.004 in.

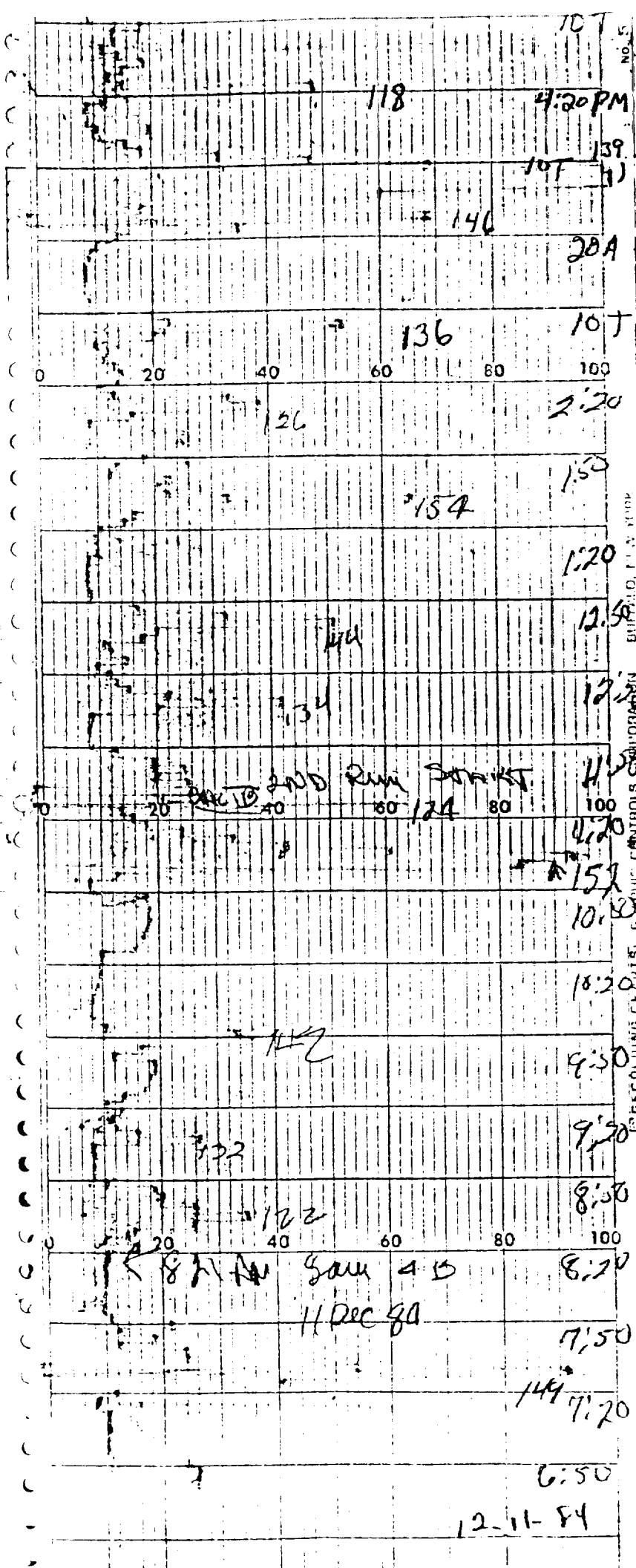
D_{avg} = average of D_1, D_2, and D_3.

Nozzle calibration data.

BCM

APPENDIX E

PROCESS DATA


10T
118
4:20PM
139
10T
146
20A
136
10T
0 20 40 60 80 100
2:20
126
1:50
154
1:20
12:50
144
12:20
134
2ND Run Start
124
4:20
152
10:50
10:20
9:50
9:20
132
8:50
122
0 20 40 60 80 100
8:20
11 Dec 84
7:50
149
7:20
6:50
12-11-84
RECORDING CHARTS GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

SEENANGO INCORPORATED

322

BA[illegible] 4 12 - 11 [illegible]

	OVEN NO.	TIME PUSHED	TIME CHARGED	TO PUSH		OVEN NO.	TIME PUSHED	TIME CHARGED	TO PUSH		OVEN NO.	TIME PUSHED	TIME CHARGED	TO PUSH
1	149	7:05	7:[illegible]	5[illegible]	1	146	3:10	3:25	800	1	153	11:16	11:27	360
2	13[illegible]	40		[illegible]	2	118	4:05	4:20	310	2	125	:42	12:04	240
3	122	[illegible]	8:36	[illegible]	3	12[illegible]	4:55	5:10	350	3	13[illegible]	12:16	:40	340
4	13[illegible]	9:[illegible]	9:02	[illegible]	4	135	5:30	5:45	310	4	145	1:02	1:13	2[illegible]
5	14[illegible]	38	49	[illegible]	5	148	6:05	6:25	450+	5	15[illegible]	:33	:51	2[illegible]
6	15[illegible]	10:[illegible]	11:[illegible]	[illegible]	6	121	6:45	7:05	400	6	117	2:[illegible]	2:22	2[illegible]
7	124	11:21	[illegible]	[illegible]	7	131	7:15	7:30	190	7	127	:35	:46	27[illegible]
8	134	12:0[illegible]	12:04	[illegible]	8	141	8:15	8:30	300	8	137	3:46	4:10	280
9	144	[illegible]	12:30	[illegible]	9	151	9:55	9:10	310	9	147	4:18	:33	200
10	154	1:[illegible]	1:[illegible]	4[illegible]	10	[illegible]	9:50	10:05	840	10	119	:48	5:08	280
11	126	0:00	2:[illegible]	200	11	127	10:20	10:35	200	11	129	5:25	:58	290
12	136	35	50	300	12	143	:46	:57	260	12	149	6:13	:35	390
13					13					13				
14			12		14			12		14			12	
15					15	139	—	8:35	—	15				
16					16					16				
17					17					17				
18					18					18				
19					19					19		[illegible]		
20					20					20				
21					21					21				
22					22					22				
23					23					23				
24	S Mascellano				24		Moyouchi			24				
25					25					25				
26					26					26				
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49					49					49				
50					50					50				

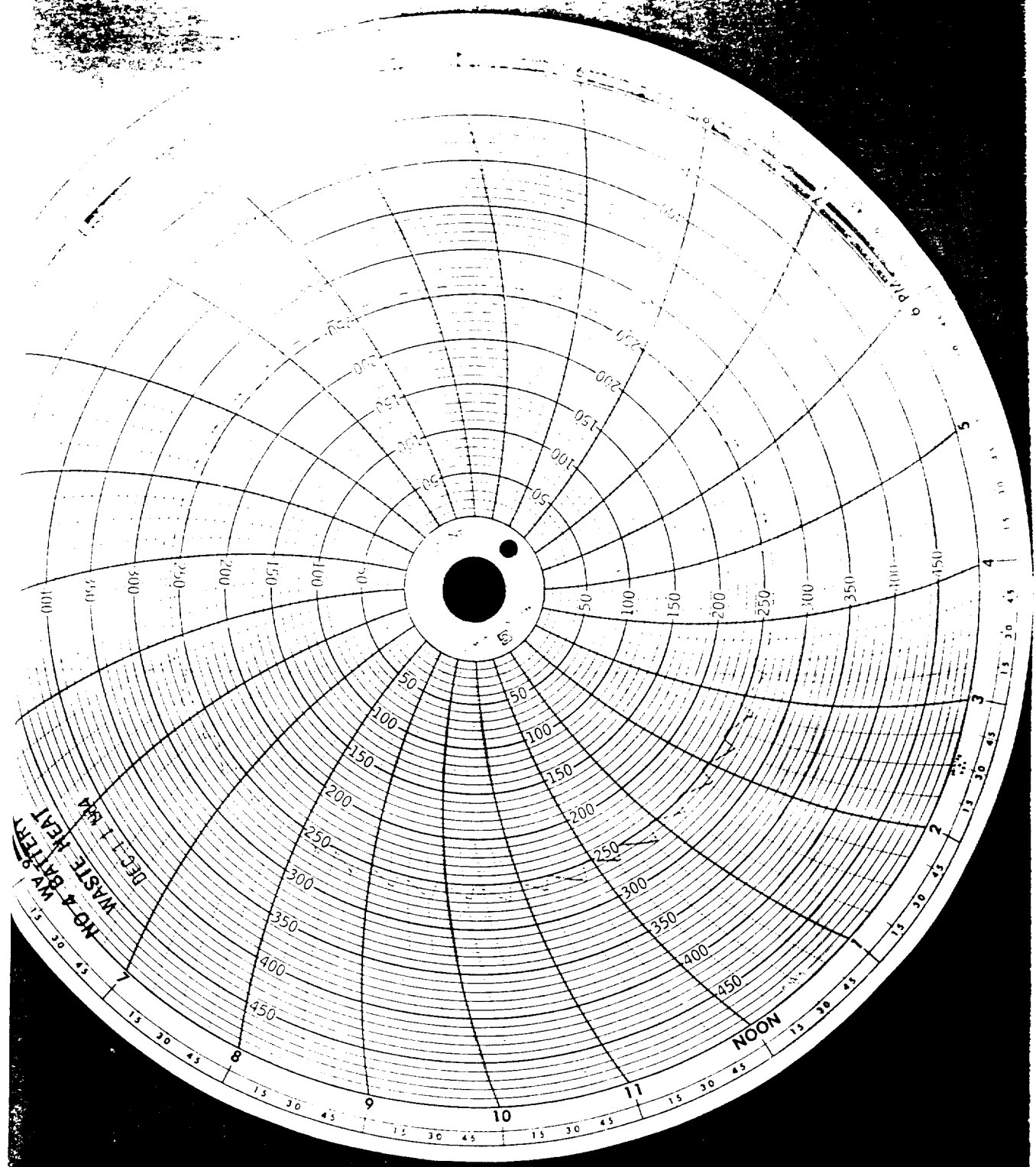
COAL	COAL	COAL
CHARGE	CHARGE	CHARGE
SPILLAGE	SPILLAGE	SPILLAGE
FOREMAN [illegible]	FOREMAN	FOREMAN [illegible]
REMARKS:	REMARKS:	REMARKS:

[illegible] (36)

NO 4 BATTERY
CROSSOVER PRESS
PUSHER SIDE
DEC 11 1984
6 AM
NOON
6 PM
GRAPHIC CONTROLS CORPORATION
MM WATER
HS 325

MIDNIGHT
NOON
6 AM
GRAPHIC CONTROLS CORPORATION
BUFFALO NEW YORK
MM WATER
HS 325
NO 4 BATTERY
CROSSOVER PRESS
COKE SIDE
DEC 11 1984

MIDNIGHT
NOON
6 AM
6 PM
GRAPHIC CONTROLS CORPORATION
BUFFALO NEW YORK
MM WATER
19
H5 325
NO 4 BATTERY
CROSSOVER PRESS
COKE SIDE
DEC 11 1964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WASTE HEAT
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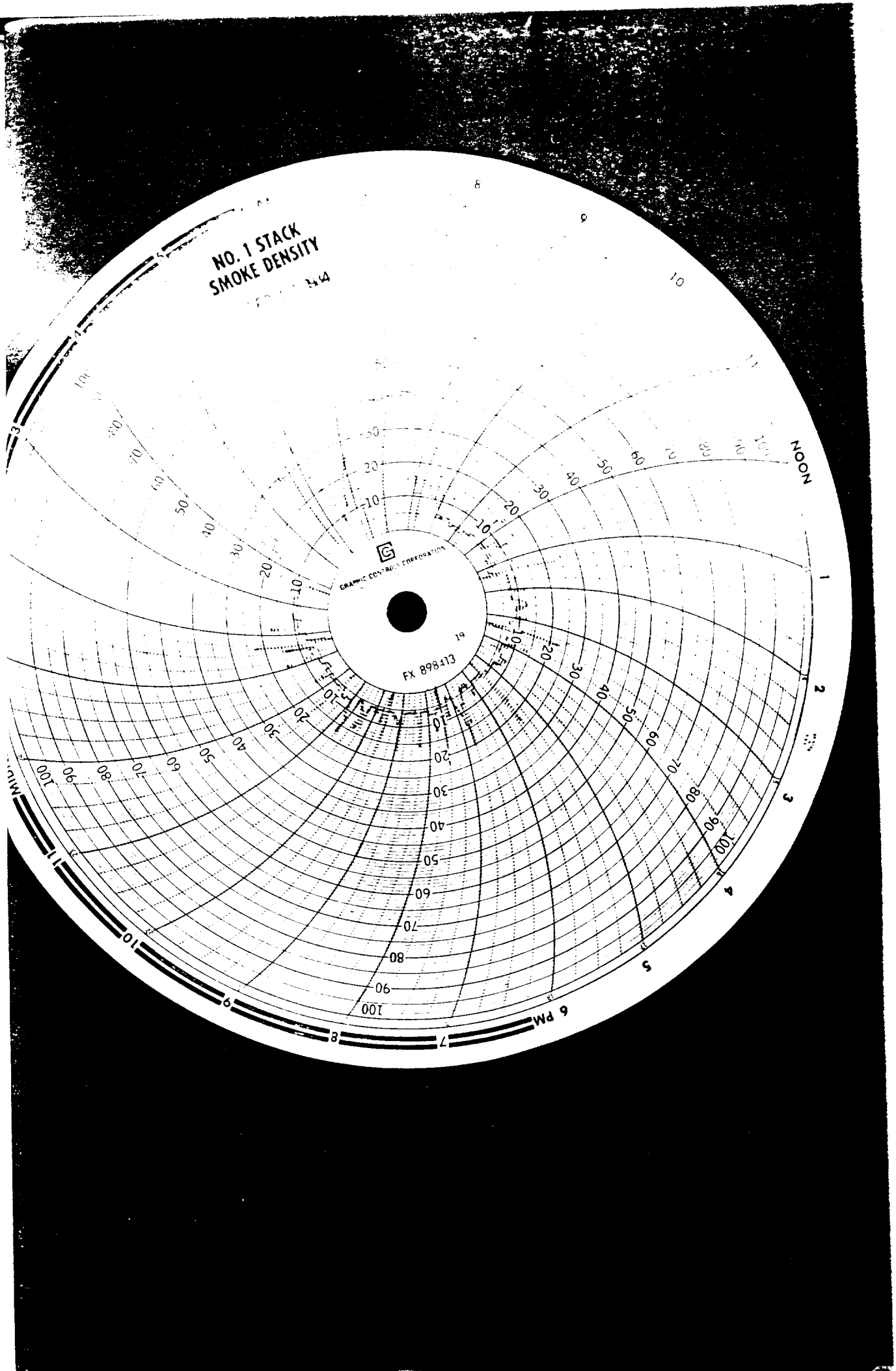
4
5
7
8
9
10
11
50
100
150
200
250
300
350
400
450

NO. 4 BATTERY
STACK DRAFT
DEC 1 1 1944
AM
MIDNIGHT
GRAPHIC CONTROLS CORPORATION

NO 4 BATTERY
FUEL GAS PRESS
MIDNIGHT
12 PM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SMOKE DENSITY
NOON
6 PM
GRAPHIC CONTROLS CORPORATION
FX 898413

FUEL GAS
DEC 1 1 MM
MIDNIGHT
GRAPHIC CONTROLS CORPORATION
TA OP1838

RECORDING CHARTS | GRAPHIC CONTROLS

PRINTED IN U.S.A.

SHENANGO INCORPORATED

NEVILLE PLANT
PUSHERS REPORT

BATTERY NO. 4 DATE 12-12 1984

	7-3					3-11					11-7			
	OVEN NO.	TIME PUSHED	TIME CHARGED	AMPS TO PUSH		OVEN NO.	TIME PUSHED	TIME CHARGED	AMPS TO PUSH		OVEN NO.	TIME PUSHED	TIME CHARGED	AMPS TO PUSH
1	122	7:05	7:26	240	1	139	3:05	3:20	360+	1	125	11:06	11:21	240
2	132	37	8:06	220	2	128	3:45	4:00	320+	2	135	:35	:45	240
3	142	8:23	38	260	3	138	4:20	4:35	260	3	145	12:03	12:22	210
4	152	9:00	9:17	280	4	148	5:00	5:15	250	4	155	:42	:54	180
5	124	40	54	260	5	121	5:30	5:45	280	5	117	1:15	1:39	220
6	134	10:10	10:25	260	6	131	6:05	6:20	200	6	127	:54	2:10	270
7	144	55	11:20	200	7	141	6:40	6:55	220	7	137	2:36	:55	230
8	152	11:25	45	320+	8	151	7:40	7:55	210	8	147	3:54	4:10	200
9	126	12:30	12:48	200	9	129	8:10	8:25	200	9	119	4:24	:39	290
10	136	1:07	1:08	280	10	133	8:50	9:05	200	10	129	5:00	5:09	300+
11	146	1:41	1:43	190	11	143	9:20	9:35	280	11	149	:29	:45	360
12	118	2:35	2:45	300+	12	153	10:00	10:15	290	12	122	6:02	:15	240
13					13					13				
14			12		14			12		14			12	
15					15					15				
16					16					16				
17					17					17				
18					18					18				
19					19					19				
20	S Marcellino				20		M			20	[illegible]			
21					21					21				
22					22			Morgan		22				
23					23					23				
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49					49					49				
50					50					50				

COAL	COAL	COAL
CHARGE	CHARGE	CHARGE
SPILLAGE	SPILLAGE	SPILLAGE
FOREMAN Singleton	FOREMAN Simmons	FOREMAN [illegible]
REMARKS:	REMARKS:	REMARKS:

36 pie

MIDNIGHT
NOON
6 PM
GRAPHIC CONTROLS CORPORATION
PUSHER SIDE
DEC 1 2

NO 4 BATTERY
CROSSOVER SIDE
COKE SIDE
DEC 1-2 1994
MIDNIGHT
GRAPHIC CONTROLS CORPORATION
BUFFALO NEW YORK
KLINGER

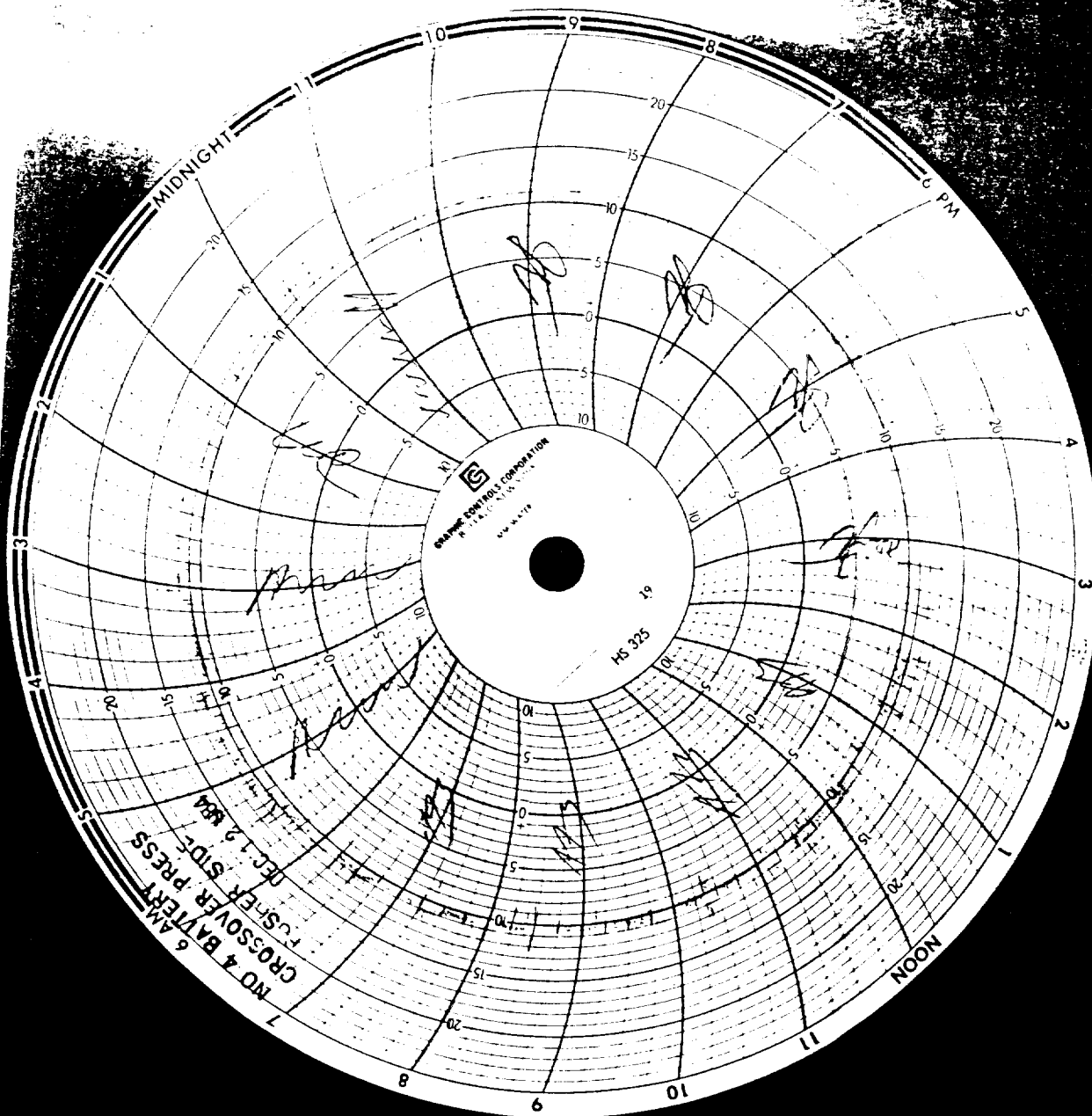
NO 4 BATTERY
WASTE HEAT
DEC 12 84
AM
MIDNIGHT
PM
BN 14150

MIDNIGHT
6 PM
NOON
6 AM
GRAPHIC CONTROLS CORPORATION
MS 3A7
NO 4 BATTERY
FUEL GAS PRESS
DEC 1 2 VDC

NO 4 BATTERY
STACK DRAFT
DEC 12 1944
6 AM
NOON
6 PM
GRAPHIC CONTROLS CORPORATION
MANUFACTURED
MS 326

NO 4 BATTERY
CROSSOVER PRESS
COKE SIDE
DEC 12
6 AM
NOON
MIDNIGHT
6 PM
HS 325

NO 4 BATTERY
GAS FOR UNDERFIRING
DEC 12 B&A
MIDNIGHT
NOON
6 PM
6 AM
BARNES CONTROLS CORPORATION
FX 898103


MIDNIGHT
6 PM
NOON
6 AM
NO 4 BATTERY
CROSSOVER PRESS
FUSHER SIDE
DEC 12 1984
GRAPHIC CONTROLS CORPORATION
HS 325