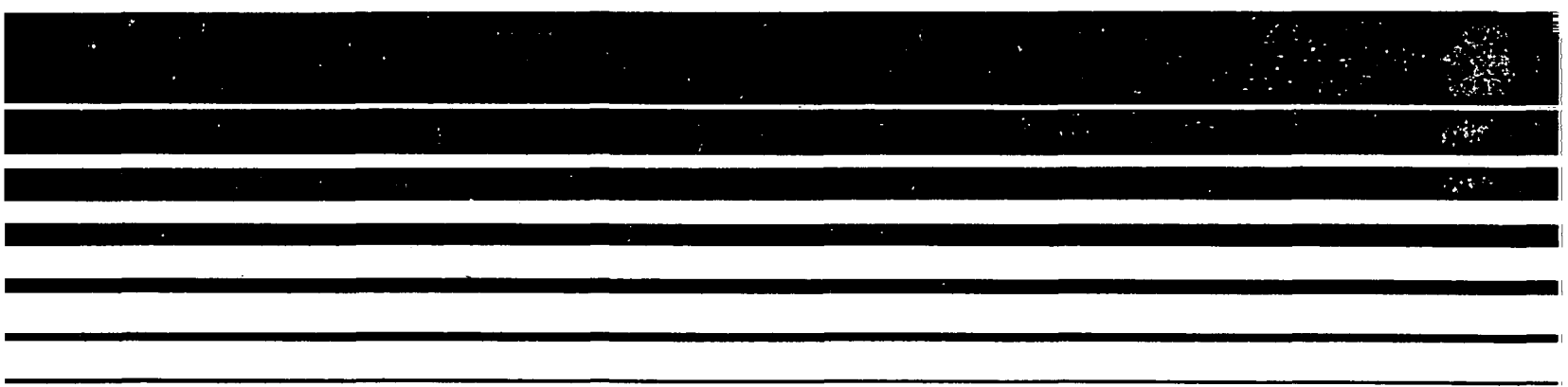


Air



Industrial Boilers

Emission Test Report General Motors Corporation Hamilton, Ohio



INDUSTRIAL BOILERS

FINAL REPORT

GENERAL MOTORS CORPORATION
FISHER BODY DIVISION
BOILER NO. 1
Hamilton, Ohio

March 1-4, 1982

Technical Directives 19 and 20

Prepared for

Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Measurement Branch
Research Triangle Park
North Carolina 27711

by

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November 1982

MONSANTO RESEARCH CORPORATION
DAYTON LABORATORY
Dayton, Ohio 45407

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SECTION 1

INTRODUCTION

Emissions from Boiler No. 1 at the General Motors Corporation, Fisher Body Division Plant in Hamilton, Ohio, were tested March 1-4, 1982 by Monsanto Research Corporation (MRC). This work was performed for the Emission Measurement Branch of the U.S. Environmental Protection Agency (EPA) under Contract No. 68-02-3547, Work Assignment No. 2.

The boiler tested is a 20,430 kg steam/hr (45,000 lb steam/hr) capacity coal-fired boiler fed by two spreader stoker units. It is equipped with multicyclone and baghouse pollution control equipment. Figure 1 is a schematic diagram of the installation showing the locations sampled.

The purpose of the sampling program was to provide background information on well-controlled industrial boilers for the development of new source performance standards. Within this framework the objectives of sampling at General Motors Corporation in Hamilton, Ohio was to determine the effect of raising the temperature of the filter and probe on an EPA Method 5 train from 120°C (248°F) to 160°C (320°F) on the amounts of particulate, sulfate, and sulfuric acid emissions measured downstream of the multicyclone and baghouse. Method 5 testing with the filter and probe at 160°C \pm 14°C (320°F \pm 25°F) will be referred to as Method 5B testing.

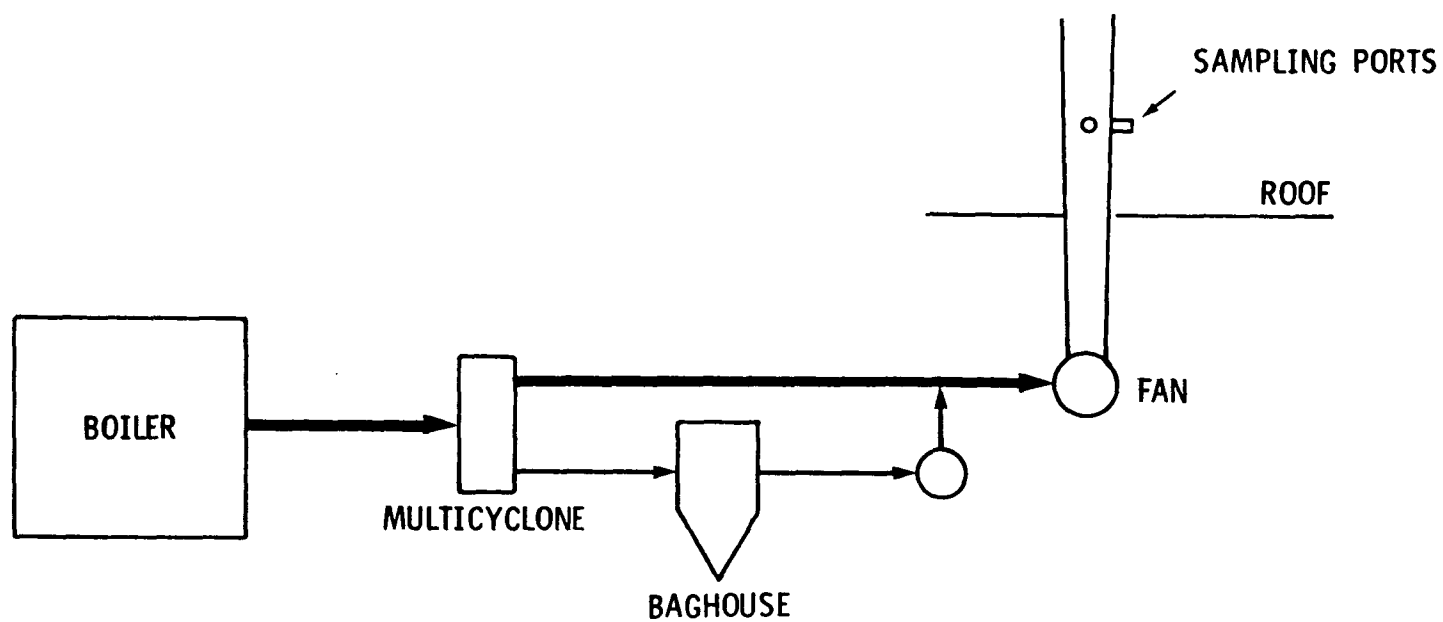


Figure 1. Schematic diagram of General Motors Corporation, Fisher Body Division boiler installation.

SECTION 2

SUMMARY OF RESULTS

DESCRIPTION OF MONITORING

Table 1 summarizes the monitoring that was performed at this plant, downstream of all pollution control equipment. Sampling consisted of three simultaneous runs of Methods 5 and 5B at approximately two-thirds boiler capacity (Runs 1, 2, and 3) and three additional runs of Method 5B at approximately 50% reduced boiler capacity (Runs 4, 5, and 6).

Heated, glass-lined sampling probes were used for all runs. In the three simultaneous runs (runs 1-3) of Methods 5 and 5B, a special dual-probe stack test system was used. The probe nozzles, each connected to a separate sampling train, were spaced 4.4 cm (1.75 in.) apart, allowing for simultaneous sampling through the same sample ports. A conventional single sample train was used for runs 4-6. Sample volumes of at least 1.7 dry standard m³ (60 dry standard ft³) were taken for all runs. The boiler was running under steady state conditions (no soot blowing, no ash unloading, etc.) during the emission testing.

The filters and dried acetone washes of the Method 5 and 5B runs were weighed to a constant weight (until the sample weight did not change more than 5 mg between successive weighings) prior to sending the samples to EPA.

Methods 1-4 were used during all Method 5 and 5B sampling runs, as in typical compliance monitoring. Plume opacity was observed according to EPA Method 9 during all sampling runs. Three additional opacity observations were made after sampling was completed and are labelled Runs 7, 8, and 9.

The coal burned was considered to be representative of normal feed. Grab samples of coal were taken before, during, and after each run and combined to make one aggregate sample. The sulfur, ash, moisture, and Btu content of each aggregate sample were determined by ASTM methods.

TABLE 1. SOURCE SAMPLING AND ANALYSES AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION IN HAMILTON, OHIO

SAMPLING AND ANALYSIS REQUIREMENTS			Contract No.: 68-02-3547			Assignment Number: 2			Technical Directive: 19 and 20		
			Company Name: GM Fisher Body Division						Company Location: Hamilton, Ohio		
			Industry: Industrial Boiler			Process: Coal-fired, spreader stoker			Control Equipment: Multi-cyclone, baghouse		
			MRC Job No. 103.1231								
Total no. of samples	Sample type	Sampling method	Sample collected by	Minimum sampling time	Minimum volume gas sampled ft ³	Initial Analysis			Final Analysis		
						Type	Method	By	Type	Method	By
3	Particulate and ORSAT at outlet	5	MRC	100	60	Velocity, temperature, H ₂ O,	1-4	MRC	Particulate	5	MRC
						CO, CO ₂ , O ₂			SO ₃ , H ₂ SO ₄	-	EPA
3	Particulate and ORSAT at outlet	5B	MRC	100	60	Velocity, temperature, H ₂ O,	1-4	MRC	Particulate	5B	MRC
						CO, CO ₂ , O ₂			SO ₃ , H ₂ SO ₄	-	EPA
3	Particulate and ORSAT at outlet	5B	MRC	100	60	Velocity, temperature, H ₂ O,	1-4	MRC	Particulate	5B	MRC
						CO, CO ₂ , O ₂			SO ₃ , H ₂ SO ₄	-	EPA
6	Coal	Grab	MRC	Simultaneous with above		-			S, Ash, Moisture, Btu	ASTM	Bowser-Morner Labs
6	Opacity	9	MRC	Simultaneous with above		Visual observation		MRC			
3	Opacity	9	MRC	After all tests were completed		Visual observation		MRC			

TEST RESULTS

The particulate emissions measured by Methods 5 and 5B are summarized in Tables 2 and 3. Totals reported for particulate emissions represent all emissions measured by weighing the Method 5 and 5B samples. Following analysis for total particulates, samples were transmitted to EPA for subsequent analysis.

Table 2 also shows the percent isokinetics for each run, which ranged between 96.3% and 102.1%. Table 3 shows the percent of the Method 5 concentrations represented by the Method 5B concentrations measured simultaneously at the same location. Particulate concentrations measured by Method 5B were between 94% and 100% those measured by Method 5.

Table 4 summarizes sampling duration, stack temperature, flow rate, static pressure, and sample volume and water content.

Table 5 summarizes integrated gas analysis results. Integrated Method 3 samples were taken from the exhaust of the Method 5B train.

Table 6 summarizes the coal analysis results for percent moisture, heat value, percent ash, and sulfur content.

Tables 7a-f summarize results of visible emissions observations according to EPA Method 9 taken during Runs 1-6. Results for three additional observations, which were taken after sampling was completed, are shown in Tables-g-i and are labelled Runs 7, 8, and 9. Complete field data sheets are provided in Appendix A.

TABLE 2. EMISSION DATA FOR GENERAL MOTORS CORPORATION,
FISHER BODY DIVISION, BOILER NO. 1 IN HAMILTON,
OHIO (METRIC UNITS) (MARCH 1-4, 1982)

Run number	Date	Sampling method	Pollutant	Average emissions			Corrected ^a to 12% CO ₂ , g/dscm	Percent isokinetic
				Actual g/dscm	kg/hr	ng/J		
1	3-2-82	5	Particulate	0.169	3.51	95.6	0.229	99.7
1	3-2-82	5B	Particulate	0.164	3.39	93.0	0.223	96.8
2	3-3-82	5	Particulate	0.184	3.89	101.3	0.245	98.7
2	3-3-82	5B	Particulate	0.171	3.54	94.7	0.228	99.2
3	3-3-82	5	Particulate	0.182	3.79	100.4	0.242	100.6
3	3-3-82	5B	Particulate	0.183	3.76	100.6	0.243	98.2
4	3-4-82	5B	Particulate	0.161	3.29	127.1	0.328	96.3
5	3-4-82	5B	Particulate	0.124	2.24	77.4	0.215	102.1
6	3-4-82	5B	Particulate	0.137	2.36	86.0	0.206	99.7

^aThis is the concentration normalized to 12% CO₂. $C = C \times \frac{12}{\%CO_2}$; where C is the measured concentration in the stack, and %CO₂ is the percent CO₂ measured in the stack.

TABLE 3. EMISSION DATA FOR GENERAL MOTORS CORPORATION,
FISHER BODY DIVISION, BOILER NO. 1 IN HAMILTON,
OHIO (ENGLISH UNITS) (MARCH 1-4, 1982)

Run number	Date	Sampling method	Pollutant	Average emissions			Corrected ^a to 12% CO ₂ , gr/dscf	Percent of Method 5 gr/dscf represented by Method 5B gr/dscf at outlet
				Actual gr/dscf	lb/hr	lb/mm Btu		
1	3-2-82	5	Particulate	0.074	7.73	0.22	0.100	
1	3-2-82	5B	Particulate	0.072	7.48	0.22	0.098	97
2	3-3-82	5	Particulate	0.080	8.57	0.24	0.107	
2	3-3-82	5B	Particulate	0.075	7.81	0.21	0.099	94
3	3-3-82	5	Particulate	0.080	8.34	0.23	0.106	
3	3-3-82	5B	Particulate	0.080	8.28	0.23	0.106	100
4	3-4-82	5B	Particulate	0.071	7.26	0.29	0.143	NA ^b
5	3-4-82	5B	Particulate	0.054	4.93	0.18	0.094	NA
6	3-4-82	5B	Particulate	0.060	5.20	0.20	0.090	NA

^aThis is the concentration normalized to 12% CO₂. $C = C \times \frac{12}{\%CO_2}$; where C is the measured concentration in the stack, and %CO₂ is the percent CO₂ measured in the stack.

^bNA = not applicable.

TABLE 4. SUMMARY OF DURATION OF SAMPLING, STACK TEMPERATURE, STACK FLOW RATE, SAMPLE VOLUME, SAMPLE WATER CONTENT, AND STATIC PRESSURE AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION, BOILER NO. 1 IN HAMILTON, OHIO

Run number	Sampling method	Duration of sampling, min	Measured stack temperature		Stack flow rate		Sample volume		Sample water content, %	Stack static pressures	
			°C	°F	dscm/min	dscf/min	dscm	dscf		cm H ₂ O	in. H ₂ O
1	5	108	218	424	347	12,250	1.9	68.6	4.2	-0.46	-0.18
	5B	108	218	424	345	12,170	1.9	67.3	4.9	-0.46	-0.18
2	5	108	217	422	353	12,450	2.0	70.3	4.2	-0.46	-0.18
	5B	108	217	422	344	12,140	1.9	67.7	7.2	-0.46	-0.18
3	5	108	218	424	347	12,240	2.0	70.4	5.3	-0.46	-0.18
	5B	108	218	424	343	12,110	1.9	66.8	6.5	-0.46	-0.18
4	5B	108	203	398	340	12,010	1.9	65.0	4.8	-0.46	-0.18
5	5B	108	196	386	302	10,670	1.8	62.2	5.8	-0.46	-0.18
6	5B	108	196	384	286	10,110	1.7	57.6	5.7	-0.46	-0.18

TABLE 5. SUMMARY OF INTEGRATED GAS ANALYSIS AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION, BOILER NO. 1 IN HAMILTON, OHIO (MARCH 1-4, 1982)

Run number	CO ₂ , %	CO, %	O ₂ , %	N ₂ , %	Dry molecular weight kg/kg mole (lb/lb mole)
1	8.8	0.0	11.2	80.0	29.9
2	9.0	0.0	10.9	80.1	29.9
3	9.0	0.0	10.9	80.1	29.9
4	5.9	0.0	13.9	80.1	29.5
5	6.9	0.0	12.1	81.0	29.6
6	8.0	0.0	12.1	79.9	29.8

6

TABLE 6. SUMMARY OF COAL ANALYSIS AT GENERAL MOTORS CORPORATION, FISHER BOD DIVISION, BOILER NO. 1 IN HAMILTON, OHIO (MARCH 1-4, 1982)

Run number	Total moisture, percent	Heating value				Ash, percent		Sulfur, percent	
		Joule/gram		Btu/lb		dry	as received	dry	as received
		dry	as received	dry	as received				
1	6.2	32,690	30,670	14,070	13,200	5.2	4.9	0.75	0.70
2	6.9	32,270	30,060	13,890	12,940	5.7	5.3	0.83	0.78
3	7.0	32,480	30,230	13,980	13,010	5.8	5.4	0.83	0.77
4	8.0	31,780	29,230	13,680	12,580	6.3	5.8	1.06	0.97
5	7.4	32,110	29,760	13,820	12,810	6.1	5.7	0.80	0.74
6	7.6	28,210	26,070	12,140	11,220	8.3	7.6	0.73	0.68

TABLE 7a. SUMMARY OF METHOD 9 VISIBLE EMISSION OBSERVATIONS
AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION,
BOILER NO. 1 IN HAMILTON, OHIO - RUN 1

Date: 3-2-82
Type of Discharge: Stack
Height of Point of Discharge: 100 ft
Wind Direction: West
Color of Plume: White
Observer Name: Dennis J. Gault
Distance from Observer to Discharge Point: 30 ft
Direction of Observer from Discharge Point: South
Height of Observation Point: 75 ft
Description of Background: Red water tower

Type of Plant: Automobile
Location of Discharge: Boiler No. 1 stack
Description of Sky: Overcast
Wind Velocity: 15-20 mph
Detached Plume: No
Duration of Observation: 225 min.

Set number	Time		Opacity	
	Start	End	Sum	Average
1	9:53	9:58	120	5
2	9:59	10:04	120	5
3	10:05	10:10	125	5.2
4	10:11	10:16	130	5.4
5	10:17	10:22	145	6.0
6	10:23	10:28	130	5.4
7	10:29	10:34	120	5
8	10:35	10:40	125	5.2
9	10:41	10:46	135	5.6
10	10:47	10:52	145	6.0
11	10:54	10:59	130	5.4
Test began				
12	11:00	11:05	130	5.4
13	11:06	11:11	130	5.4
14	11:12	11:17	145	6.0
15	11:18	11:23	145	6.0
16	11:24	11:29	150	6.3
17	11:30	11:35	145	6.0
18	11:36	11:41	135	5.6
19	11:42	11:47	145	6.0
20	11:48	11:53	135	5.6
21	11:55	12:00	155	6.5
22	12:01	12:06	125	5.2
23	12:07	12:12	125	5.2
24	12:13	12:18	125	5.2
25	12:19	12:24	125	5.2
26	12:25	12:30	125	5.4
27	12:31	12:36	140	5.8
28	12:37	12:42	120	5
29	12:43	12:48	125	5.2
30	12:49	12:54	130	5.4
31	13:00	13:05	135	5.6
32	13:06	13:11	125	5.2
33	13:12	13:17	130	5.4
34	13:18	13:23	125	5.2
35	13:24	13:29	150	6.3
36	13:30	13:35	170	7.1
37	13:36	13:41	130	5.4
38	13:42	13:45	70	5.8
Test ended				
Average, all sets				5.6

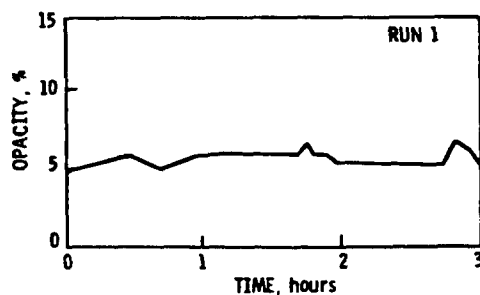


TABLE 7b. SUMMARY OF METHOD 9 VISIBLE EMISSION OBSERVATIONS
AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION,
BOILER NO. 1 IN HAMILTON, OHIO - RUN 2

Date: 3-3-82
Type of Discharge: Stack
Height of Point of Discharge: 100 ft
Wind Direction: East
Color of Plume: White
Observer Name: Dennis J. Gault
Distance from Observer to Discharge Point: 30 ft
Direction of Observer from Discharge Point: South
Height of Observation Point: 75 ft
Description of Background: Red water tower

Type of Plant: Automobile
Location of Discharge: Boiler No. 1 stack
Description of Sky: Overcast
Wind Velocity: 15-20 mph
Detached Plume: No
Duration of Observation: 180 min.

Summary of average opacity				
Set number	Time		Opacity	
	Start	End	Sum	Average
1	9:15	9:20	110	5.0
2	9:21	9:26	110	5.0
3	9:27	9:32	135	6.1
4	9:33	9:38	115	5.0
5	9:39	9:44	120	5.2
6	9:45	9:50	110	5.2
Test began				
7	9:51	9:56	130	5.7
8	9:57	10:02	120	5.5
9	10:03	10:08	160	7.0
10	10:09	10:14	115	5.5
11	10:16	10:21	130	5.4
12	10:22	10:27	125	6.0
13	10:28	10:33	130	5.9
14	10:34	10:39	145	6.3
15	10:40	10:45	115	5.2
16	11:00	11:05	120	5.0
17	11:06	11:11	135	5.9
18	11:12	11:17	110	5.0
19	11:18	11:23	130	5.7
20	11:24	11:29	130	5.7
21	11:31	11:36	125	5.2
22	11:37	11:42	120	5.5
23	11:43	11:48	120	5.5
24	11:49	11:54	135	5.9
25	11:55	12:00	125	5.4
Test ended				
26	12:01	12:06	115	5.2
27	12:07	12:12	155	6.7
28	12:13	12:18	120	5.2
29	12:19	12:24	125	5.2
30	12:25	12:30	125	5.2
Average; all sets				5.5

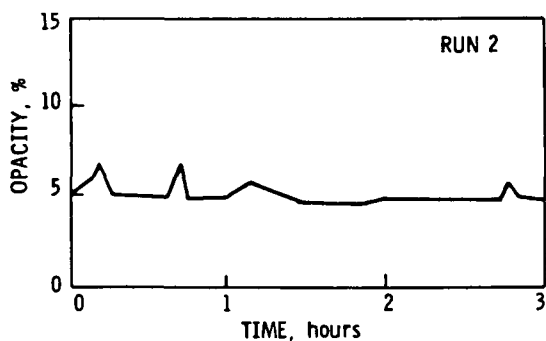


TABLE 7c. SUMMARY OF METHOD 9 VISIBLE EMISSION OBSERVATIONS
AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION,
BOILER NO. 1 IN HAMILTON, OHIO - RUN 3

Date: 3-3-82
Type of Discharge: Stack
Height of Point of Discharge: 100 ft
Wind Direction: East
Color of Plume: White
Observer Name: Dennis J. Gault
Distance from Observer to Discharge Point: 30 ft
Direction of Observer from Discharge Point: South
Height of Observation Point: 75 ft
Description of Background: Red water tower

Type of Plant: Automobile
Location of Discharge: Boiler No. 1 stack
Description of Sky: Overcast
Wind Velocity: 15-20 mph
Detached Plume: No
Duration of Observation: 180 min.

Summary of average opacity				
Set number	Time		Opacity	
	Start	End	Sum	Average
1	13:37	13:42	120	5.0
2	13:43	13:48	140	5.8
3	13:49	13:54	145	6.3
4	13:55	14:00	125	5.4
5	14:01	14:06	130	5.4
6	14:07	14:12	140	5.8
7	14:13	14:18	125	5.4
Test began				
8	14:19	14:24	145	6.0
9	14:25	14:30	135	5.6
10	14:31	14:36	125	5.4
11	14:39	14:44	135	5.9
12	14:45	14:50	140	6.1
13	14:51	14:56	150	6.3
14	14:57	15:02	145	6.3
15	15:03	15:08	145	6.0
16	15:09	15:14	125	5.7
17	15:34	15:39	115	5.0
18	15:40	15:45	105	5.0
19	15:46	15:51	130	5.4
20	15:52	15:57	120	5.2
21	16:00	16:05	145	6.3
22	16:06	16:11	150	6.3
23	16:12	16:17	135	5.9
24	16:18	16:23	150	6.8
25	16:24	16:29	135	5.9
Test ended				
26	16:30	16:35	145	6.0
27	16:36	16:41	140	5.8
28	16:42	16:47	125	5.4
29	16:48	16:53	145	6.3
30	16:54	16:59	150	6.3
Average, all sets				5.8

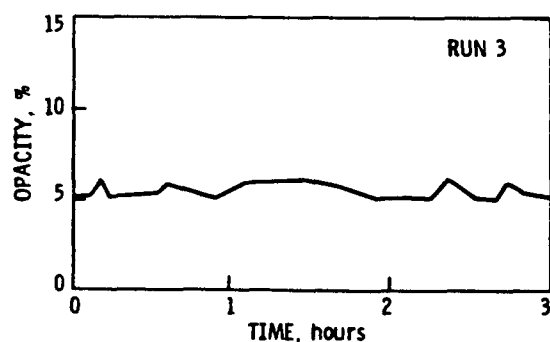


TABLE 7d. SUMMARY OF METHOD 9 VISIBLE EMISSION OBSERVATIONS
AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION,
BOILER NO. 1 IN HAMILTON, OHIO - RUN 4

Date: 3-4-82
Type of Discharge: Stack
Height of Point of Discharge: 100 ft
Wind Direction: South-West
Color of Plume: White
Observer Name: Dennis J. Gault
Distance from Observer to Discharge Point: 30 ft
Direction of Observer from Discharge Point: South
Height of Observation Point: 75 ft
Description of Background: Red water tower

Type of Plant: Automobile
Location of Discharge: Boiler No. 1 stack
Description of Sky: Overcast
Wind Velocity: Calm
Detached Plume: No
Duration of Observation: 180 min.

Summary of average opacity				
Set number	Time		Opacity	
	Start	End	Sum	Average
1	9:07	9:12	200	10.0
2	9:13	9:18	235	9.8
3	9:19	9:24	185	9.3
4	9:25	9:30	135	6.4
5	9:31	9:36	125	6.0
Test began				
6	9:37	9:42	200	8.7
7	9:43	9:48	275	12.5
8	9:49	9:54	230	10.0
9	9:55	10:00	200	9.1
10	10:01	10:06	175	7.3
11	10:07	10:12	155	7.8
12	10:13	10:18	140	7.0
13	10:19	10:24	110	7.9
14	10:25	10:30	190	9.5
15	10:31	10:36	125	6.9
16	10:37	10:42	170	9.4
17	10:43	10:48	140	7.4
18	10:49	10:54	95	5.3
19	10:55	11:00	120	6.0
20	11:01	11:06	115	6.4
21	11:09	11:14	110	5.2
22	11:15	11:20	110	6.1
23	11:21	11:26	130	6.8
24	11:27	11:32	115	6.1
Test ended				
25	11:33	11:38	130	6.2
26	11:39	11:44	120	6.3
27	11:45	11:50	110	5.8
28	11:51	11:56	105	5.8
29	11:57	12:02	145	6.6
30	12:03	12:08	145	7.3
Average, all sets				7.5

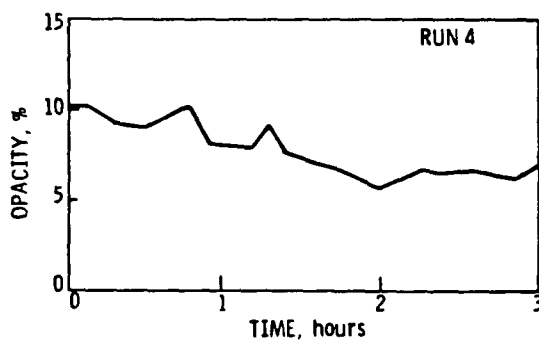


TABLE 7e. SUMMARY OF METHOD 9 VISIBLE EMISSION OBSERVATIONS
AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION,
BOILER NO. 1 IN HAMILTON, OHIO - RUN 5

Date: 3-4-82
Type of Discharge: Stack
Height of Point of Discharge: 100 ft
Wind Direction: West to Southwest
Color of Plume: White
Observer Name: Dennis J. Gault
Distance from Observer to Discharge Point: 30 ft
Direction of Observer from Discharge Point: South
Height of Observation Point: 75 ft
Description of Background: Water tower

Type of Plant: Automobile
Location of Discharge: Boiler No. 1 stack
Description of Sky: Overcast
Wind Velocity: 15-25 mph
Detached Plume: No
Duration of Observation: 144 min.

Summary of average opacity				
Set number	Time		Opacity	
	Start	End	Sum	Average
1	12:20	12:25	185	9.3
2	12:26	12:31	135	6.4
3	12:32	12:37	190	9.5
4	12:38	12:43	120	6.3
Test began				
5	12:44	12:49	130	5.7
6	12:50	12:55	125	5.7
7	12:56	13:01	120	6.3
8	13:02	13:07	130	6.2
9	13:08	13:13	115	6.1
10	13:14	13:19	90	5.6
11	13:26	13:31	105	5.8
12	13:32	13:37	115	6.4
13	13:38	13:43	140	6.4
14	13:44	13:49	130	6.5
15	13:50	13:55	125	6.9
16	13:56	14:01	145	6.9
17	14:02	14:07	135	7.1
18	14:08	14:13	115	6.8
19	14:14	14:19	130	7.7
20	14:20	14:25	130	7.7
21	14:31	14:36	150	8.8
22	14:37	14:42	185	8.4
Test ended				
23	14:43	14:48	140	7.0
24	14:49	14:54	120	6.7
Average, all sets				6.8

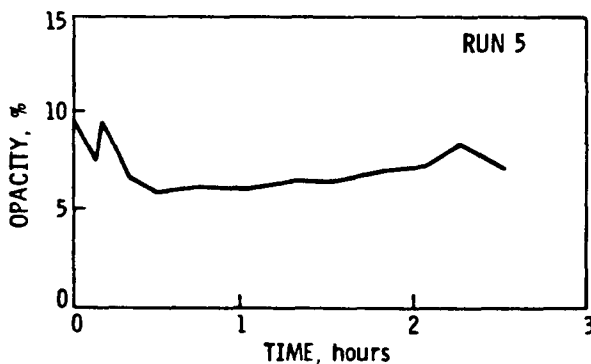


TABLE 7f. SUMMARY OF METHOD 9 VISIBLE EMISSION OBSERVATIONS
AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION,
BOILER NO. 1 IN HAMILTON, OHIO - RUN 6

Date: 3-4-82
Type of Discharge: Stack
Height of Point of Discharge: 100 ft
Wind Direction: South-West
Color of Plume: White
Observer Name: Dennis J. Gault
Distance from Observer to Discharge Point: 30 ft
Direction of Observer from Discharge Point: South
Height of Observation Point: 75 ft
Description of Background: Red water tower

Type of Plant: Automobile
Location of Discharge: Boiler No. 1 stack
Description of Sky: Overcast
Wind Velocity: 15-25 mph
Detached Plume: No
Duration of Observation: 142 min.

Set number	Summary of average opacity			
	Time		Opacity	
	Start	End	Sum	Average
Test began				
1	15:11	15:16	140	7.4
2	15:17	15:22	125	5.4
3	15:23	15:28	140	7.0
4	15:29	15:34	200	8.7
5	15:35	15:40	170	7.7
6	15:41	15:46	180	8.2
7	15:47	15:52	120	6.0
8	15:53	15:58	135	6.1
9	15:59	16:04	135	6.1
10	16:05	16:10	170	7.4
11	16:13	16:18	150	6.8
12	16:19	16:24	160	7.0
13	16:25	16:30	125	6.6
14	16:31	16:36	150	7.1
15	16:37	16:42	135	7.5
16	16:43	16:48	140	7.0
17	16:49	16:54	150	6.8
18	16:55	17:00	140	6.1
19	17:01	17:06	155	6.7
Test ended				
20	17:07	17:12	165	7.2
21	17:15	17:20	170	7.4
22	17:21	17:26	175	7.6
23	17:27	17:32	150	6.5
24	17:33	17:38	95	6.3
Average, all sets				6.9

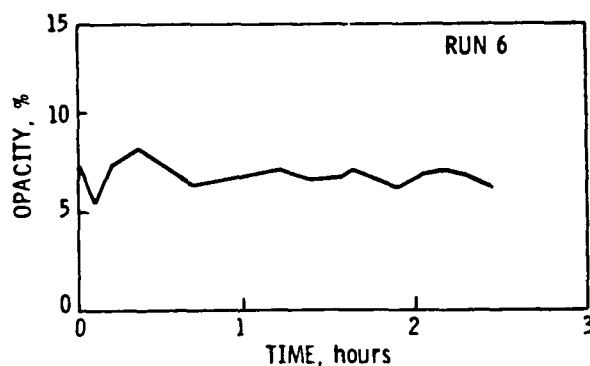


TABLE 7g. SUMMARY OF METHOD 9 VISIBLE EMISSION OBSERVATIONS
AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION,
BOILER NO. 1 IN HAMILTON, OHIO - RUN 7

Date: 3-5-82
Type of Discharge: Stack
Height of Point of Discharge: 100 ft
Wind Direction: -
Color of Plume: White
Observer Name: Dennis J. Gault
Distance from Observer to Discharge Point: 30 ft
Direction of Observer from Discharge Point: South
Height of Observation Point: 75 ft
Description of Background: Red water tower

Type of Plant: Automobile
Location of Discharge: Boiler No. 1 stack
Description of Sky: Overcast
Wind Velocity: Calm
Detached Plume: No
Duration of Observation: 60 min.

Summary of average opacity				
Set number	Time		Opacity	
	Start	End	Sum	Average
1	10:30	10:35	135	5.9
2	10:36	10:41	130	5.9
3	10:42	10:47	145	6.3
4	10:48	10:53	155	6.7
5	10:54	10:59	160	6.7
6	11:00	11:05	160	6.7
7	11:06	11:11	155	6.7
8	11:12	11:17	165	6.9
9	11:18	11:23	140	6.1
10	11:24	11:29	170	7.4
Average, all sets				6.5

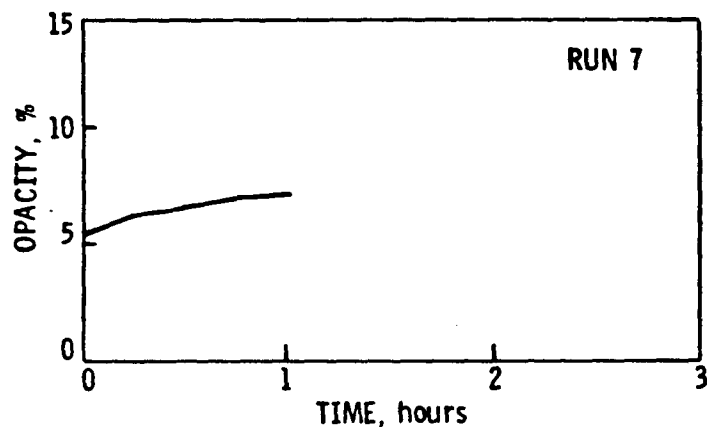


TABLE 7h. SUMMARY OF METHOD 9 VISIBLE EMISSION OBSERVATIONS
AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION,
BOILER NO. 1 IN HAMILTON, OHIO - RUN 8

Date: 3-5-82
Type of Discharge: Stack
Height of Point of Discharge: 100 ft
Wind Direction: -
Color of Plume: White
Observer Name: Dennis J. Gault
Distance from Observer to Discharge Point: 30 ft
Direction of Observer from Discharge Point: South
Height of Observation Point: 75 ft
Description of Background: Red water tower

Type of Plant: Automobile
Location of Discharge: Boiler No. 1 stack
Description of Sky: Overcast
Wind Velocity: Calm
Detached Plume: No
Duration of Observation: 60 min.

Summary of average opacity				
Set number	Time		Opacity	
	Start	End	Sum	Average
1	12:00	12:05	130	5.9
2	12:06	12:11	120	6.0
3	12:12	12:17	110	5.5
4	12:18	12:23	115	6.1
5	12:24	12:29	120	6.0
6	12:30	12:35	140	6.1
7	12:36	12:41	95	5.0
8	12:42	12:47	100	5.6
9	12:48	12:53	120	5.5
10	12:54	12:59	140	6.1
Average, all sets				5.8

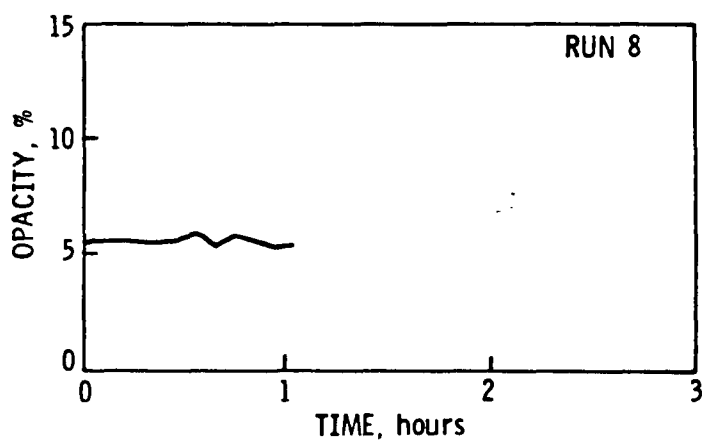
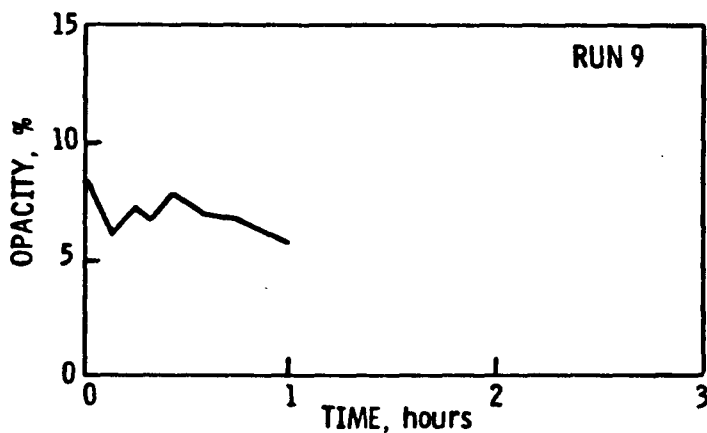


TABLE 7i. SUMMARY OF METHOD 9 VISIBLE EMISSION OBSERVATIONS
AT GENERAL MOTORS CORPORATION, FISHER BODY DIVISION,
BOILER NO. 1 IN HAMILTON, OHIO - RUN 9

Date: 3-5-82
Type of Discharge: Stack
Height of Point of Discharge: 100 ft
Wind Direction: West
Color of Plume: White
Observer Name: Dennis J. Gault
Distance from Observer to Discharge Point: 30 ft
Direction of Observer from Discharge Point: South
Height of Observation Point: 75 ft
Description of Background: Red water tower

Type of Plant: Automobile
Location of Discharge: Boiler No. 1 stack
Description of Sky: Overcast
Wind Velocity: Calm
Detached Plume: No
Duration of Observation: 60 min.

Summary of average opacity				
Set number	Time		Opacity	
	Start	End	Sum	Average
1	13:20	13:25	190	7.9
2	13:26	13:31	140	6.1
3	13:32	13:37	165	6.9
4	13:38	13:43	160	6.7
5	13:44	13:49	185	7.7
6	13:50	13:55	175	7.3
7	13:56	14:01	165	6.9
8	14:02	14:07	175	7.3
9	14:08	14:13	155	6.7
10	14:14	14:19	155	6.7
Average, all sets				7.0



SECTION 3

PROCESS DESCRIPTION (Provided by Radian Corporation)

This section presents a generalized description of the boiler and side stream separator processes. Both processes are discussed individually in the following two subsections. Process descriptions include flow diagrams and descriptions, equipment design data, typical operating conditions and performance data.

The process data collected during all emission testing periods are tabulated in Appendix C. Also present in Appendix C is a discussion of any process upsets or abnormalities that occurred during the testing period. Some general comments on the process operation are also included.

BOILER SYSTEM DESCRIPTION

The Fisher Body Hamilton plant is a metal stamping facility producing automotive parts. Steam is required almost exclusively for heating purposes and is supplied from three coal-fired boilers of equal size (20,430 kg/hr or 45,000 lb/hr) in a power plant adjacent to the manufacturing facility.

The test boiler, shown in Figure 2, is a Babcock and Wilcox unit installed in 1946 and designed with a maximum continuous capacity of 20,430 kilograms of dry saturated steam per hour at 1.2 MPa (45,000 lb/hr at 175 psig). Currently, the boiler rarely exceeds a load of 15,890 kg/hr (35,000 lb/hr). The boiler has a Detroit Stoker traveling grate with front end ash discharge and coal is fed into the boiler by two Detroit Stoker spreader stokers. Design data for the boiler and stokers are presented in Table 8. Predicted performance data for this unit at the time of installation is provided in Table 9.

Boiler bottom ash is reinjected through the rear overfire air jets on a continuous basis. The rear overfire air jets are angled to fire toward the center of the furnace, while the front two jets fire straight toward the rear wall of the furnace. Soot blowing operations normally occur once a day. The soot blowing system uses compressed air generated in the powerhouse to clean the heat exchanger tubes.

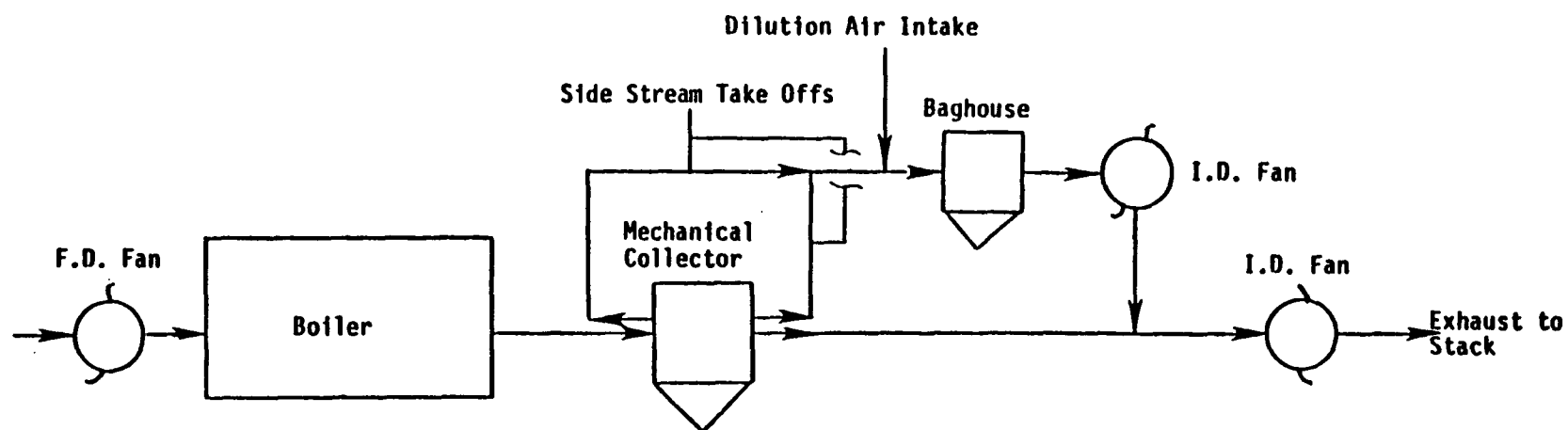


Figure 2. Boiler/side stream separator process diagram.

TABLE 8. DESIGN DATA FOR BOILER 1

Boiler	Type	F-22-BG-6/54
	Boiler heating surface	5,831 ft ²
	Design steam pressure	175 psig
	No. of gas passes (horizontal passes)	3
Economizer		None
Furnace	Volume	2,586 ft ³
	Width	8' - 7-3/4"
	Depth	13'
Stoker	Type	Detroit Rotograte
	Grate type	Spreader
	No. of feeders	2
	Effective grate area	120 ft ²
Heat rate	Maximum continuous steam	45,000 lb/hr
	Capacity	

TABLE 9. PREDICTED PERFORMANCE DATA FOR
BOILER 1 AT TIME OF INSTALLATION

Steam leaving boiler (design)	45,000 lb/hr
Excess air leaving boiler (minimum)	32%
Coal flow at rated capacity	2.1 tons/hr
Flue gas leaving boiler	33,000 acfm
Steam pressure	175 psig
Gas temperature leaving boiler	520°F
Furnace draft loss	0.10" w.g.
Efficiency of unit	79.9%

Unit one is capable of burning a wide range of coals. However, the plant restricts coal purchases to the following specifications:

Sulfur content:	1.0% or less
Heating value:	Not less than 12,500 Btu/lb
Ash content:	Less than 10%
Sizing:	1-1/4" x 1/4" modified stoker coal with not more than 15% passing through a 1/4" screen
Moisture:	Not greater than 6%
Ash fusion:	Not less than 2,600°F

Throughout the duration of the testing period a fuel additive, Gamlenite 6201, was added to the coal at the weighing scale. Gamlenite 6201 is a combination combustion improver, slag controller and cold corrosion inhibitor. Gamlenite acts as a combustion catalyst by lowering the auto ignition temperature of carbon. Therefore, more carbon is burned in the combustion chamber rather than being deposited on the tubes or carried out in the bottom or flyash. The marketers of Gamlenite 6201 (Sybron Chemical) feel that Gamlenite may act to slightly reduce uncontrolled particulate matter mass emissions from stoker boilers. However, the extent of this reduction has not been quantified.

SIDE STREAM SEPARATOR SYSTEM DESCRIPTION

The particulate matter collection equipment installed with Unit 1 at the time of construction was a mechanical collector manufactured by Pratt-Daniel Corporation. In 1974, this collector was replaced with a higher efficiency mechanical collector. Although this installation resulted in a higher pressure drop across the collector, no appreciable loss in boiler capacity was experienced, as the induced draft fan was equipped with enough spare capacity to overcome these losses. The new mechanical collector was installed after the boiler and before the induced draft fan and met the following specifications:

Manufacturer:	Western Precipitation Division Joy Manufacturing Company
Type:	9VM Series
Number of tubes:	48
Tube size:	6"
Pressure drop:	3.5" w.g.
Design efficiency:	96.5%

The design efficiency listed above is qualified to apply if less than 15 percent of the flyash particles are 10 μ m in diameter or less. The collector was designed for a continuous load of 20,430 kg/hr (45,000 lb/hr) of steam with intermittent peaks of 22,700 kg/hr (50,000 lb/hr).

In 1979 - 1980, the baghouse and mechanical collector take-offs were installed on Unit One to collectively form the side stream separator system. A 255 m³/min (9,000 acfm) induced draft fan, located downstream of the baghouse, pulls between 12-15 percent of the flue gas flow from the mechanical collector hopper. Because this fan is a constant cfm unit, the percentage flow to the baghouse increases with decreasing overall flue gas flow rate from the boiler. Flue gas flow rate decreases with decreasing load. Therefore, as boiler load decreases percent flow to the baghouse increases.

Table 10 presents design data for the baghouse installed on Unit One. The unit is a Western Precipitation PULSEFLO baghouse and consists of a rectangular air tight housing containing an array of filter bags suspended from a tube sheet. The housing is approximately 6.9 m (22.5 ft) in height and 2.4 m (8 ft) wide.

TABLE 10. BAGHOUSE DESIGN DATA

Type	Model PF SQ 4508 Size 144
Filter bags:	
Total quantity	144
Grounding	None
Material	Teflon
Diameter	4-1/2"
Length	8 ft
Power requirements	480 V, 3 ph, 60 Hz
Air requirements	16.8 acfm at 100 to 125 psi
Monitoring devices:	
Annunciator	Panalarm Mod II-Series 10
Pressure indicators	Inlet & outlet gas pressure
Temperature indicator	Boiler outlet gas temperature

A solid-state timer is programmed to provide a smooth, continuous cleaning cycle by pulsing each of the 12 rows of filter bags in sequence. When the timer is energized, it will continuously pulse each row of bags in sequence, automatically returning to the first row after the last one has been pulsed. This bag cleaning system operates on a continuous basis.

To lower the gas temperature entering the PULSEFLO filter, a mixing tee is provided. The mixing tee contains two butterfly valves, one 20 cm (8 inch) and one 41 cm (16 inch). An air pressure signal controls these valves to allow the mixing tee to effectively mix ambient air with the gas flow to lower the temperature entering the PULSEFLO filter to 191°C (375°F). Temperatures above this value would cause deterioration of the Teflon bag fabric used in these units.

SECTION 4

LOCATION OF SAMPLING POINTS

Emissions to the atmosphere from Boiler No. 1 were measured in the smokestack. The coal fed into the boiler was sampled at the end of the coal feed belts from the coal weighing devices that dump coal into the spreader stokers.

STACK

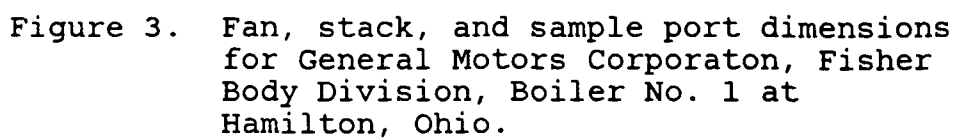
Four 10.2 cm (4 in.) I.D. sampling ports are located on a 8.8 m (29 ft) tall, 1.5 m (58 in.) I.D. round smokestack. The sampling ports are 6.0 m (19.6 ft) downstream of the flue gas inlet (4.1 duct diameters) and 2.8 m (9.1 ft) upstream of the stack outlet (1.9 duct diameters) (see Figure 3). The maximum diameter of 58 in. at the top of the stack was used in the determination of duct diameters and number of traverse points required based on information given in Reference [1]. This arrangement meets all criteria for an acceptable measurement specified under EPA Methods 1-5.

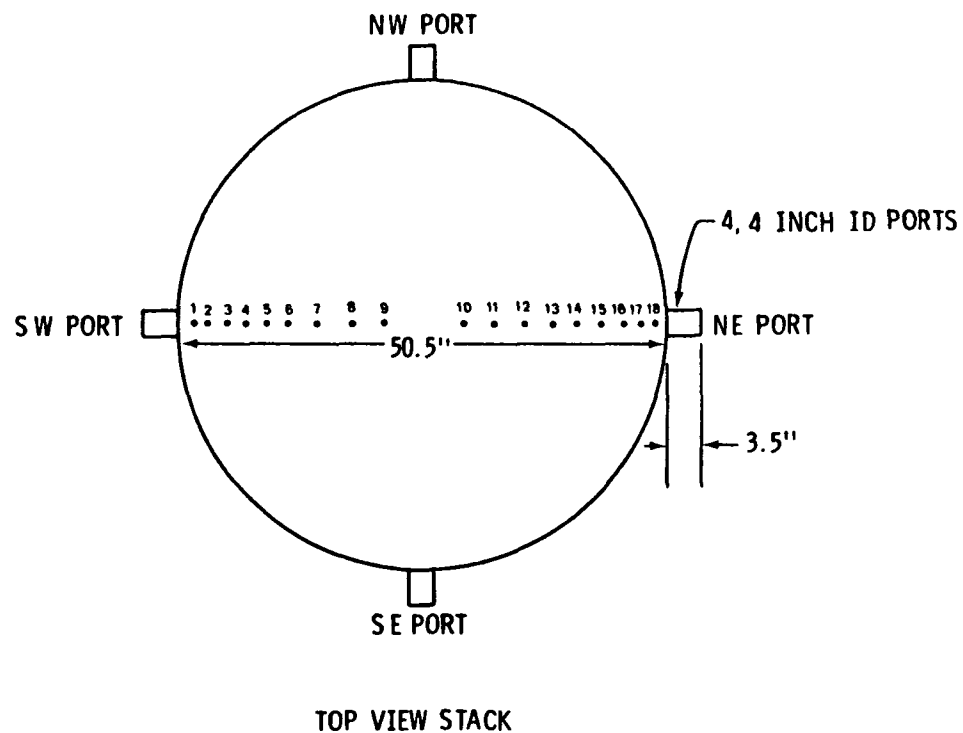
A 36 point traverse was conducted at this location, with 18 points being sampled at the Southwest (SW) and Southeast (SE) ports as shown in Figure 4.

COAL FEED SYSTEM

Coal samples were taken from the end of the coal feed belts that dump the coal into the spreader stokers located inside the building.

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- [1] "Guidelines for Sampling in Tapered Stacks," by Tom Logan and Roger Sigahara. From EPA 450/2-78-042D, Stack Sampling Technical Information - A Collection of Monographs and Papers. U.S. EPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711. October 1978.





POINT NUMBER	DISTANCE	
	% FROM INNER STACK	INCHES FROM INNER STACK
1	1.4	0.71
2	4.4	2.2
3	7.5	3.8
4	10.9	5.5
5	14.6	7.4
6	18.8	9.5
7	23.6	11.9
8	29.6	15.0
9	38.2	19.3
10	61.8	31.2
11	70.4	35.6
12	76.4	38.6
13	81.2	41.0
14	85.4	43.1
15	89.1	45.0
16	92.5	46.7
17	95.6	48.3
18	98.6	49.8

Figure 4. Traverse point location for General Motors Corporation, Fisher Body Division, Boiler No. 1 at Hamilton, Ohio.

SECTION 5

SAMPLING AND ANALYSIS PROCEDURES

SUMMARY

The sampling and analysis methods used at the Hamilton site are shown in Table 1. Three simultaneous runs of Methods 5 and 5B and three additional runs of Method 5B alone were conducted at the stack downstream of all pollution control equipment. In all simultaneous runs a special dual-probe stack test system, with nozzle centers located 4.4 cm (1.7 in.) from each other, was used for sampling by Methods 5 and 5B through the same ports.

The flue gas velocity, temperature, flow rate, oxygen content, and carbon dioxide content were measured by EPA Methods 1-4 during all the Method 5 and 5B stack sampling runs. Integrated gas samples were taken from the exhaust of the Method 5B train.

Particulate analysis followed standard Method 5 gravimetric procedures. All Method 5 and 5B filters and acetone probe washes were dried and weighed to a constant weight.

During each stack sampling run representative grab samples of the coal being burned were taken from the feed line to the spreader stoker. The sulfur, ash, moisture, and heat content of the samples were analyzed by ASTM Methods D3176 and D2015-66(72).

STACK SAMPLING

Heated glass-lined probes and Reeve Angel Type 934 AH filters were used for the Method 5 and 5B testing. The filter temperatures were monitored using thermocouples installed in the oven. A special dual-probe stack test system was used for simultaneous stack testing by Methods 5 and 5B through the same individual stack ports. Figure 5 is a schematic diagram of the dual-probe system. The nozzle centers of the Method 5 and 5B trains were 4.4 cm (1.75 in.) apart in this system. A single pitot tube between the Method 5 and 5B sampling probes was used to measure the flue velocity for both trains. Method 3 integrated bag samples were taken from the exhaust of the Method 5B train. Method 5 and 5B sample volumes of at least 1.7 dry m³ (60 ft³) were taken. When Methods 5 and/or 5B were used, Methods 1-4 were also used, as in compliance monitoring.

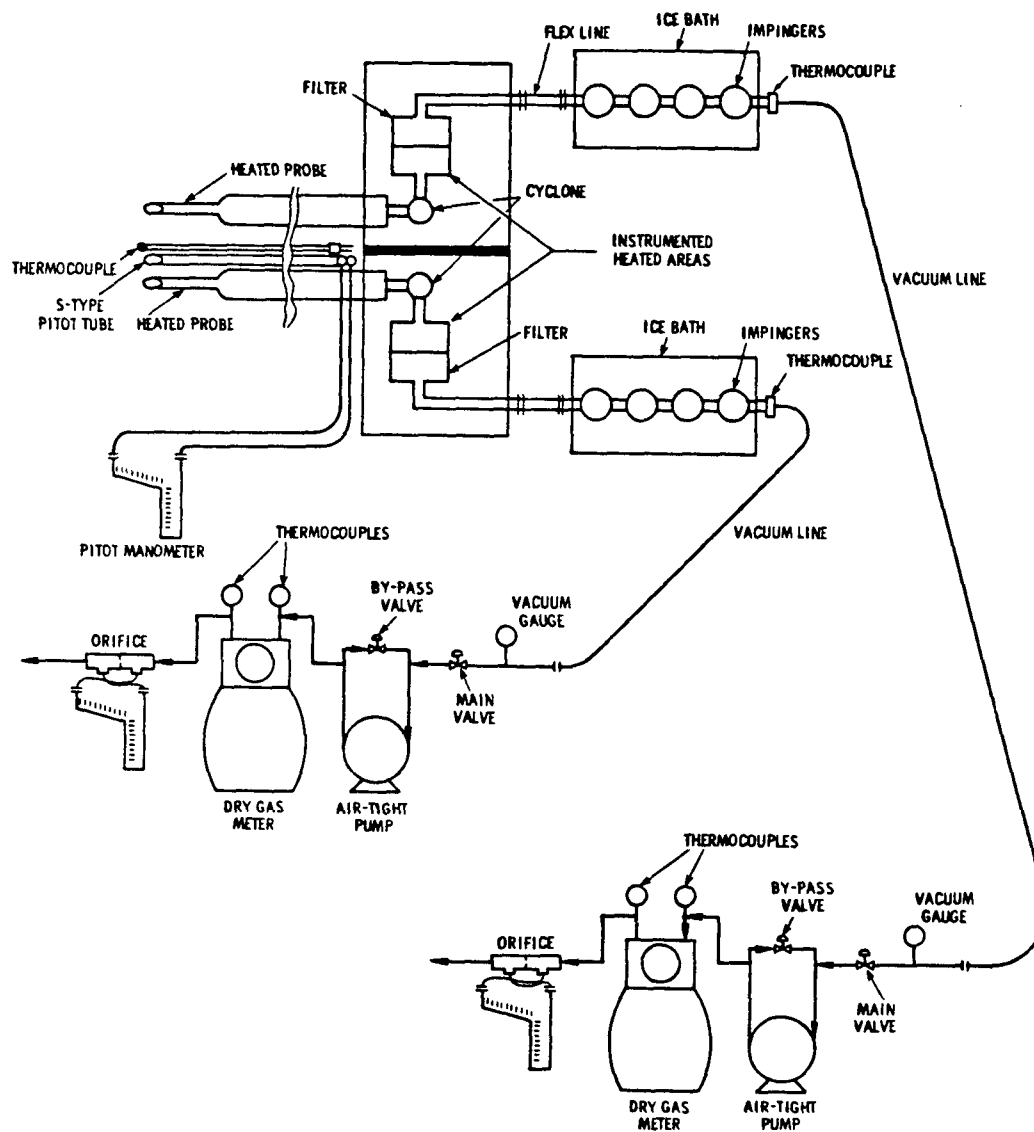


Figure 5. Dual-probe sampling train.

Plume opacity was observed according to EPA Method 9 during all sampling runs.

STACK SAMPLE ANALYSES

Gravimetric particulate analyses according to standard Method 5 procedures were conducted on all Method 5 and 5B samples. The Method 5 and 5B filters and acetone probe washes were dried and weighed to a constant weight. The weighing was repeated until the weight of the particulates was within 5 mg of the weight on the previous weighing. Following particulate analyses, the samples were submitted to EPA for subsequent analyses.

COAL SAMPLING AND ANALYSES

Aggregate coal samples, corresponding to the coal burned during each stack sampling run, were taken by grab sampling the coal from the end of the coal feed belts that dump the coal into the spreader stokers. Three grab samples were taken during each sampling run, combined into one aggregate sample per run, and stored in labelled bottles prior to analyses. Each coal sample was analyzed for sulfur, moisture, ash, and Btu content according to ASTM D3176 and D2015-66 bomb calorimetry methods.

SAMPLE HANDLING

Filters were transferred into closed clean containers. Deposits of the inside of the sampling equipment were removed with acetone and distilled water. The acetone rinse was bottled. This occurred in the boiler room or on tables located near the stack. The coal samples were sealed in plastic containers until ready for analysis. Access to the samples was limited by storing them in a locked truck, except when being handled by authorized individuals. The samples were shipped in the truck to the MRC Dayton Laboratory for analysis. Records of the chain of custody of the samples have been maintained.

DATA REDUCTION

MRC's computer and programmable calculators were used to reduce the analytical and field data to determine results. The "F" value used to determine ng/joule ($\text{lb}/10^6$ Btu) emissions was taken from the boiler emission regulations in 40CFR 60.45(f)(4)(ii).

Appendix A contains copies of all raw field data sheets and coding sheets for data processing.

Appendix B contains complete computer printouts of the results of the sampling and emission calculations.

Appendix C (supplied by Radian Corporation) contains boiler monitoring data during the testing.

Appendix D contains the analytical report and a summary of the results of the quality control and assurance procedures.

Appendix E identifies the people performing the sampling, analysis, and data reduction.

QUALITY ASSURANCE

The quality assurance and control program included all applicable procedures specified in the Federal Register for EPA Methods 1-5 and the procedures specified in the EPA Guidelines for the Development of Quality Assurance Programs for these methods.

Standard ASTM procedures were used for the coal analysis. Bowser-Morner Testing Laboratories, Inc., the coal analysis subcontractor, participates in EPA's new quality assurance program for coal sulfur, ash, and moisture content. This program involves the analysis of samples provided by EPA.

The accuracy of the data used in computerized data processing was checked by comparing the printout of the data used to calculate results with the raw field data used to code the computer input.