SCC # 30300306

12/3/75

AP-42 Section 12.2
Reference
Report Sect. 4
Reference 116

BETHLEHEM STEEL CORPORATION
JOHNSTOWN, PA.

PROCESS DESCRIPTION

The Bethlehem Steel Corporation operates three by-product coke oven batteries at its Franklin Works in Johnstown, Pa. These batteries are numbered 17, 18, and 19. A common coke oven gas collection system collects the gas from all three batteries and recovers coal chemicals. A portion of this gas is then burned in the coke ovens as underfire gas, while the remainder is utilized throughout the plant. Stack Tests 4175 A and B were conducted in the stack which services the combustion zone exhaust from battery 17.

Coke oven operation consists of three basic processes:

1. Coking,
2. Recovery of coal chemicals, and
3. Combustion of coke oven gas.

Coke Oven Battery 17 consists of 77 underfired retort type ovens with self-sealing doors. The battery consists of alternate coking chambers and heating chambers with the regenerate chambers under the ovens. Each coking chamber is 40' 7-5/8" (length) by 12' 5-1/4". The chamber width is tapered and varies from 16 inches on the pusher side to 20 inches on the coke side.

The heating chamber consists of 29 vertical flues. The flues are divided into two groups by a wall with 13 on the coke side and 16 on the pusher side. The two vertical flue groups are ducted together at the top of the chamber by a common horizontal flue. Underfire gas burners are located at the bottom of each flue. Each group of burners is capable of burning approximately 4,000 cubic feet per hour per oven.

Coal is charged into the coking chamber through openings located in the top of each oven. After charging, the coal is leveled and the doors and charge openings are closed and sealed. The charged coal consists of approximately 30-32 percent volatile matter. The volatile matter content is reduced to less than one percent during the coking process which lasts from 17-20 hours. After coking is completed, the coke is removed from the coking chamber by the pusher.

The pusher pushes the coke out of the oven on the coking side into the coke quench car. The coke is transported to the quench tower where the coke is cooled by a water spray. The cooled coke is then transported to the coke wharf for distribution to the blast furnace.

The volatile matter from the coal is collected in a single collection main. The main recovers coke gas from all three batteries and carries it to the by-product recovery plant. The by-product recovery consists of three processes: tar and napthalene removal, ammonia removal, and light oil recovery.

Tar removal begins in the collecting main where the gas is flushed with ammonia liquor to remove the tar. This liquor is decanted to remove the tar and then recycled to the main. The gases are then cooled in primary coolers to a temperature of 45° C and further cooled in secondary coolers to a temperature of 30° C. These gases are then ducted into an electrostatic precipitator to remove any remaining tars and napthalene. After leaving the precipitator, the gases then enter the ammonia removal section of the by-product recovery system where the ammonia is removed as ammonia sulfate by scrubbing the gas with a weak sulfuric acid solution.

Finally, the gas is treated in a light oil absorber to remove the light oil from the gas.

A process flow diagram is shown in Figure I.

A typical production rate for the by-product recovery plant is shown in Table I.

BETHLEHEM STEEL CORPORATION
JOHNSTOWN, PA.

TABLE I

BY-PRODUCT RECOVERY PLANT PRODUCT RATE

Material Recovered	Rate
Tar and Napthalene	35,268 gallons per day
Ammonia Sulfate	45.5 tons per day
Light Oil	14,149 gallons per day
Coke Oven Gas	50,256,000 cu. ft. per day

After treatment in the by-product recovery system, the gas consists primarily of hydrogen and hydrocarbons and has a heating value of approximately 530 BTU's per cubic foot. Approximately 40% of the gas is distributed to the coke ovens and burned as underfire gas, while the remainder is distributed throughout the plant as fuel.

Coke oven gas is burned in the heating chambers to provide heat for the coking chambers. Ambient air is drawn through the regenerative chamber on the pusher side into the 16 vertical flues on the pusher side. Combustion occurs and the hot effluent is drawn over and downward through the 13 vertical flues on the coke side and down into the coke side regenerative chamber. Every 30 minutes, the ambient air flow direction is reversed so that the combustion air is always preheated by a hot regenerative chamber. All 77 ovens are reversed at the same time.

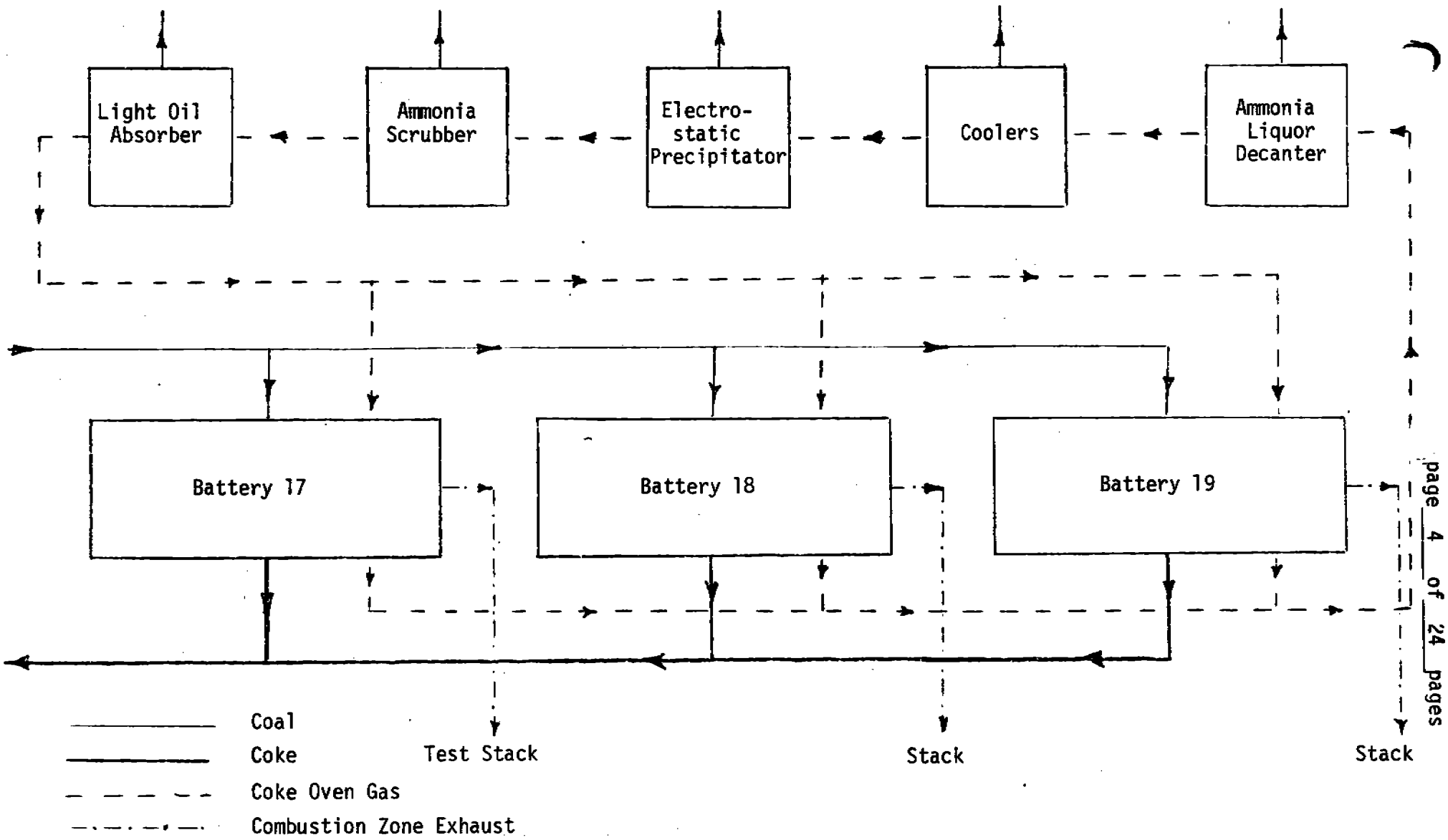
On both the pusher side and the coke side outlets of the regenerative chambers, there is a flue for the exhaust gas flow to the stack. The flue is opened in the direction of flow so that the exhaust gas is drawn by natural draft to the combustion zone exhaust stack. Flow in the flues are regulated by a damper. A partial cross-sectional view of the heating chamber and coke chamber are shown in Figure II.

The exhaust gases from Coke Oven Battery 17 are exhausted to the atmosphere through a 198 inch diameter stack having an exit point approximately 200 feet above grade.

BETHLEHEM STEEL CORPORATION
JOHNSTOWN PLANT

FIGURE I

PROCESS FLOW DIAGRAM



BETHLEHEM STEEL CORPORATION
JOHNSTOWN, PA.

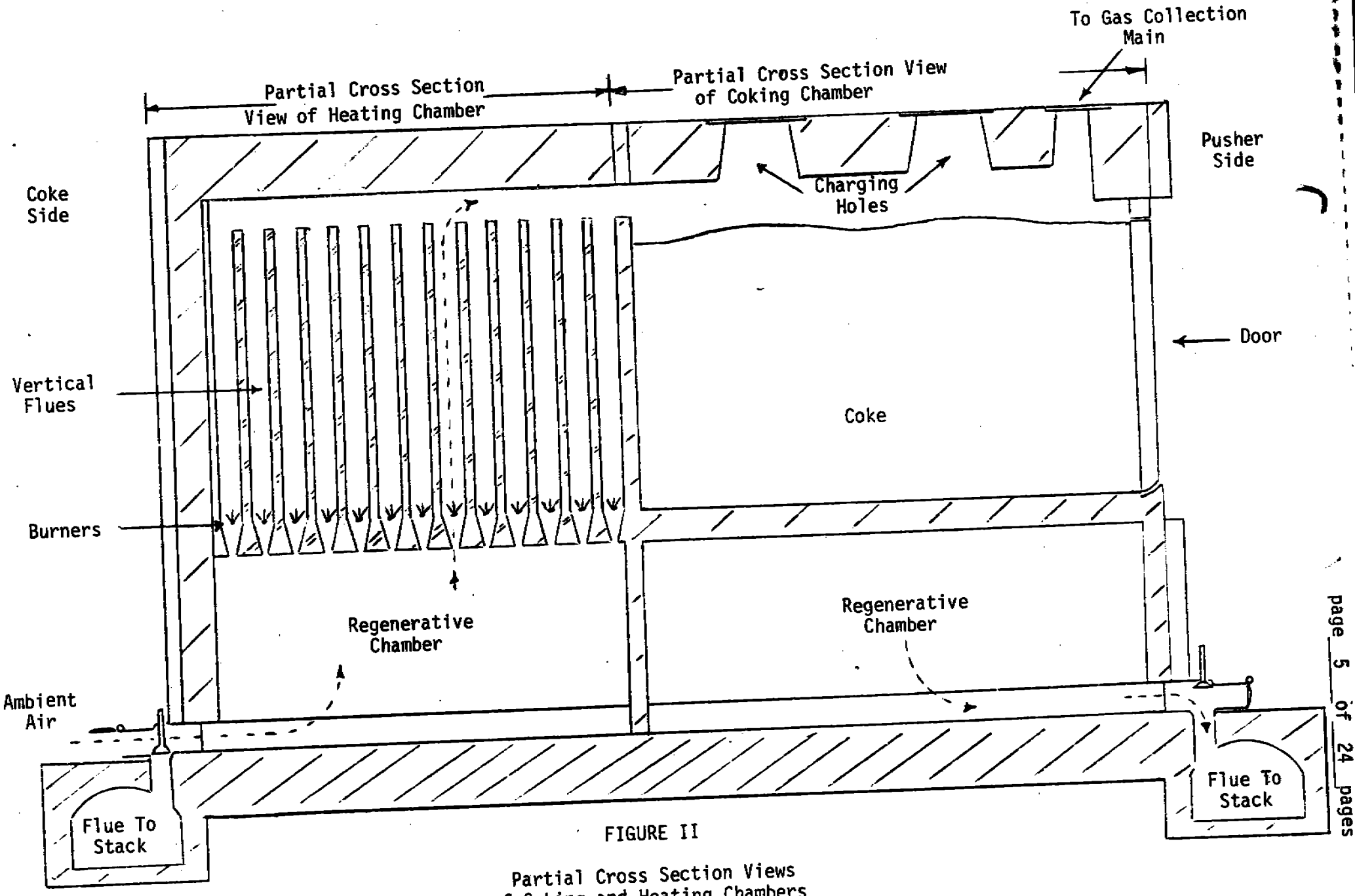


FIGURE II

Partial Cross Section Views
of Coking and Heating Chambers

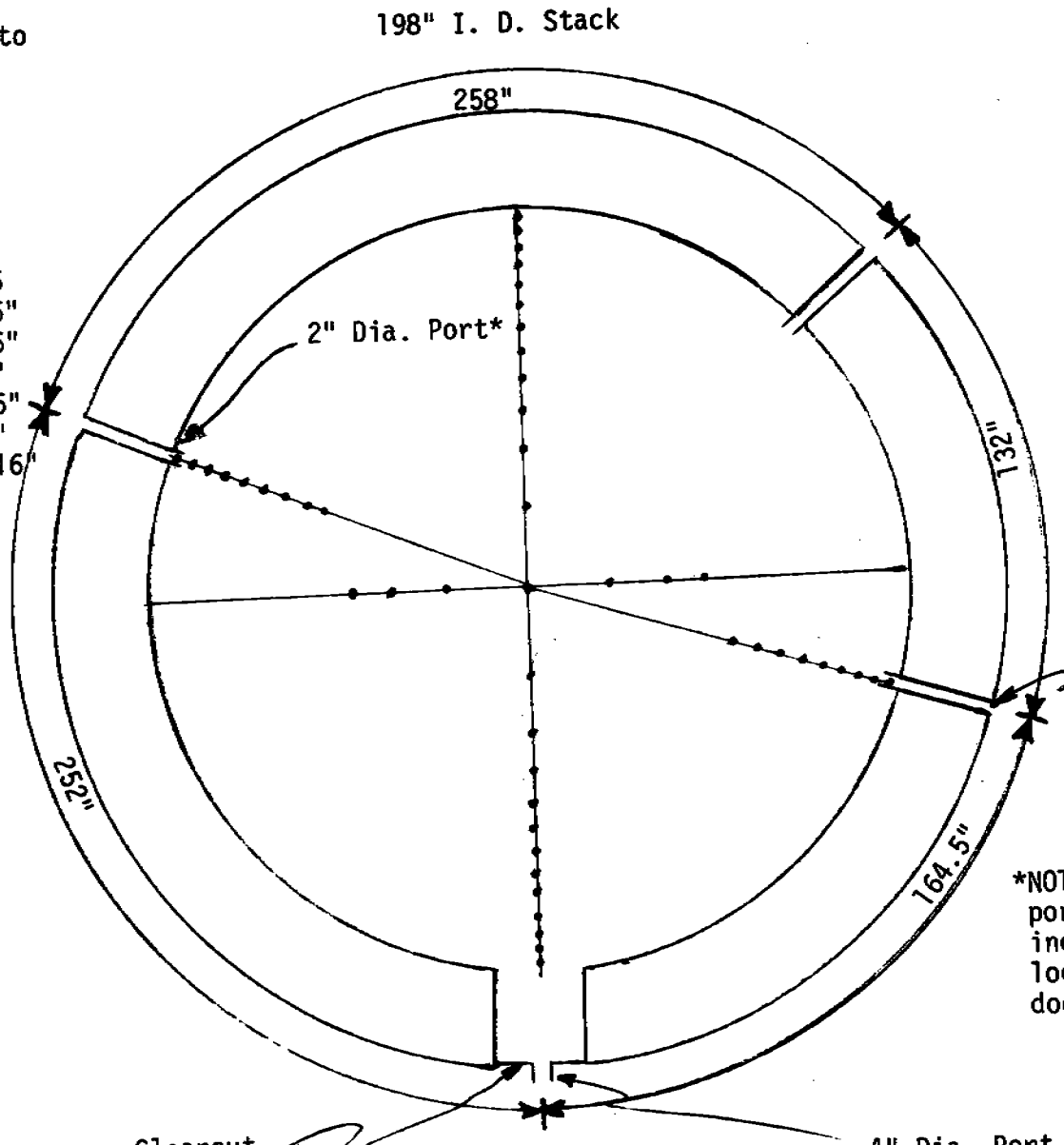
FIGURE III

BETHLEHEM STEEL CORPORATION
JOHNSTOWN, PA.

COKE OVEN BATTERY NO. 17 STACK

Distance from Inside Wall to Sampling Point:

1. 2 3/16"	2. 6 5/16"
3. 10 7/8"	4. 15 5/8"
5. 20 13/16"	6. 26 1/8"
7. 31 7/8"	8. 38 7/16"
9. 45 9/16"	10. 53 7/8"
11. 63 15/16	12. 78 13/16
13. 119 3/16"	14. 134 1/16"
15. 144 1/8"	16. 152 7/16"
17. 159 9/16"	18. 166 1/8"
19. 171 7/8"	20. 177 3/16"
21 182 3/8"	22. 187 1/8"
23. 191 11/16"	24. 195 13/16"



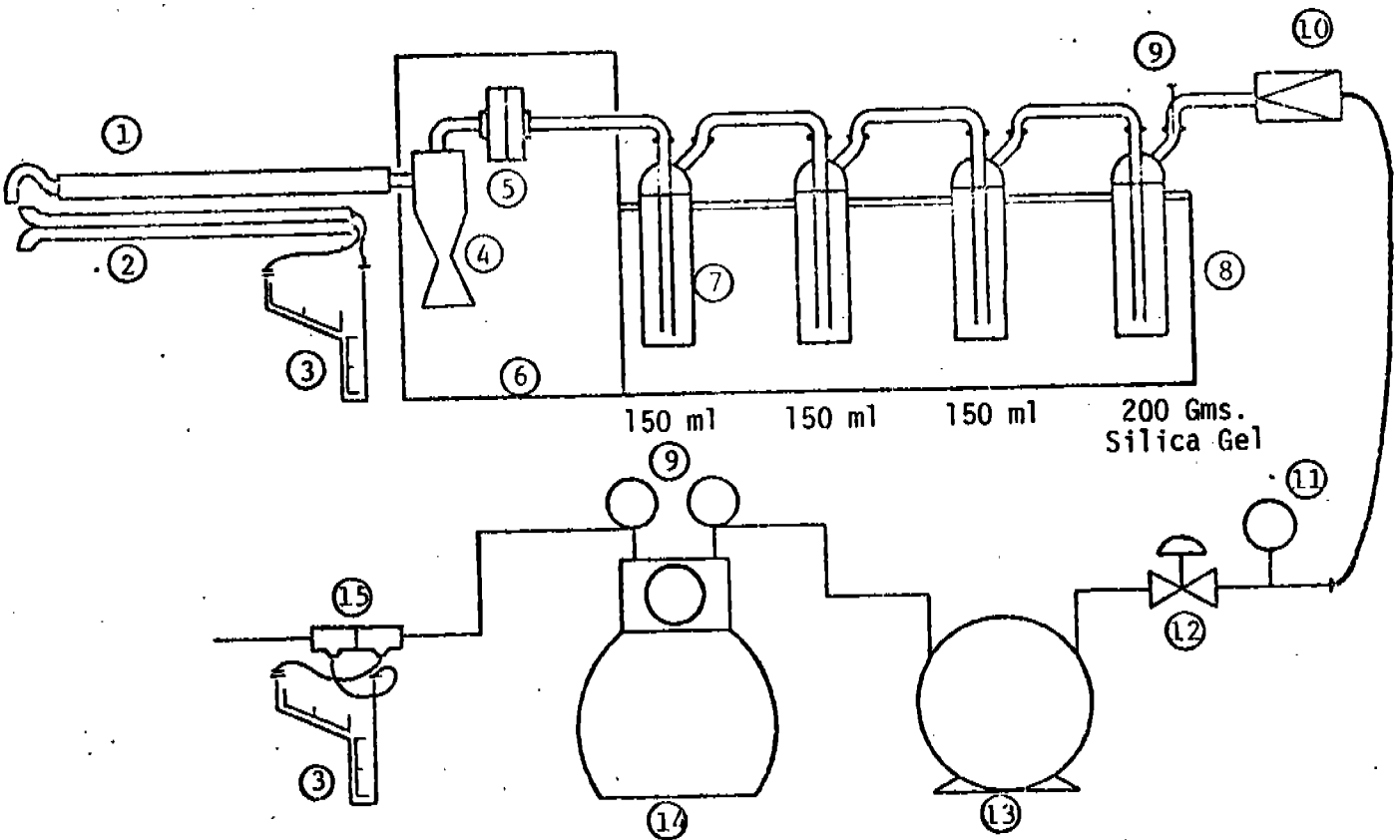
*NOTE: 2 inch Dia. traverse ports were approximately 12 inches below the sample port located in the stack cleanout door.

Commonwealth of Pennsylvania
Department of Environmental Resources
Bureau of Air Quality

Test No. 4175A

SAMPLING APPARATUS

Date 12/3/75



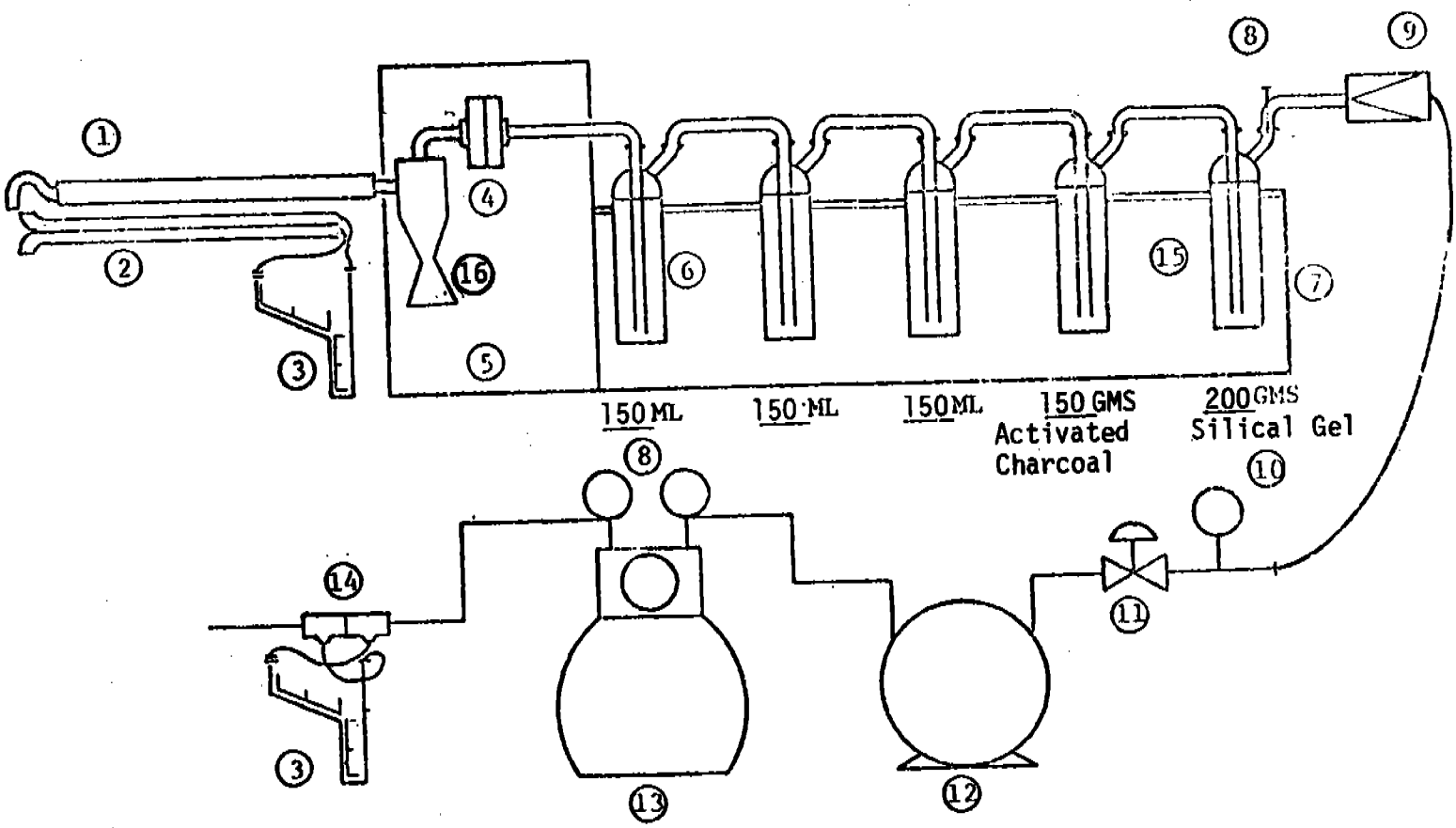
1. Sample Probe and Tubing (Teflon Lined)
2. "S" Type Pitot Tube
3. Inclined Manometer
4. Cyclone and Flask
5. 5 Inch Dia. Glass Fiber Filter
6. Heated Sample Box
7. Impinger
8. Ice Bath Container
9. Thermocouple
10. Check Valve
11. Vacuum Guage
12. Valves To Control Gas Flow Rate
13. Leak Free Pump
14. Dry Gas Meter
15. Orifice Meter

Impinger Solution: Distilled H_2O

Test No. 4175B

SAMPLING APPARATUS

Date 12/3/75



1. Sample Probe and Tubing (Teflon Lined)
2. "S" Type Pitot Tube
3. Inclined Manometer
4. 5 Inch Dia. Glass Fiber Filter
5. Heated Sample Box
6. Impinger
7. Ice Bath Container
8. Thermocouple
9. Check Valve
10. Vacuum Guage
11. Valves To Control Gas Flow Rate
12. Leak Free Pump
13. Dry Gas Meter
14. Orifice Meter
15. Silica Gel
16. Cyclone and Flask

H720.686 REV. 9-71

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
AIR QUALITY AND NOISE CONTROL

GAS VOLUME DATA
PRELIMINARY TRAVERSE

TEST NO. 4175 A & B

DATE 12/3/75

NAME OF FIRM Bethlehem Steel Corporation, Johnstown, Pa.

SAMPLE STATION Sampling port and traverse ports located in stack approximately 10 feet above grade.

TIME	POINT	V. H.	T °F.	VEL FT/SEC
11:00 AM	S-1	0.031	430	15.2
	2	0.040	540	18.3
	3	0.033	589	17.1
	4	0.030	587	16.2
	5	0.029	611	16.2
	6	0.028	608	15.8
	7	0.025	609	15.0
	8	0.026	604	15.2
	9	0.029	598	16.1
	10	0.021	594	13.6
	11	0.018	590	12.6
	12	0.011	596	9.9
	13	0.017	591	12.2
	14	0.010	594	9.4
	15	0.020	596	13.3
	16	0.013	606	10.8
	17	0.014	607	11.2
	18	0.025	607	15.0
	19	0.050	605	21.2
	20	0.025	603	14.9
	21	0.017	604	12.3
	22	0.011	605	9.9
	23	0.013	605	10.8
	24	0.016	602	12.0

TIME	POINT	V. H.	T °F.	VEL FT/SEC
11:20 AM	E-1	*		
	2	0.040	329	16.3
	3	0.035	458	16.4
	4	0.020	478	12.6
	5	0.020	579	13.2
	6	0.010	609	9.5
	7	0.0	613	0.0
	8	*		
	9	*		
	10	0.012	592	10.3
	11	0.000	588	0.0
	12	0.007	595	7.9
	13	0.028	601	15.8
	14	0.03	602	16.4
	15	0.032	601	16.9
	16	*		
	17	*		
	18	0.035	608	17.7
	19	0.037	615	18.3
	20	0.065	597	24.0
	21	0.058	590	22.6
	22	0.054	470	20.6
	23	0.030	490	15.5
	24	*		

$P_{Barometric}$ = 29.02 in. Hg

P_{Static} = - 1.9 in. H_2O

* Velocity and temperature values could not be determined.
** Procedure for determining velocities included in discussion

TRAVERSE VELOCITY 13.9 ** FT./SEC.

REFERENCE POINT VELOCITY _____ FT./SEC.

FLUE FACTOR (TRAVERSE/REF. PT.) _____

PITOT CORRECTION FACTOR 0.85

GAS DENSITY CORRECTION FACTOR 1.02

CORRECTED TRAVERSE VELOCITY -

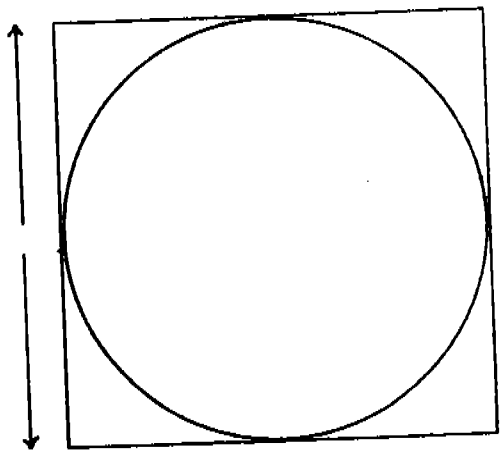
13.9 x 0.85 x 1.02 x _____ = 12.0 FT./SEC.

AREA OF FLUE 213.8 SQ. FT. AV. FLUE TEMP. 576 °F.

VOL. = 12.0 FT./SEC. x 213.8 SQ. FT. x 60 = 153,900 CFM

VOL. = 153,900 CFM x $\frac{530^{\circ}R}{1036^{\circ}R}$ x $\frac{28.88 \text{ in.Hg.}}{29.92 \text{ in.Hg}}$ = 76,000 SCFM

Vol = 76,000 (100 - 12.8% H_2O/100) = 66,300 DSCFM



Sampling point locations:
See Figure III

H730.686 REV. 9-71

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
AIR QUALITY AND NOISE CONTROL

GAS VOLUME DATA
SAMPLING TRAVERSE

TEST NO. 4175A

DATE 12/3/75

NAME OF FIRM Bethlehem Steel Corporation, Johnstown, Pa.

SAMPLE STATION Sampling port located in stack cleanout door approximately 10 ft. above grade.

TIME	POINT	V. H.	T °F.	VEL FT/SEC
12:50 PM	S-21	0.017	570	12.1
+ 5		0.017	577	12.2
+ 10		0.017	584	12.2
1:00	S-20	0.025	578	14.8
+ 5		0.025	584	14.8
+ 10		0.025	578	14.8
1:10	S-18	0.025	594	14.9
+ 5		0.025	598	14.9
+ 10		0.025	559	14.6
1:20	S-17	0.014	560	11.0
+ 5		0.014	570	11.0
+ 10		0.014	569	11.0
1:30	S-15	0.020	566	13.1
+ 5		0.020	576	13.2
+ 10		0.020	573	13.2
1:40	E-10	0.012	580	10.2
+ 5		0.012	572	10.2
+ 10		0.012	552	10.1
1:50 PM	E-15	0.032	567	16.6
+ 5		0.032	559	16.6
+ 7		0.032	564	16.6
EQUIPMENT CHECK: LEAK CHECK				
3:02	E-15	0.032	518	16.2
+ 3		0.032	536	16.4
3:05	S-10	0.021	530	13.2
+ 5		0.021	541	13.3
+ 10		0.021	543	13.3
3:15	S-9	0.029	521	15.5
+ 2		0.029	540	15.6
CHANGE FILTER: LEAK CHECK				
3:52	S-9	0.029	532	15.6
+ 3		0.029	521	15.5
+ 8		0.029	523	15.5
4:00	S-6	0.028	530	15.3
+ 5		0.028	556	15.5
+ 10		0.028	566	15.5
4:10	S-5	0.029	560	15.8
+ 5		0.029	555	15.7
+ 10		0.029	550	15.7
4:20	S-3	0.033	530	16.6
+ 5		0.033	540	16.6
+ 10		0.033	543	16.7
LEAK CHECK: PURGE IMPINGERS				
		Avg.	559	14.1

TRAVERSE VELOCITY _____ FT./SEC.

REFERENCE POINT VELOCITY _____ FT./SEC.

FLUE FACTOR (TRAVERSE/REF. PT.) _____

PITOT CORRECTION FACTOR _____

GAS DENSITY CORRECTION FACTOR _____

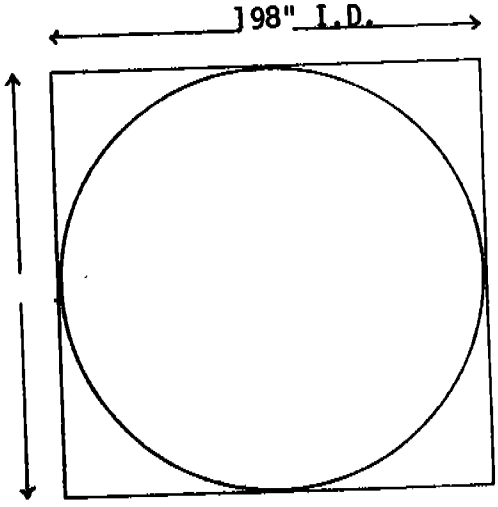
CORRECTED TRAVERSE VELOCITY -

_____ X _____ X _____ X _____ = _____ FT./SEC.

AREA OF FLUE _____ SQ. FT. AV. FLUE TEMP. _____ °F.

VOL. = _____ FT./SEC. X _____ SQ. FT. X 60 = _____ CFM

VOL. = _____ CFM X 520/ = _____ SCFM



Distance from Port to Sampling Point:

See Figure III

EB-1Q-0-0

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF AIR QUALITY AND NOISE CONTROL

CALCULATION DATA SHEET

TEST NO. 4175A

DATE: 12/3/75

NAME OF FIRM: Bethlehem Steel Corporation, Johnstown, Pa.

SAMPLE STATION: Sampling port located in stack cleanout door approximately 10 ft. above grade.

COLLECTION TRAIN FOR: Particulate

SAMPLE POINT: S-21,20,18,17,15,10,9, 6,5,3 E-10,15

SAMPLE NOZZLE DIA.: 0.561 in.

TOTAL WGT. COLLECTED (GMS): 0.9939

CONDENSATE CC.: 204

SAMPLING POINT	TIME	Meter CU. FT.	Line VAC IN. HG	Meter Avg. T°F	Orifice ΔH in. H_2O	SAMPLING POINT	TIME	Meter CU. FT.	Line VAC IN. HG	Meter Avg. T°F	Orifice ΔH in. H_2O
S-21	12:50AM	926.8	4.0	68.0	0.65	E-15	1:50PM	957.7	6.5	104.5	1.3
	+ 5	929.8	3.2	70.0	0.66		+ 5	960.7	12.0	101.0	1.0
	+ 10	931.8	3.2	92.5	0.66		+ 7	961.7	15.0	122.5	0.55
S-20	1:00	931.8	4.0	95.0	1.0		EQUIPMENT CHECK: LEAK CHECK				
	+ 5	934.9	4.5	84.0	0.86	E-15	3:02	962.1	9.5	74.0	2.3
	+ 10	937.8	4.5	86.0	0.86		+ 3	964.6	9.5	76.0	2.3
S-18	1:10	937.8	4.6	94.5	0.85	S-10	3:05	964.6	5.1	78.5	0.78
	+ 5	940.6	4.6	79.0	0.85		+ 5	967.0	5.5	88.0	0.79
	+ 10	942.9	4.6	92.0	0.86		+ 10	970.2	14.0	85.0	1.3
S-17	1:20	942.9	3.4	91.0	0.64	S-9	3:15	970.2	17.0	87.0	0.72
	+ 5	945.2	3.4	93.0	0.64		+ 2	971.2	17.0	86.5	0.75
	+ 10	947.5	3.4	90.0	0.64		CHANGE FILTER: LEAK CHECK				
S-15	1:30	947.5	4.0	94.0	0.74	S-9	3:52	971.4	6.0	97.5	1.4
	+ 5	950.2	4.1	100.0	0.74		+ 3	973.5	6.0	87.0	1.4
	+ 10	952.9	4.1	100.0	0.77		+ 8	977.0	6.0	87.0	1.5
E-10	1:40	952.9	3.0	105.5	0.62	S-6	4:00	977.0	6.0	93.5	1.4
	+ 5	955.6	3.1	103.0	0.60		+ 5	981.0	6.0	89.5	1.4
	+ 10	957.7	3.1	100.5	0.61		+ 10	984.1	6.0	95.0	1.4
						S-5	4:10	984.1	5.5	91.0	1.2
							+ 5	987.0	5.5	97.0	1.2
							+ 10	990.8	5.5	97.5	1.0
						S-3	4:20	990.8	6.7	101.0	1.6
							+ 5	939.9	6.7	103.0	1.6
							+ 10	997.6	6.0	102.5	1.4
							LEAK CHECK: PURGE IMPINGERS				
						Total	120 min	70.2			
								Avg.	5.6	92.0	1.0

ER-AQ-037
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COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF AIR QUALITY AND NOISE CONTROL

CALCULATION SHEET

TEST NO. 4175A

NAME OF FIRM		DATE
Bethlehem Steel Corporation, Johnstown, Pa.		12/3/75
SAMPLE STATION: Sampling port located in stack cleanout door approximately 10 ft. above grade.		
COLLECTION TRAIN FOR: Particulate	SAMPLE POINT: S-21,20,18,17,15,10,9 6,5,3 E-10, 15	SAMPLE NOZZLE DIA.: 0.561 in.
TOTAL WGT. COLLECTED (GMS): 0.9939	CONDENSATE CC.: 204	

CONDENSATE: .00267 × 204 × 552/29.09 = 10.3 CF

TOTAL METER VOL. = 70.2 + ______ = 70.2 DCF

METER CORR. 70.2 × 530/552 × 29.09/29.92 = 65.5 DSCF

CONCENTRATION $\frac{0.9939}{65.5}$ GM/SCF × 15.43 = 0.23 GR/DSCF

CALCULATED LOSS: 0.23 GR/DSCF x 66,300 DSCFM × 60 / 7000 = 130.7 LBS/HR

SAMPLING POINT	TIME	GAS METER CU. FT.	GAS METER VAC IN. HG	GAS METER T °F.	IMP. T °F.	SAMPLING POINT	TIME	GAS METER CU. FT.	GAS METER VAC IN. HG	GAS METER T °F.	IMP. T °F.

H730.686 REV. 9-71

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF ENVIRONMENTAL RESOURCES
AIR QUALITY AND NOISE CONTROL

GAS VOLUME DATA
SAMPLING TRAVERSE

TEST NO. 4175B

DATE

NAME OF FIRM

Bethlehem Steel Corporation, Johnstown, Pa. 12/3/75

SAMPLE STATION

Sampling port located in stack cleanout door approximately 10 ft. above grade.

TIME	POINT	V. H.	T °F.	VEL FT/SEC
6:20 PM	S-21	0.017	555	12.0
+ 5		0.017	555	12.0
+ 10		0.017	560	12.1
6:30	S-20	0.025	561	14.6
+ 5		0.025	571	14.7
+ 10		0.025	576	14.8
6:40	S-18	0.025	578	14.8
+ 5		0.025	576	14.8
+ 10		0.025	574	14.7
6:50	S-17	0.014	576	11.0
+ 5		0.014	570	11.0
+ 10		0.014	577	11.0
7:00	S-15	0.020	580	13.2
+ 5		0.020	586	13.3
+ 10		0.020	592	13.3
7:10 PM	S-10	0.021	591	13.6
+ 5		0.021	568	13.5
+ 10		0.021	544	13.3
7:20	S-9	0.029	530	15.5
+ 5		0.029	514	15.4
+ 10		0.029	515	15.4
	CHANGE FILTER: LEAK CHECK			
7:40	S-6	0.028	497	15.0
+ 1		0.028	470	14.8
	EQUIPMENT CHECK			
7:51	S-6	0.028	472	14.8
+ 4		0.028	464	14.8
+ 9		0.028	465	14.8
8:00	S-5	0.029	420	14.6
+ 5		0.029	413	14.6
+ 10		0.029	486	15.2
8:10	S-3	0.033	460	16.0
+ 5		0.033	454	15.9
+ 10		0.033	426	15.7
	LEAK CHECK: PURGE IMPINGERS			
		Avg.	530	14.0

TRAVERSE VELOCITY _____ FT./SEC.

REFERENCE POINT VELOCITY _____ FT./SEC.

FLUE FACTOR (TRAVERSE/REF. PT.) _____

PITOT CORRECTION FACTOR _____

GAS DENSITY CORRECTION FACTOR _____

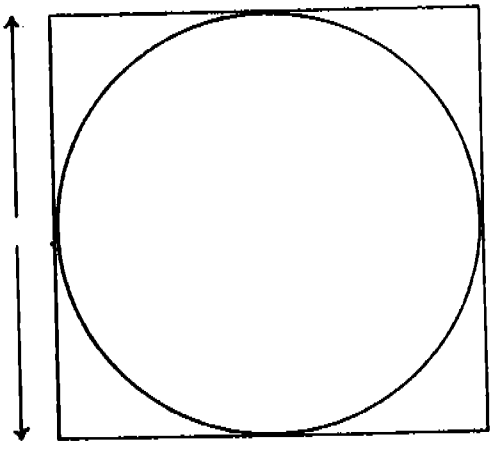
CORRECTED TRAVERSE VELOCITY -

_____ X _____ X _____ X _____ = _____ FT./SEC.

AREA OF FLUE _____ SQ. FT. AV. FLUE TEMP. _____ °F.

VOL. = _____ FT./SEC. X _____ SQ. FT. X 60 = _____ CFM

VOL. = _____ CFM X 520/ = _____ SCFM



Distance from Wall to Sampling Point:

See Figure III

EH-AQ-0-0

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF AIR QUALITY AND NOISE CONTROL

CALCULATION DATA SHEET

TEST NO. 4175B

NAME OF FIRM: Bethlehem Steel Corporation, Johnstown, Pa.

DATE: 12/3/75

SAMPLE STATION: Sampling port located in stack cleanout door approximately 10 ft. above grade.

COLLECTION TRAIN FOR: Organics - Benzo (α) Pyrene

SAMPLE POINT: S-21,20,18,17,15,10,9 6, 5, 3

SAMPLE NOZZLE DIA.: 0.561 in.

TOTAL WGT. COLLECTED (GMS): See page No. 17

CONDENSATE CC.: 168

SAMPLING POINT	TIME	Meter CU. FT.	Line VAC IN. HG	Meter Avg. T°F	Orifice ΔH in. H_2O	SAMPLING POINT	TIME	Meter CU. FT.	Line VAC IN. HG	Meter Avg. T°F	Orifice ΔH in. H_2O
S-21	6:20 PM	998.2	8.0	68.5	0.66	S-9	7:20 PM	1030.9	13.0	107.0	0.92
	+ 5	1000.5	8.7	71.0	0.67		+ 5	1034.0	15.0	111.0	1.0
	+ 10	1003.0	8.7	76.5	0.67		+ 10	1037.1	15.0	111.5	1.0
S-20	6:30	1003.0	12.0	75.5	0.82		CHANGE	FILTER:	LEAK CHECK		
	+ 5	1005.5	12.0	77.5	0.82	S-6	7:40	1037.3	15.0	107.5	1.3
	+ 10	1008.7	12.5	83.0	0.88		+ 1	1037.9	15.0	107.0	1.3
S-18	6:40	1008.7	12.5	83.5	0.89		EQUIPMENT CHECK				
	+ 5	1011.4	13.0	88.0	0.83	S-6	7:51	1037.9	15.0	104.5	1.2
	+ 10	1014.1	13.0	85.5	0.93		+ 4	1040.7	15.0	103.0	1.2
S-17	6:50	1014.1	7.6	89.5	0.65		+ 9	1043.8	14.5	100.5	1.1
	+ 5	1016.3	8.8	93.0	0.66	S-5	8:00	1043.8	15.0	102.0	1.2
	+ 10	1019.0	8.8	96.5	0.66		+ 5	1047.1	15.0	106.0	1.2
S-15	7:00	1019.0	10.5	97.5	0.76		+ 10	1050.4	15.0	105.5	1.1
	+ 5	1021.8	11.0	100.0	0.87	S-3	8:10	1050.4	15.0	106.0	1.1
	+ 10	1025.4	11.0	102.5	0.86		+ 5	1053.6	15.0	107.5	1.1
S-10	7:10	1025.4	10.0	103.0	0.71		+ 10	1056.9	15.0	105.0	1.1
	+ 5	1028.2	10.0	105.0	0.72		LEAK CHECK: PURGE IMPINGERS				
	+ 10	1030.9	10.0	107.0	0.73	Total	100 min.	58.5			
								Avg.	12.2	96.0	0.91

TEST NO. 4175B

CALCULATION SHEET

NAME OF FIRM	DATE
Bethlehem Steel Corporation, Johnstown, Pa.	12/3/75

SAMPLE STATION: Sampling port located in stack cleanout door approximately 10 ft. above grade.

COLLECTION TRAIN FOR	SAMPLE POINT	SAMPLE NOZZLE DIA.
Organics - Benzo (α) Pyrene	S-21,20,18,17,15,10,9, 6,5,3	0.561 in.
TOTAL WGT. COLLECTED (GMS)	CONDENSATE CC.	
See page No. 17	168	

Condensate: .00267 x 168 x 556/29.09 = 8.6 CF

Meter Corr. 58.5 x 530/556 x 29.09/29.92 = 54.2 DSCF

Concentration $\frac{0.2286}{54.2}$ $\frac{GM \times 15.43}{DSCF}$ = 0.065 GR/DSCF or 0.149 $\mu g/m^3$ Organics

Calculated Loss: $\frac{0.065 \text{ GR/DSCF} \times 66{,}300 \text{ DSCFM} \times 60}{7000}$ = 36.9 LBS/HR (Organics)

Concentration: $\frac{12{,}300}{54.2}$ $\frac{ng \times 35.314}{DSCF}$ = 8,010 ng/m^3 (BAP)

ER 730.033

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
AIR QUALITY & NOISE CONTROL

MOISTURE CALCULATIONS

DATE 12/3/75

	TEST NUMBERS				
1. PERCENT WATER VAPOR IN GASES	4175A				
A. Gas pressure at meter (Inches HG-ABS)	N. A.				
B. Vapor pressure of water at impinger temp. (In. HG.)	N. A.				
C. Vol. of metered gas (Cu. Ft.)	70.2				
D. Vol. of water vapor metered (BC/A, Cu. Ft.)	N. A.				
E. Vol. of water vapor condensed (Cu. Ft.)	10.3				
F. Total vol. of water vapor in gas sample (D + E, Cu. Ft.)	10.3				
G. Total vol. of gas sample (C + E, Cu. Ft.)	80.5				
H. % water vapor in sampled gas (100 F/G)	12.8				
I. % water vapor (Average Value) EPA Method IV	13.0				
2. ORSAT ANALYSIS – DRY BASIS					
A. CO_2 (%)	3.7				
B. CO (%)	0.0				
C. O_2 (%)	14.8				
D. N_2 (%)	81.5				

LABORATORY RESULTS:

Sampling Train Component	Insoluble Wt. (gms.)	Soluble Wt. (gms.)
Probe, Nozzle, Tubing Washings	0.0463	0.1650
Cyclone and Flask	0.0064	0.3968
Glass Fiber Filter No. 50169	0.1780	
Glass Fiber Filter No. 50156	0.1339	
Impingers and back half washings	0.0451	0.0224
Subtotals	0.4097	0.5842
Total	0.9939 gms.	

Condensate: 68 ml Impingers
120 ml Cyclone Flask
16 ml Silica Gel
204 Total

ER 730.033

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
AIR QUALITY & NOISE CONTROL

MOISTURE CALCULATIONS

DATE 12/3/75

1. PERCENT WATER VAPOR IN GASES	TEST NUMBERS				
	4175B				
A. Gas pressure at meter (Inches HG–ABS)	N. A.				
B. Vapor pressure of water at impinger temp. (In. HG.)	N. A.				
C. Vol. of metered gas (Cu. Ft.) (Dry)	58.5				
D. Vol. of water vapor metered (BC/A, Cu. Ft.)	N. A.				
E. Vol. of water vapor condensed (Cu. Ft.)	8.6				
F. Total vol. of water vapor in gas sample (D + E, Cu. Ft.)	8.6				
G. Total vol. of gas sample (C + E, Cu. Ft.)	67.1				
H. % water vapor in sampled gas (100 F/G)	12.8				
EPA Method IV I. % water vapor (Average Value)	13.0				
2. ORSAT ANALYSIS – DRY BASIS					
A. CO_2 (%)	3.7				
B. CO (%)	0.0				
C. O_2 (%)	14.8				
D. N_2 (%)	81.5				

LABORATORY RESULTS:

Sampling Train Component	Organic Wt. (gms.)	Benzo (α) Pyrene Wt. (ug)
Nozzle, Probe, Teflon Tubing	0.0664	2.071
Cyclone and Flask	0.0037	4.601*
Glass Fiber Filter No. 50166	0.0557	0.928
Glass Fiber Filter No. 50167	0.0542	0.820*
Impingers Nos. 1, 2, 3	0.0385	2.741*
Impinger No. 4 (Activated Charcoal)	0.0101	1.187*
Total	0.2286	12.348

*Because of interference from unknown materials, the accuracy of the result is questionable.

Condensate 86 ml Impingers

72 ml Cyclone Flask

10 ml Silica Gel

168 ml Total

EM-AQ-034
2/73

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF AIR QUALITY AND NOISE CONTROL

DATE 12/3/75

PROCESS DATA

TEST NUMBER 4175 A & B

NAME OF FIRM
Bethlehem Steel Corporation, Johnstown, Pa.

DESCRIPTION OF EQUIPMENT TESTED AND OPERATION COVERED IN TEST
Coke oven battery No. 17 combustion zone exhaust

SAMPLING STATION LOCATION
Sampling port located in stack cleanout door approximately 10 ft. above grade.

LENGTH OF PROCESS CYCLE continuous TIME CYCLE BEGINS _____ ENDS _____

TIME OF TEST: BEGINS 11:00 A.M. ENDS 8:20 P.M. CYCLE COVERAGE _____

RAW MATERIAL CHARGED DURING THIS TIME:

MATERIAL	Bituminous Coal	WT(LBS.) * 1,095,480 Cubic Ft. WT 2,659,050
MATERIAL	Coke oven gas	
MATERIAL		WT(LBS.)
MATERIAL		WT(LBS.)
MATERIAL		WT(LBS.)
SOLID FUEL CHARGED		WT(LBS.)
TOTAL POUNDS		WT(LBS.) 1,095,480

COLLECTION EQUIPMENT TYPE
None

PLANT OFFICIAL AND TITLE
T. N. Crowley, General Manager

ADDITIONAL COMMENTS
*Based on 16.11 tons per push

The operating conditions as recorded in Table I and Table II, to the best of the Department's knowledge, are normal operating conditions for Coke Oven Battery 17.

BETHLEHEM STEEL CORPORATION
JOHNSTOWN, PA.

PROCESS DATA

TABLE I
BATTERY 17 - CHARGE AND PUSH TIMES

OVEN NUMBER	PUSH TIME	CHARGE* TIME	(CHG/PUSH) COKE TIME
85	8:41 AM	8:55 AM	19:13
7	9:53	10:03	20:16
17	10:00	10:14	20:08
27	10:12	10:22	20:12
37	10:20	10:33	20:11
47	10:31	10:40	20:14
57	10:38	10:52	20:08
67	10:50	10:59	20:20
77	10:57	11:10	19:27
9	11:20	11:44	19:30
19	11:42	11:57	19:45
29	11:55	12:04 PM	19:43
39	12:02 PM	12:12	19:42
49	12:10	12:23	19:33
59	12:20	12:34	19:35
79	12:32	12:45	19:18
2	1:35	1:47	20:13
12	1:45	1:53	20:16
22	1:51	2:02	20:14
32	2:00	2:16	20:15
42	2:14	2:23	20:07
52	2:27	2:32	20:08
62	3:20	3:32	20:50
72	3:30	3:40	20:46
82	3:37	3:55	20:38
69	4:10	4:42	20:08
4	4:40	4:53	20:31
14	4:50	5:02	20:33
24	5:00	5:14	20:36
34	5:12	5:22	20:40
44	5:20	5:35	20:41
54	5:32	5:47	20:47
64	5:45	6:02	20:50
74	6:00	6:12	20:28
84	6:10	6:45	20:30
6	6:42	6:55	20:40
16	6:52	7:04	20:43
26	7:00	7:13	20:40
36	7:10	7:20	19:40
46	7:17	7:32	19:30
56	7:30	7:50	19:33
66	7:50	8:10	19:38
76	8:08	8:25	19:46

*Time of Next Charge.

BETHLEHEM STEEL CORPORATION
JOHNSTOWN, PA.

TABLE II

BATTERY 17 - OPERATING PARAMETERS

TIME	FLUE GAS PRESS. IN.	FLUE GAS TEMP.	GAS VOLUME HR.	STACK DRAFT mm	WASTE HEAT TEMP.
8:15 AM	2.0	106°	285,000	19	640°
8:45	2.0	106°	285,000	19	640°
9:15	2.0	107°	285,000	19	640°
9:45	2.0	106°	285,000	19	640°
10:15	2.0	107°	285,000	19	640°
10:45	2.0	108°	285,000	19	640°
11:15	2.0	107°	285,000	19	640°
11:45	2.0	106°	285,000	19	640°
12:15 PM	2.0	106°	285,000	19	640°
12:45	2.0	106°	285,000	19	640°
1:15	2.0	106°	285,000	19	640°
1:45	2.0	105°	285,000	19	640°
2:17	2.0	105°	285,000	19	640°
2:45	2.0	106°	285,000	19	640°
3:15	2.0	104°	285,000	19	640°
3:45	2.0	105°	285,000	19	635°
4:15	2.0	105°	285,000	19	640°
6:15	2.0	106°	285,000	19	640°
6:45	2.0	106°	285,000	19	630°
7:15	2.0	105°	285,000	19	640°
7:45	2.0	106°	285,000	19	630°
8:15	2.0	106°	285,000	19	640°

NOTE: For both Tables I and II, all 77 ovens were in service and 90 pushes were scheduled for the day.

All reported data was collected by Robert Clark, Air Pollution Control Engineer, Pa. Department of Environmental Resources, Bureau of Air Quality & Noise Control, Ebensburg Office, during sampling.

ER-AQ-038
2/73

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF AIR QUALITY AND NOISE CONTROL

TEST NO. 4175 A & B

SUMMARY

DATE 12/3/75

NAME OF FIRM

Bethlehem Steel Corporation, Johnstown, Pa.

Description of Equipment Tested and Operation Covered in Test

Coke oven battery No. 17 combustion zone exhaust

	4175A	4175B
Sampling Station Location	S (21,20,18,17,15,10,9,6,5,3) E (15,10) - S (21,20,18,17,15,10,9,6,5,3)	
Average Gas Velocity (Ft./Sec.)	12.0	12.0
Area of Flue at Sampling Station (ft.2)	213.8	213.8
Flue Gas Volume (SCFM) (Dry)	66,300	66,300
Sample Nozzle Diameter (In.)	0.561	0.561
Sampling Rate at Meter (CFM)(avg.)	0.58	0.58
Total Sampling Time (Minutes)	120	100
Orifice Pressure Drop (in. H_2O)	1.0	0.91
Meter Temperature – Average (°F)	85	96
Volume of Gas Sampled, Meter Conditions (CF) (Dry)	70.2	58.5
Water Vapor Condensate (CC)	204	168
Water Vapor Volume Meter Conditions (CF)	10.3	8.6
Moisture in Gases (%)	12.8	12.8
Total Sampled Volume, Meter Conditions (CF)	80.5	67.1
Corrected Sample Volume (SCF) (Dry)	65.5	54.2
Type Material Collected	Particulate	Organics / Benzo(a) Pyrene
Total Weight Collected (GMS)	0.9939	0.2286 / 12,300 ng
Concentration Grains/SCF (Dry)	0.23	0.065 / 8,010 ng/m³
Calculated Loss (Lbs./Hr.)	130.7	36.9
% Isokinetic Sampling	99.1	96.4

REGULATORY STANDARD

4175A

Type of Material

Particulate

Allowable Loss (GR/DSCF)

0.04

COLLECTOR EFFICIENCY

Total Material to Collector (Lbs./Hr.)

Total Loss to Atmosphere (Lbs./Hr.)

Total Material Collected

COMMENTS

Approved By

L Blaine DeHaven 12/22/75

Test Conducted By

Downey, Mentzer, Nazzaro, Mills, DeHaven

Test Computed and Checked By

L. Blaine DeHaven, P. E.

BETHLEHEM STEEL CORPORATION
JOHNSTOWN, PA.

DISCUSSION

Stack Test Nos. 4175A and 4175B are conducted using standard procedures for the isokinetic collection of a particulate sample. These procedures are referenced in Chapter 139 of the Pa. Department of Environmental Resources' Rules and Regulations. Stack Test No. 4175A was performed for particulate, while 4175B was performed for organics and Benzo (α) Pyrene (BAP).

The sampling points in the 198 inch I.D. stack are shown in Figure III. Points S-1 through S-24 and E-10 through E-15 were accessed through a four inch diameter port located in the stack cleanout door while points E-2 through E-7 and E-18 through E-24 were accessed through two 2 inch diameter ports located as shown in Figure III. Points E-8, E-9, E-16 and E-17 could not be reached due to the size of the access ports. Points E-1 and E-24 were not used in the volumetric flow calculations due to the close proximity of these points to the stack wall and the inability to measure the exact protrusion distance of the port into the stack.

On December 2, 1975 a preliminary velocity traverse was conducted. Low velocities in the stack required the utilization of a capacitance head manometer capable of measuring 0.001 in H_2O. Using this device, unsteady velocity heads were encountered as were expected. Due to the difficulty in obtaining a constant velocity head reading at each point, the average velocity head was based on the median value for the point. These values were utilized for the volumetric flow rate. These initial velocity heads were also utilized to establish the isokinetic sampling rates. The velocity head monitored at each point during sampling was found to be consistent with the initial values.

A forty-two point velocity traverse was conducted in order to determine the velocity profile in the stack at the sampling location. It should be noted the two inch ports were located on a plane 12 inches below the cleanout door sample port plane. The average velocity was calculated by averaging the velocity readings and temperature for each equal concentric area, then averaging the 12 equal area averages.

A 12 point sampling program was conducted using points on both diameters. Points which appeared to yield more consistent velocity head readings and which could be accessed through the four inch diameter port were selected as sample points. Sampling was conducted for a period of 10 minutes per point for a total sampling time of 120 minutes.

During sampling at 1:57 P.M., a high pressure drop was encountered in the sample train. It was suspected that the pressure drop was due to condensate in the sample line. In an attempt to move the condensate into the flask, the flask was broken and a small portion of condensate was lost. The flask was replaced and sampling was continued. The broken flask was processed to recover any material collected in the flask.

The results of Stack Test No. 4175A indicate an actual total particulate emission rate of 130.7 pounds per hour and a total particulate concentration of 0.23 grains per dry standard cubic foot. The allowable total particulate concentration for a source with a volumetric flow less than 150,000 DSCFM according to Chapter 123 § 123.13 (C)(1) is 0.04 grains per dry standard cubic foot.

Stack Test No. 4175B was conducted using standard procedures for the isokinetic collection of a particulate sample with the impinger train modified with a extra impinger containing charcoal and placed in the sampling train prior to the silica gel impinger.

A ten point sampling program was conducted using points on one diameter which were considered to be representative of the overall flow characteristics in the stack and which could be accessed through the four inch diameter port. Sampling was conducted for a period of ten minutes per point for a total sampling time of 100 minutes.

The procedure for the recovery and analysis of the organic sample was based on the Environmental Protection Agency (EPA) Method 5 (Federal Register, Vol. 36, No. 159 - Tuesday, August 17, 1971.) The charcoal was also extracted and analyzed for organics.

A portion of the organic extract from each sampling train component was analyzed for Benzo (α) Pyrene (BAP) using an EPA procedure entitled "Tentative Method for the Determination of Benzo (α) Pyrene in Extracts of Airborne Particulates". Interferences were encountered in the thin layer chromatographic separation of the BAP. A subsequent set of samples was analyzed utilizing the EPA Method. After the initial thin layer chromatographic separation, described in the EPA Method,an additional thin layer chromatographic separation was performed utilizing a developing solution described in "An Improved Fluorometric

Method of Analysis for Benzo (α) Pyrene in Airborne Particulate", *American Industrial Hygiene Association Journal*, Lannoye and Greinke, Dec. 1974, p. 755. After the second separation of the sample, the analysis was continued as specified in the EPA Method. The utilization of the second separation eliminated the interferences from several of the samples. The results which are considered questionable are indicated on the laboratory sheet of this report. Both analytical methods mentioned in this paragraph are contained in Appendix A.

The results of Stack Test No. 4175B indicate an actual organics emission rate of 36.9 pounds per hour and an organics concentration of 0.065 grains per dry standard cubic foot. Analysis of the sample for Benzo (α) Pyrene resulted in a concentration of 8,010 ng/m^3. When the questionable results are not included in the calculation, the minimum BAP concentration is 1,940 ng/m^3.

Stack Test Nos. 4175A and 4175B are the best available data that could be obtained at this sampling location under the existing test conditions.

STACK TEST SUMMARY REPORT FOR AP42

Process: Coke Oven Underfiring Pollutant: TP, organics

Description of process that was tested:
Sampling port located in stack cleanout door

Description of control device:
ESP ck

Plant/Location: Bethlehem Steel Corp./ Johnstown PA (Franklin Works)

Reference: Report of Emission Test #17 Coke oven Battery Combustion Stack.

Test Method: EPA Method 5-organics

Test done by: PADER Test dates: 12/75

General Comments:

PM. ?

Test rating:

Run ID/ Inlet or (Outlet)	Results (attach particle sizing curve, if applicable)	Production Data (also indicate page no.)*	Comments (any unusual conditions, test problems)
PART-1	.23 gr/dscf		Avg. from 12 sample points
ORGA-1	.065 gr/dscf		Avg. from 10 sample points

* Include type of fuel for combustion stack data

REPORT ID: ✓

PLANT: Bethlehem Steel Corp.

LOCATION: Johnstown, PA

PROCESS OPERATION: Coke Oven underfiring

PROCESS DATA? Y

OTHER TEST DATA: BAP, Organics

COMMENTS (CONTROL SYSTEM): ✓

DATA:	PM10	TP	NO_2	SO_2	CO	PB	VOC
IN		1					
OUT							

SOTDAT/STEEL LIBRARY SYSTEM

Report Title:

Plant and Location: BSC, Johnstown, PA

SCC: 30300306

Testing Date(s): 12/3/75

By Whom: Penner

Stack Test Review Attached:

Reviewed by:

Problems Seen by Reviewer:

Confidentiality Status: Clear

If status is confidential, list confidential pages or sections:

Source of Determination of the Confidentiality Status: Memo entitled: "Steel Technical Support Materials", From: Edward Reich, Director DSSE. To: Tom Voltaggio

Report Encoded by:

Date Encoded:

Form Numbers:

Comments:

Title:

Plant and Location: BSC, Johnstown, PA

SCC: 30300306

Test Date: 12/3/75

By Whom: PADER

Encoded By: GL

Date Encoded: 4/18/80

Completed By:

Form No.: E00208
E00209