

PB-229 660

BACKGROUND INFORMATION FOR PROPOSED NEW SOURCE
PERFORMANCE STANDARDS: ASPHALT CONCRETE PLANTS,
PETROLEUM REFINERIES, STORAGE VESSELS, SECONDARY
LEAD SMELTERS AND REFINERIES, BRASS OR BRONZE INGOT
PRODUCTION PLANTS, IRON AND STEEL PLANTS, SEWAGE
TREATMENT PLANTS: VOLUME II, APPENDIX: SUMMARIES OF
TEST DATA

U. S. Environmental Protection Agency
Research Triangle Park, North Carolina

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OCM 00866318

PB 229 660

BIBLIOGRAPHIC DATA SHEET		1. Report No.	2. PB 229 660
4. Title and Subtitle		5. Report Date	
BACKGROUND INFORMATION FOR PROPOSED NEW SOURCE PERFORMANCE STANDARDS: Asphalt Concrete Plants, Petroleum Refineries, Storage Vessels, Secondary Lead Smelters and Refineries, Brass or Bronze Ingot Production Plants, Iron and Steel Plants, Sewage Treatment Plants; Volume 2, Appendix: Summaries of Test Data		June 1973	
7. Author(s)		8. Performing Organization Rep. No.	
9. Performing Organization Name and Address		10. Project/Task/Work Unit No.	
U.S. Environmental Protection Agency Office of Air and Water Programs Office of Air Quality Planning and Standards Research Triangle Park, North Carolina 27711		11. Contract/Grant No.	
12. Sponsoring Organization Name and Address		13. Type of Report & Period Covered	
15. Supplementary Notes		14.	
16. Abstracts. This document provides background information on the derivation of the proposed second group of new source performance standards and their economic impact on the construction and operation of asphalt concrete plants, petroleum refineries, storage vessels, secondary lead smelters and refineries, brass or bronze ingot production plants, iron and steel plants, and sewage treatment plants. Information is also provided on the environmental impact of imposing the standards. The standards require control at a level typical of well controlled existing plants and attainable with existing technology. To determine these levels, extensive on-site investigations were conducted, and design factors, maintenance practices, available test data, and the character of emissions were considered. Economic analyses of the effects of the standards indicate they will not cause undue reductions of profit margins or reductions in growth rates. This appendix presents summaries of source tests cited in Volume 1. The summaries are concerned principally with tests for particulate matter and carbon monoxide, but also describe the facilities, characteristics of exhaust gas streams, and conditions of operation.			
17. Key Words and Document Analysis. 17a. Descriptors			
Air Pollution Pollution control * Performance standards * Asphalt concrete plants * Petroleum refineries * Lead smelters and refineries * Brass ingot production * Bronze ingot production * Iron production * Steel production * Sewage treatment			
17b. Identifiers/Open-Ended Terms			
* Air pollution control			
Reproduced by NATIONAL TECHNICAL INFORMATION SERVICE U.S. Department of Commerce Springfield VA 22151			
18. Availability Statement On request from: Emission Standards and Engineering Division Environmental Protection Agency Research Triangle Park, North Carolina 27711		19. Security Class (This Report) UNCLASSIFIED	
ATTN: Mr. Don R. Goodwin		21. No. of Pages 71	
FORM NTIS-35 (REV. 3-73)		22. Price UNCLASSIFIED	

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Publication No. APTD-1352b

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INTRODUCTION

This appendix presents summaries of source tests cited in the document. The summaries are concerned principally with tests for particulate matter and carbon monoxide, but also describe the facilities, characteristics of exhaust gas streams, and conditions of operation.

For each source category, facilities are identified by the same coding used in the technical reports. For example, Table A-16 summarizes results of the December 1971 test of petroleum refinery catalytic cracking Facility A. These results are also plotted as Bar A₁ in Figure 3 of the Technical Report Number 7. In this case, the bar represents the range of the two valid results. Table A-17 summarizes a second test, A₂, conducted in February 1972 at the same facility.

Most of the tests summarized herein were conducted using the reference test methods of 40 CFR 60. Wherever particulate tests were conducted, additional measurements were made to evaluate materials that condense and collect in impingers as the gases are cooled to 70°F. In the summaries, the "probe and filter catch" is the particulate that relates to the standard and the EPA reference method (Method 5 of 40 CFR 60 as published December 23, 1971). The "total catch" includes the probe and filter catch, plus material collected in the impingers using the particulate method as described in 36 FR 15704, published on August 17, 1971.

Where particulate testing was performed using methods other than those cited above, the method is noted under "Facility" in the discussion and also in the appropriate table. Code test methods are listed in the "Introduction" of the main text.

HOT MIX ASPHALT CONCRETE PLANTS

PARTICULATE TEST RESULTS

Four hot mix asphalt concrete plants were tested by EPA, one controlled with a high-pressure-venturi scrubber and three with baghouses. In addition, State and local control agencies provided data from the testing of four plants controlled with venturi scrubbers and three with baghouses. National Asphalt Pavement Association tests of four plants controlled with baghouses are also included. Two of these are not representative of "best demonstrated technology" because poor collector maintenance or operation was observed during testing. Additional information was available from an EPA study of asphalt concrete plants in the Seattle, Washington, area. The latter plants were not necessarily well controlled and were tested to determine average emission factors.

For each plant, exhaust gases were analyzed after discharge from the particulate collector. These gases included drier exhaust gases and sweep air used to gather dust at various points in the system such as elevators, screens, and scavenger systems. The front and back half catches could not be separated (based on data supplied) for Plants F and G, and therefore are comparable to the catch from the total EPA train.

Facilities:

- A₁. Oil-fired, 120-ton/hr design capacity, equipped with a cyclone and a closed suction-type cyclic-cleaned baghouse designed for 99.9+ percent efficiency. Plant was operating at or near

capacity for conditions prevalent during the test periods.

- A₂. Same location as plant A₁. Gas-fired rotary dryer, production rate of 115 tons/hr during sampling, equipped with a cyclone and a baghouse. Opacity was reported to be less than 5 percent. Data provided by the National Asphalt Pavement Association.
- B. Oil-fired, 300-ton/hr design capacity, equipped with a closed suction-type cyclic-cleaned baghouse designed for 99.9+ percent efficiency. Plant was operating at an estimated 80 to 90 percent capacity for conditions prevalent during the test periods.
- C. Oil-fired, 200-ton/hr design capacity, equipped with a cyclone and a high-pressure venturi scrubber operating at 20.4 inches of water pressure drop and approximately 14 gallons of water per 1000 scfm of exhaust gases. Data were provided by a local control agency. The plant was operating at approximately 70 percent and 100 percent of design capacity during the test periods. No exhaust gas opacity readings were available. The air flow rates (dscfm) for this plant were unusually high for a typical 200-ton/hr plant. The plant was not observed or tested by EPA.
- D. Gas-fired, 240-ton/hr design capacity, equipped with a multicyclone and a closed suction-type cyclic-cleaned baghouse designed for 99.9+ percent efficiency. Plant was operating at or near capacity for conditions prevalent during the test periods.
- E. Batch process, 180-ton/hr rated capacity, gas-fired, equipped with a multicyclone and a closed suction-type cyclic-cleaned baghouse designed for 99.9+ percent efficiency. Plant production during

the test period is unknown. Data were provided by a local control agency. No exhaust gas opacity readings were available.

- F. Gas-fired, 250- to 300-ton/hr design capacity, equipped with a cyclone and a closed suction-type cyclic-cleaned baghouse designed for 99.9+ percent efficiency. Plant production during the test periods is unknown. The testing was performed and data were provided by a local control agency. No exhaust gas opacity readings were available.
- G. Gas-fired, 75-ton/hr design capacity, equipped with two cyclones and a high-pressure venturi scrubber operating at 16 inches water pressure drop and approximately 11.5 gallons of water per 1000 scfm of exhaust gases. Tested using Code Method 3. Production rate during the test period was approximately 100 percent of capacity. Data were provided by a local control agency. No exhaust gas opacity readings were available.
- H₁. Oil-fired, 240-ton/hr design capacity, equipped with a cyclone and a high-pressure venturi operating at 18.5 inches water pressure drop and approximately 18 gallons of water per 1000 scfm of exhaust gas. Plant was operating at capacity for conditions prevalent during the test periods. Exhaust gas opacity readings were not recorded.
- H₂. Same plant as H₁. Testing conditions differed in that production rate was 200 tons/hr, the venturi scrubber was operating at 19.5 inches water pressure drop and the test results were provided by a local agency.

- I. Gas-fired, 120-ton/hr design capacity, equipped with a venturi scrubber operating at 26 inches water pressure drop. Plant production data during the test periods is unknown. Testing was performed and data were provided by a State control agency. No exhaust gas opacity readings were available.
- J. Baghouse collector. Data provided by a State control agency. Operating conditions unknown.
- K. Oil-fired rotary dryer, production rate approximately 120 tons/hr, equipped with a cyclone and a baghouse. Data provided by the National Asphalt Pavement Association.
- L. Oil-fired, production rate of 200 tons/hr during sampling, equipped with a cyclone and a baghouse. "Very little visible emissions from stack" observed. Data provided by the National Asphalt Pavement Association.
- M. Oil-fired rotary dryer, production rate varying from 132 to 173 tons/hr during sampling, equipped with a cyclone and a baghouse. Data provided by the National Asphalt Pavement Association.

Table A-1. ASPHALT CONCRETE FACILITY A₁,

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	11/15/71	11/16/71	11/17/71	
Test time, minutes	126	63.0	63.0	84.0
Production rate, tons/hr	112	89	98	99.7
Stack effluent				
Flow rate, dscfm	16,228	16,139	16,520	16,296
Flow rate, dscf/ton product	8693	10,880	10,114	9896
Temperature, °F	195	196	187	192.7
Water vapor, vol. %	18.35	18.38	17.48	18.07
CO ₂ , vol. % dry	0.9	4.6	4.0	3.2
O ₂ , vol. % dry	19.2	14.8	15.4	16.5
CO, vol. % dry	0	0.1	0.1	0.1
Visible emissions, % opacity	<10	<10	<10	<10
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0057	0.0077	0.0068	0.0067
gr/acf	0.0037	0.0050	0.0045	0.0044
lb/hr	0.79	1.06	0.98	0.94
lb/ton of product	0.007	0.011	0.010	0.009
Total catch				
gr/dscf	0.0272	0.0194	0.0184	0.0217
gr/acf	0.0176	0.0126	0.0122	0.0141
lb/hr	3.78	2.68	2.60	3.02
lb/ton of product	0.033	0.029	0.027	0.030

Table A-2. ASPHALT CONCRETE FACILITY A₂.

SUMMARY OF RESULTS

Run number	1
Date	7/20/72
Test time, minutes	42
Production rate, tons/hr	135
Stack effluent	
Flow rate, dscfm	15,650
Flow rate, dscf/ton product	8165
Temperature, °F	218
Water vapor, vol. %	28.2
CO ₂ , vol. % dry	4.5
O ₂ , vol. % dry	12.8
CO, vol. % dry	0
Visible emissions, % opacity	--
Particulate emissions	
Probe and filter catch	
gr/dscf	0.021
gr/acf	--
lb/hr	2.8
lb/ton of product	0.0243

Table A-3. ASPHALT CONCRETE FACILITY B.

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	11/11/71	11/13/71	11/13/71	
Test time, minutes	144	90	90	108.0
Production rate, tons/hr	203	198	236	212.3
Stack effluent				
Flow rate, dscfm	19,756	21,065	22,407	21,076
Flow rate, dscf/ton product	5839	6383	5697	5973
Temperature, °F	275	247	234	252
Water vapor, vol. %	31.71	23.71	21.78	25.73
CO ₂ , vol. % dry	5.3	5.8	5.1	5.4
O ₂ , vol. % dry	14.1	13.6	14.6	14.1
CO, vol. % dry	0.05	0.05	0.05	0.05
Visible emissions, % opacity	<10	<10	<10	<10
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0079	0.0100	0.0064	0.0081
gr/acf	0.0038	0.0056	0.0038	0.0044
lb/hr	1.34	1.80	1.23	1.46
lb/ton of product	0.007	0.012	0.005	0.008
Total catch				
gr/dscf	0.1006	0.0550	0.0168	0.0575
gr/acf	0.0490	0.0308	0.0099	0.0299
lb/hr	17.04	9.94	3.23	10.07
lb/ton of product	0.089	0.066	0.014	0.056

Table A-4. ASPHALT CONCRETE FACILITY C,

SUMMARY OF RESULTS

Run number	1	2	3	4	Average
Date	11/18/71	11/18/71	11/19/71	11/19/71	
Test time, minutes	--	--	--	--	
Production rate, tons/hr	130	130	175	175	152.5
Stack effluent					
Flow rate, dscfm	36,522	35,399	36,148	34,883	35,738
Flow rate, dscf/ton product	16,856	16,338	12,394	11,960	14,387
Temperature, °F	90	90	90	90	90
Water vapor, vol. %	2.82	4.70	4.34	4.51	4.09
CO ₂ , vol. % dry	--	--	--	--	--
O ₂ , vol. % dry	No orsat available				
CO, vol. % dry	--	--	--	--	--
Visible emissions, % opacity	--	--	--	--	--
Particulate emissions					
Probe and filter catch					
gr/dscf	0.022	0.021	0.012	0.012	0.017
gr/acf	0.019	0.018	0.010	0.010	0.014
lb/hr	7.09	6.68	3.89	3.82	5.37
lb/ton of product	0.054	0.051	0.022	0.022	0.037
Total catch					
gr/dscf	0.024	0.024	0.013	0.013	0.018
gr/acf	0.021	0.020	0.011	0.011	0.016
lb/hr	7.51	7.28	4.03	3.89	5.68
lb/ton of product	0.058	0.056	0.023	0.022	0.040

Table A-5. ASPHALT CONCRETE FACILITY D,

SUMMARY OF RESULTS

Run number	1	2	Average
Date	10/29/71	10/29/71	
Test time, minutes	48	48	48
Production rate, tons/hr	221	234	222.5
Stack effluent			
Flow rate, dscfm	24,028	23,919	23,974
Flow rate, dscf/ton product	6523	6133	6328
Temperature, °F	238	230	234
Water vapor, vol. %	21.6	23.2	22.40
CO ₂ , vol. % dry	3.0	4.6	3.8
O ₂ , vol. % dry	14.8	12.7	13.8
CO, vol. % dry	0	0	0
Visible emissions, % opacity	<10	<10	<10
Particulate emissions			
Probe and filter catch			
gr/dscf	0.0122	0.0234	0.0178
gr/acf	0.0071	0.0136	0.0104
lb/hr	2.49	4.80	3.64
lb/ton of product	0.010	0.020	0.015
Total catch			
gr/dscf	0.0517	0.1281	0.0899
gr/acf	0.0302	0.0746	0.0524
lb/hr	10.64	26.26	18.45
lb/ton of product	0.044	0.109	0.076

Table A-6. ASPHALT CONCRETE FACILITY E,

SUMMARY OF RESULTS

Run number	1	2	Average
Date	11/4/71	11/11/71	
Test time, minutes	65	65.4	65.2
Production rate, tons/hr	--	--	--
Stack effluent			
Flow rate, dscfm	21,706	21,651	21,678
Flow rate, dscf/ton product	--	--	--
Temperature, °F	262	268	266
Water vapor, vol. %	23.3	27.1	25.2
CO ₂ , vol. % dry	--	--	--
O ₂ , vol. % dry	--	--	--
CO, vol. % dry	--	--	--
Visible emissions, % opacity	--	--	--
Particulate emissions			
Probe and filter catch			
gr/dscf	0.0163	0.0215	0.0189
gr/acf	0.0093	0.0122	0.0108
lb/hr	3.03	3.99	3.51
lb/ton of product	--	--	--
Total catch			
gr/dscf	0.025	0.029	0.027
gr/acf	0.0142	0.0160	0.0151
lb/hr	4.74	5.47	5.10
lb/ton of product	--	--	--

Table A-7. ASPHALT CONCRETE FACILITY E,

SUMMARY OF RESULTS

Run number	1	2	Average
Date	9/25/68	9/26/68	
Test time, minutes	120	120	120
Production rate, tons/hr	--	--	--
Stack effluent			
Flow rate, dscfm	26,160	26,160	26,160
Flow rate, dscf/ton product	--	--	--
Temperature, °F	281	281	281
Water vapor, vol. %	24	24	24
CO ₂ , vol. % dry	No orsat available		
O ₂ , vol. % dry	No orsat available		
CO, vol. % dry	No orsat available		
Visible emissions, % opacity	--	--	--
Particulate emissions			
Probe and filter catch			
gr/dscf	Could not be calculated from test report		
gr/acf			
lb/hr			
lb/ton of product			
Total catch			
gr/dscf	0.006	0.007	0.0065
gr/acf	0.003	0.004	0.004
lb/hr	1.35	1.57	1.46
lb/ton of product	--	--	--

Table A-8. ASPHALT CONCRETE FACILITY G,
SUMMARY OF RESULTS^a

Run number	1	2	Average
Date	7/23/70	7/23/70	
Test time, minutes	60	60	60
Production rate, tons/hr	74	--	--
Stack effluent			
Flow rate, dscfm	17,092	--	--
Flow rate, dscf/ton product	13,858	--	--
Temperature, °F	107	--	--
Water vapor, vol. %	2.0	--	--
CO ₂ , vol. % dry	No orsat available		
O ₂ , vol. % dry	No orsat available		
CO, vol. % dry	No orsat available		
Visible emissions, % opacity	--	--	--
Particulate emissions			
Probe and filter catch			
gr/dscf	0.0133	0.0162	0.01525
gr/acf	0.0122	--	--
lb/hr	1.994	--	--
lb/ton of product	0.027	--	--
Total catch			
gr/dscf	0.0143	--	--
gr/acf	0.0134	--	--
lb/hr	0.029	--	--
lb/ton of product	2.137	--	--

^aTested by local agency using Code Method 3.

Table A-9. ASPHALT CONCRETE FACILITY H₁,
SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	11/4/71	11/4/71	11/5/71	
Test time, minutes	54	54	54	54
Production rate, tons/hr	176	193	170	180
Stack effluent				
Flow rate, dscfm	28,217	28,118	26,126	27.487
Flow rate, dscf/ton product	9619	8741	9221	9194
Temperature, °F	112	109.1	122	114
Water vapor, vol. %	9.2	8.4	12.2	9.93
CO ₂ , vol. % dry	3.3	3.1	3.9	3.4
O ₂ , vol. % dry	16.6	16.4	15.9	16.3
CO, vol. % dry	0.1	0	0	0
Visible emissions, % opacity	--	--	--	--
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0314	0.0340	0.0292	0.0315
gr/acf	0.0259	0.0282	0.0229	0.0257
lb/hr	7.63	8.15	6.27	7.35
lb/ton of product	0.043	0.042	0.037	0.041
Total catch				
gr/dscf	0.0497	0.1087	0.0555	0.0713
gr/acf	0.0409	0.0901	0.0435	0.0582
lb/hr	12.02	26.19	12.43	16.88
lb/ton of product	0.068	0.136	0.073	0.092

Table A-10. ASPHALT CONCRETE FACILITY H₂.

SUMMARY OF RESULTS

Run number	1
Date	11/17/71
Test time, minutes	70
Production rate, tons/hr	200
Stack effluent	
Flow rate, dscfm	29,400
Flow rate, dscf/ton product	8820
Temperature, °F	110
Water vapor, vol. %	8.7
CO ₂ , vol. % dry	--
O ₂ , vol. % dry	--
CO, vol. % dry	--
Visible emissions, % opacity	--
Particulate emissions	
Probe and filter catch	
gr/dscf	0.011
gr/acf	--
lb/hr	--
lb/ton of product	--
Total catch	
gr/dscf	0.022
gr/acf	--
lb/hr	5.05
lb/ton of product	0.025

Table A-11. ASPHALT CONCRETE FACILITY I,

SUMMARY OF RESULTS

Run number	1
Date	7/17/72
Test time, minutes	--
Production rate, tons/hr	--
Stack effluent	
Flow rate, dscfm	30,460
Flow rate, dscf/ton product	--
Temperature, °F	175
Water vapor, vol. %	15
CO ₂ , vol. % dry	--
O ₂ , vol. % dry	--
CO, vol. % dry	--
Visible emissions, % opacity	--
Particulate emissions	
Probe and filter catch	
gr/dscf	0.025
gr/acf	--
lb/hr	6.45
lb/ton of product	--
Total catch	
gr/dscf	0.026
gr/acf	--
lb/hr	6.75
lb/ton of product	--

Table A-12. ASPHALT CONCRETE FACILITY J,

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	(10/16/72 and 10/17/72)			
Test time, minutes	80	80	80	80
Production rate, tons/hr	--	--	--	--
Stack effluent				
Flow rate, dscfm	17,060	17,060	17,060	17,060
Flow rate, dscf/ton product	--	--	--	--
Temperature, °F	268	268	268	268
Water vapor, vol. %	25	25	25	25
CO ₂ , vol. % dry	--	--	--	--
O ₂ , vol. % dry	--	--	--	--
CO, vol. % dry	--	--	--	--
Visible emissions, % opacity	--	--	--	--
Particulate emissions				
Probe and filter catch				
gr/dscf	0.00571	0.01142	0.01423	0.01012
gr/acf	--	--	--	--
lb/hr	2.89	1.894	2.301	2.362
lb/ton of product	--	--	--	--

Table A-13. ASPHALT CONCRETE FACILITY K,

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	8/22/72	8/22/72	8/22/72	
Test time, minutes	61.25	61.25	61.25	61.25
Production rate, tons/hr	120	120	120	120
Stack effluent				
Flow rate, dscfm	23,000	21,700	17,800	20,500
Flow rate, dscf/ton product	11,500	10,850	8900	10,417
Temperature, °F	207	205	189	200
Water vapor, vol. %	14.3	14.0	16	14.8
CO ₂ , vol. % dry	4	4	4	4
O ₂ , vol. % dry	15	15	15	15
CO, vol. % dry	0	0	0	0
Visible emissions, % opacity	--	--	--	--
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0534	0.0918	0.180	0.108
gr/acf	--	--	--	--
lb/hr	10.5	17.1	27.5	18.4
lb/ton of product	0.0875	0.1425	0.2291	0.1530

Table A-14. ASPHALT CONCRETE FACILITY L,

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	8/21/72	8/21/72	8/21/72	
Test time minutes	60	60	60	60
Production rate, tons/hr	208	200	200	200
Stack effluent				
Flow rate, dscfm	29,900	30,700	27,200	29,267
Flow rate, dscf/ton product	8970	9210	8160	8780
Temperature, °F	193	200	200	198
Water vapor, vol. %	22.3	21.0	26.7	23.3
CO ₂ , vol. % dry	6	6	6	6
O ₂ , vol. % dry	12	12	12	12
CO, vol. % dry	0	0	0	0
Visible emissions, % opacity	--	--	--	--
Particulate emissions				
Probe and filter catch				
gr/dscf	0.00447	0.00402	0.0131	0.00720
gr/acf	--	--	--	--
lb/hr	14.1	1.06	3.05	1.75
lb/ton of product	0.0057	0.0053	0.0152	0.0087

Table A-15. ASPHALT CONCRETE FACILITY M,

SUMMARY OF RESULTS

Run number	1	2	Average
Date	7/14/72	7/14/72	
Test time, minutes	67.5	67.5	67.5
Production rate, tons/hr	173	132	153
Stack effluent			
Flow rate, dscfm	18,290	18,270	18,280
Flow rate, dscf/ton product	6345	8304	7325
Temperature, °F	251	245	248
Water vapor, vol. %	27.1	26.2	26.7
CO ₂ , vol. % dry	8	8	8
O ₂ , vol. % dry	10.6	10.6	10.6
CO, vol. % dry	0	0	0
Visible emissions, % opacity	--	--	--
Particulate emissions			
Probe and filter catch			
gr/dscf	0.043	0.043	0.043
gr/acf	--	--	--
lb/hr	6.74	6.73	6.735
lb/ton of product	0.0389	0.0501	0.0445

PETROLEUM REFINERIES
FLUID CATALYTIC CRACKING UNITS

PARTICULATE TEST RESULTS

Stack tests were carried out at four fluid catalytic cracking (FCC) units located in different petroleum refineries. At each installation, carbon monoxide emissions were controlled by the use of an incinerator waste heat boiler (carbon monoxide boiler) and particulate matter by the use of an electrostatic precipitator. Effluent gases were sampled after they had passed through both control devices. At one of the sites tested by EPA, particulate emissions also were measured by refinery personnel. Six other units were tested by a local agency and one by a refinery.

Facilities:

- A. FCC unit of about 55,000-bbl/day capacity, equipped with an electrostatic precipitator followed by a carbon monoxide boiler. Tables A-16 and A-17 summarize results of tests conducted in December 1971 and February 1972. Unit had been onstream about six months and eight months, respectively, following the last major turnaround. Additional source test data were supplied by the refinery and are listed in Table A-21. These were determined using Code Method 6.
- B. FCC unit of about 70,000-bbl/day capacity, equipped with a carbon monoxide boiler followed by an electrostatic precipitator. Unit had been onstream about 10 months following the last

major turnaround at the time of the test. Ammonia was injected into the gas stream ahead of the precipitator as a conditioning agent.

- C. FCC unit of about 65,000-bbl/day capacity, equipped with a carbon monoxide boiler followed by an electrostatic precipitator. Unit had been onstream about 13 months following the last major turnaround. Ammonia was injected into the effluent ahead of the precipitator as a conditioning agent. During the test, a malfunction occurred in the FCC unit.
- D. FCC unit of about 55,000-bbl/day capacity, equipped with an electrostatic precipitator followed by a carbon monoxide boiler. Unit had been onstream about 8 months following the last major turnaround. During the test, an equipment malfunction occurred, invalidating the particulate results.
- E. FCC unit of about 45,000-bbl/day capacity, equipped with an electrostatic precipitator followed by a carbon monoxide boiler. Tested by refinery personnel using Code Method 6 (alundum thimble packed with glass wool followed by a Gelman type A glass fiber filter). Emission data gathered over 18-month period of operation.
- F. FCC unit of about 65,000-bbl/day capacity, equipped with a carbon monoxide boiler followed by an electrostatic precipitator. Tested by local control agency using Code Method 5.

- G. FCC unit of about 30,000-bbl/day capacity, equipped with an electrostatic precipitator followed by a carbon monoxide boiler. Tested by local control agency using Code Method 5.
- H. FCC unit of 45,000-bbl/day capacity, equipped with an electrostatic precipitator followed by a carbon monoxide boiler. Tested by local control agency using Code Method 5.
- I. FCC unit of about 55,000-bbl/day capacity, equipped with an electrostatic precipitator followed by a carbon monoxide boiler. Tested by local control agency using Code Method 5.
- J. FCC unit of about 45,000-bbl/day capacity, equipped with a carbon monoxide boiler followed by an electrostatic precipitator. Tested by local control agency using Code Method 5.
- K. FCC unit of about 55,000-bbl/day capacity, equipped with an electrostatic precipitator followed by a carbon monoxide boiler. Tested by local control agency using Code Method 5.

Table A-16. CATALYTIC CRACKING FACILITY A₁.

SUMMARY OF RESULTS				
Run number	1	2	3	Average
Date	12/16/71	12/17/71	12/17/71	
Test time, minutes	120	120	120	120
Stack effluent				
Flow rate, dscfm	185,200	175,600	171,100	177,300
Temperature, °F	645	655	661	653
Water vapor, vol. %	17.9	19.4	19.7	19
CO ₂ , vol. % dry	13	14	14	14
O ₂ , vol. % dry	4	4	4	4
Carbon monoxide emissions, ppm (volume)	14	Nil	Nil	5
Visible emissions, % opacity	10	10	10	10
Particulate emissions				
Probe and filter catch				
gr/dscf	0.1021 ^a	0.0156	0.0114	0.0135
gr/acf	0.0410	0.0061	0.0044	0.0053
lb/hr	161.9 ^a	23.5	16.7	20.1
Total catch				
gr/dscf	0.2866 ^a	0.0246	0.0174	0.0210
gr/acf	0.1150 ^a	0.0096	0.0067	0.0034
lb/hr	455.6	37.0	25.5	31.2

^aExcessive emissions. Test run not considered representative of normal operation, and not included in averages.

Table A-17. CATALYTIC CRACKING FACILITY A₂.

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	2/8/72	2/9/72	2/10/72	
Test time, minutes	120	120	120	120
Stack effluent				
Flow rate, dscfm	183,800	183,900	184,700	184,100
Temperature, °F	652	666	686	668
Water vapor, vol. %	21.5	20.9	22.0	21.5
CO ₂ , vol. % dry	11.2	12.8	13.2	12.4
O ₂ , vol. % dry	6.4	4.4	4.0	4.9
Carbon monoxide emissions, 10 ppm (volume)		9	11	10
Visible emissions, % opacity	10	10	10	10
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0233	0.0202	0.0225	0.0220
gr/acf	0.0088	0.0076	0.0082	0.0082
lb/hr	36.7	31.8	35.6	34.7
Total catch				
gr/dscf	0.0331	0.0272	0.0308	0.0304
gr/acf	0.0125	0.0102	0.0112	0.0113
lb/hr	52.1	42.8	48.7	47.9

Table A-18. CATALYTIC CRACKING FACILITY B.

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	12/9/71	12/9/71	12/10/71	
Test time, minutes	120	60	60	80
Stack effluent				
Flow rate, dscfm	180,600	183,500	187,000	183,700
Temperature, °F	543	519	547	536
Water vapor, vol. %	14.5	15.5	16.9	15.6
CO ₂ , vol. % dry	13.0	12.0	14.0	13.0
O ₂ , vol. % dry	3.0	3.8	3.0	3.3
Carbon monoxide emissions, Nil ppm (volume)		Nil	Nil	Nil
Visible emissions, % opacity	30	30	25	30
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0355	0.0364	0.0403	0.0374
gr/acf	0.0161	0.0166	0.0177	0.0168
lb/hr	54.2	56.6	64.1	58.3
Total catch				
gr/dscf	0.1055	0.1320	0.1219	0.1198
gr/acf	0.0480	0.0602	0.0534	0.0539
lb/hr	162.5	207.6	195.5	188.5

Table A-20. CATALYTIC CRACKING FACILITY D.

SUMMARY OF RESULTS					
Run number	1	2	3	4	Average
Date	12/14/71	12/15/71	12/16/71	12/16/71	
Test time, minutes	160	240	120	120	160
Stack effluent					
Flow rate, dscfm	196,400	186,400	205,000	195,800	195,900
Temperature, °F	739	732	723	734	732
Water vapor, vol. %	24.7	23.2	20.6	25.9	23.6
CO ₂ , vol. % dry	7.0	7.0	10.2	13.1	9.3
O ₂ , vol. % dry	12.4	12.4	7.4	3.8	9.0
Carbon monoxide emissions, ppm (volume)	Nil	Nil	Nil	6	Nil
Visible emissions, % opacity	15	10	15	15	15

Table A-19. CATALYTIC CRACKING FACILITY C.

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	1/11/72	1/12/72	1/13/72	
Test time, minutes	140	138	224	196
Stack effluent				
Flow rate, dscfm	91,200	93,600	87,900	90,900
Temperature, °F	459	489	456	468
Water vapor, vol. %	16.9	16.4	20.1	17.3
CO ₂ , vol. % dry	9	9	9	9
O ₂ , vol. % dry	4	4	4	4
Carbon monoxide emissions, ppm (volume)	16	38	17	16
Visible emissions, % opacity	15	20	15	15
Particulate emissions ^b				

Probe and filter catch

Total catch	1/11/72		1/12/72		1/13/72		Average
	gr/dscf	gr/acf	gr/dscf	gr/acf	gr/dscf	gr/acf	
	0.2366	0.1136	0.2092	0.0979	0.2159	0.0978	
	184.8	184.8	167.8	162.5	162.5	162.5	
	0.0380	0.0182	0.1066	0.0499	0.0369	0.0167	
	29.7	29.7	85.5	27.8	27.8	27.8	
	0.0380	0.0182	0.0589	0.0282	0.0352	0.0169	
	29.7	29.7	49.0	27.4	27.4	27.4	
	0.0450	0.0213	0.0450	0.0213	0.0450	0.0213	
	36.5	36.5	36.5	36.5	36.5	36.5	
	0.0367	0.0173	0.0367	0.0173	0.0367	0.0173	
	28.3	28.3	28.3	28.3	28.3	28.3	
	0.0702	0.0331	0.0702	0.0331	0.0702	0.0331	
	57.0	57.0	57.0	57.0	57.0	57.0	

^a b stack precipitator was not functioning properly throughout test.

^b Malfunction of test equipment invalidated particulate results.

Table A-21. ADDITIONAL PARTICULATE EMISSION DATA
FOR CATALYTIC CRACKING FACILITIES

Facility A ₃ ^a	Stack Effluent flow rate, dscfm	Concentration		Emission rate, lb/hr
		gr/dscf	gr/acf	
Low	166,000	0.010	0.0031	16
High	202,000	0.021	0.0067	34
Average	181,000	0.014	0.0044	22
Facility E ^b				
Low	106,000	0.015	0.0066	13.6
High	194,000	0.022	0.0094	28.2
Average	161,000	0.017	0.0076	23.3
Control agency data ^c				
Unit F	169,500	0.017	0.0077	24.7
Unit G	233,300	0.018	0.0059	36.0
Unit H	171,600	0.017	0.0062	25.0
Unit I	224,400	0.013	0.0045	25.0
Unit J	198,300	0.020	0.0085	34.0
Unit K	226,900	0.018	0.0061	35.0

^aData covers 7 months operation with two emission tests per month, alundum thimble plus glass fiber filter (Code Method 6).

^bData covers 17 months operation with an emission test about every 2 months, alundum thimble plus glass fiber filter (Code Method 6).

^cData supplied by control agency covering 18 emission tests, Los Angeles County APCD method (Code Method 5). Impingers precede filter.

SECONDARY LEAD SMELTERS AND REFINERIES,
BLAST AND REVERBERATORY FURNACES

Test results are summarized for seven blast furnaces and three reverberatory furnaces. A local agency supplied test data for three of the blast furnaces and one reverberatory furnace. Nine of the 10 furnaces were equipped with baghouses, six employed afterburners to burn combustibles, and two units had scrubbers for control of sulfur dioxide.

Facilities:

- A. Blast furnace rated at 77 tons of lead per day, equipped with an afterburner and baghouse.
- B. Two blast furnaces having a combined rating of 80 tons of lead per day, equipped with an afterburner, baghouse, and venturi scrubber, calcium hydroxide liquor circulated in scrubber.
- C. Blast furnace rated at 45 tons of lead per day, equipped with a caustic venturi scrubber, sodium hydroxide liquor circulated in scrubber.
- D. Blast furnace having an estimated production rate of 90 tons of lead per day, equipped with afterburner and baghouse. Tested by local agency using Code Method 9.
- E. Blast furnace having an estimated production of 20 tons of lead per day, equipped with afterburner and baghouse. Tested by local agency using Code Method 9.

- F. Blast furnace having an estimated production rate of 52 tons of lead per day, equipped with afterburner and baghouse. Tested by local agency using Code Method 9.
- G. Reverberatory furnace rated at 40 tons of lead per day equipped with baghouse.
- H. Reverberatory furnace rated at 65 tons of lead per day, equipped with baghouse.
- I. Reverberatory furnace having an estimated production of 20 tons of lead per day, equipped with a baghouse. Tested by local agency using Code Method 9.

Table A-22. LEAD SMELTING FACILITY A,

SUMMARY OF RESULTS				
Run number	1	2	3	Average
Date	11/17/71	11/18/71	11/18/71	
Test time, minutes	91	188	186	155
Lead production, tons/hr	3.7	2.5	3.0 ^a	3.1
Stack effluent				
Flow rate, dscfm	23,200	22,900	23,120	23,070
Flow rate, dscf/ton	376,200	549,600	462,400	462,700
Temperature, °F	176	182	177	178
Water vapor, vol. %	3.7	2.3	3.1	3.0
CO ₂ , vol. % dry	2.2	2.1	1.5	1.9
O ₂ , vol. % dry	19.0	19.0	19.5	19.2
CO emissions, vol. % dry	0.5	0.2	0.4	0.36
CO emissions, lb/hr	503	199	401	368
SO ₂ emissions, ppm dry	443	264	204	304
SO ₂ emissions, lb/hr	101	59	46	69
Visible emissions, % opacity	10 to 15	10 to 70	5 to 15	12
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0028	0.0027	0.0023	0.0026
gr/acf	0.0022	0.0021	0.0018	0.0020
lb/hr	0.5541	0.5231	0.4570	0.5114
lb/ton lead	0.1498	0.2092	0.1523	0.1704
Total catch				
gr/dscf	--	0.0471	0.0396	0.0434
gr/acf	--	0.0368	0.0310	0.0339
lb/hr	--	9.2439	7.8566	8.5503
lb/ton lead	--	3.6976	2.6189	3.1583
Lead emissions				
Probe and filter catch				
gr/dscf	--	0.00035	0.00033	0.00034
gr/acf	--	0.00027	0.00026	0.00027
lb/hr	--	0.0679	0.0648	0.0664
lb/ton lead	--	0.0272	0.0216	0.0244
Total catch				

Essentially the same as probe and filter.

^aThe lead holding pot level was altered by plant personnel during this test and a rate based on average production figures was assumed.

Table A-23. LEAD SMELTING FACILITY B,

Run number	SUMMARY OF RESULTS			
	1	2	3	Average
Date	12/15/71	12/16/71	12/16/71	
Test time, minutes	195	200	200	198
Lead production, tons/hr	4.2	4.9	3.5	4.2
Stack effluent				
Flow rate, dscfm	32,060	29,420	38,060	32,960
Flow rate, dscf/ton	458,000	360,200	652,500	490,200
Temperature, °F	124	121	118	121
Water vapor, vol. %	6.34	10.33	11.04	9.24
CO ₂ , vol. % dry	3.2	2.8	3.4	3.1
O ₂ , vol. % dry	16.8	17.0	16.4	16.7
CO emissions, vol. % dry	<0.1	0.2	0.4	0.23
CO emissions, lb/hr	139	255	660	350
SO ₂ emissions, ppm dry	1050	310	138	499
SO ₂ emissions, lb/hr	334	90	52	159
SO ₂ inlet, ppm dry	1680 ^a	1100	1900 ^b	1560
SO ₂ inlet, lb/hr	534	321	718	524
Visible emissions, % opacity	--	--	--	--
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0079	0.0042	0.0115	0.0079
gr/acf	0.0066	0.0033	0.0094	0.0064
lb/hr	2.1743	1.0551	3.7600	2.3298
lb/ton lead	0.5177	0.2153	1.0743	0.6024
Total catch				
gr/dscf	0.0417	0.0364	0.0454	0.0412
gr/acf	0.0348	0.0290	0.0372	0.0366
lb/hr	11.4461	9.1715	14.8245	11.8140
lb/ton lead	2.7253	1.8717	4.2356	2.9442
Lead emissions				
Probe and filter catch				
gr/dscf	0.00011	0.00013	0.00016	0.00013
gr/acf	0.00009	0.00010	0.00013	0.00011
lb/hr	0.0300	0.0328	0.0506	0.0378
lb/ton lead	0.0070	0.0067	0.0145	0.0094
Total catch	Essentially the same as probe and filter.			

^aScrubber pH acid for portions of test (control efficient lowered).^bScrubber operating properly. 34

Table A-24. LEAD SMELTING FACILITY C,

Run number	SUMMARY OF RESULTS			
	1	2	3	Average
Date	12/8/71	12/9/71	12/9/71	
Test time, minutes	120	112	112	115
Lead production, tons/hr	1.5	1.2	1.2	1.3
Stack effluent				
Flow rate, dscfm	12,100	13,330	12,540	12,657
Flow rate, dscf/ton	484,000	666,500	627,000	592,500
Temperature, °F	97	95	93	95
Water vapor, vol. %	2.4	1.7	2.3	2.13
CO ₂ , vol. % dry	0.5	0.8	0.8	0.7
O ₂ , vol. % dry	20.3	20.2	18.8	19.7
CO emissions, vol. % dry	0.8	0.3	0.2	0.4
CO emissions, lb/hr	420	160	109	330
SO ₂ emissions, ppm dry	0.06	0.04	0.08	0.06
SO ₂ emissions, lb/hr	0.01	0.01	0.01	0.01
Visible emissions, % opacity	10 to 15	10 to 20	5 to 15	12
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0196	0.0084	0.0149	0.0143
gr/acf	0.0184	0.0080	0.0140	0.0135
lb/hr	2.0354	0.8913	1.6061	1.5109
lb/ton lead	1.3570	0.7750	1.2849	1.1389
Total catch				
gr/dscf	0.0275	0.0157	0.0235	0.0222
gr/acf	0.0257	0.0149	0.0221	0.0208
lb/hr	2.8474	1.6556	2.5200	2.3410
lb/ton lead	1.8983	1.4397	2.0160	1.7847
Lead emissions				
Probe and filter catch				
gr/dscf	0.00127	0.00061	0.00127	0.00105
gr/acf	0.00119	0.00058	0.00120	0.00099
lb/hr	0.1320	0.0646	0.1368	0.1111
lb/ton lead	0.0880	0.0562	0.1095	0.0846
Total catch	Essentially the same as probe and filter			

Table A-25. LEAD SMELTING FACILITY D.

SUMMARY OF RESULTS^a

Lead production, tons/hr	3.9 (estimated)
Stack effluent	
Flow rate, dscfm	20,900
Flow rate, dscf/ton	321,500
Temperature, °F	152
Water vapor, vol. %	8.7
CO ₂ , vol. % dry	4.2
O ₂ , vol. % dry	16.8
CO emissions, vol. % dry	1.5
CO emissions, lb/hr	1363
SO ₂ emissions, ppm dry	1170
SO ₂ emissions, lb/hr	248
Visible emissions, % opacity	0
Particulate emissions	
Probe and filter catch	
gr/dscf	0.0013
gr/acf	0.0010
lb/hr	0.233
lb/ton lead	0.060
Total catch	
gr/dscf	0.0075
gr/acf	0.0059
lb/hr	1.344
lb/ton lead	0.345
Lead emissions	
Probe and filter catch	
gr/dscf	0.00061
gr/acf	0.00048
lb/hr	0.1093
lb/ton lead	0.0280

^aTested by local agency using Code Method 9.

Table A-26. LEAD SMELTING FACILITY E.

SUMMARY OF RESULTS^a

Lead production, tons/hr	0.8 (estimated)
Stack effluent	
Flow rate, dscfm	13,000
Flow rate, dscf/ton	975,000
Temperature, °F	175
Water vapor, vol. %	3.9
SO ₂ emissions, ppm dry	300
SO ₂ emissions, lb/hr	40
Visible emissions, % opacity	0
Particulate emissions	
Probe and filter catch	
gr/dscf	0.0059
gr/acf	0.0047
lb/hr	0.657
lb/ton lead	0.822
Total catch	
gr/dscf	0.0350
gr/acf	0.0281
lb/hr	3.900
lb/ton lead	4.875

^aTested by local agency using Code Method 9.

Table A-27. LEAD SMELTING FACILITY F,

SUMMARY OF RESULTS^a

Lead production, tons/hr	2.2 (estimated)
Stack effluent	
Flow rate, dscfm	7500
Flow rate, dscf/ton	204,500
Temperature, °F	110
Visible emissions, % opacity	10 to 30
Particulate emissions	
Probe and filter catch	
gr/dscf	0.0142
lb/hr	0.913
lb/ton lead	0.415
Total catch	
gr/dscf	0.084
lb/hr	5.400
lb/ton lead	2.455

^aTested by local agency using Code Method 9.

Table A-28. LEAD SMELTING FACILITY G,

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	1/26/72	1/26/72	1/26/72	
Test time, minutes	120	120	120	120
Lead production, tons/hr	2.1	2.1	2.1	2.1
Stack effluent				
Flow rate, dscfm	14,600	15,200	14,200	14,667
Flow rate, dscf/ton	417,100	434,300	405,700	419,000
Temperature, °F	166	164	175	168
Water vapor, vol. %	3.1	2.8	3.1	3.0
CO ₂ , vol. % dry	1.8	1.8	1.8	1.8
O ₂ , vol. % dry	18.6	18.7	18.7	18.7
CO emissions, vol. % dry	<0.1	<0.1	<0.1	<0.1
CO emissions, lb/hr	63.5	66.0	61.7	63.7
SO ₂ emissions, ppm dry	1580	1525	1618	1574
SO ₂ emissions, lb/hr	229	230	228	229
Visible emissions, % opacity	0	0	0	0
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0043	0.0028	0.0035	0.0035
gr/acf	0.0035	0.0023	0.0028	0.0029
lb/hr	0.5387	0.3702	0.4297	0.4462
lb/ton lead	0.2565	0.1763	0.2046	0.2125
Total catch				
gr/dscf	0.0132	0.0086	0.0200	0.0139
gr/acf	0.0170	0.0070	0.0161	0.0113
lb/hr	1.6520	1.1148	2.4321	1.7330
lb/ton lead	0.7867	0.5309	1.1581	0.8252
Lead emissions				
Probe and filter catch				
gr/dscf	0.00090	0.00049	0.00045	0.00061
gr/acf	0.00073	0.00040	0.00037	0.00050
lb/hr	0.1130	0.0640	0.0553	0.0775
lb/ton lead	0.0538	0.0305	0.0263	0.0369
Total catch				
gr/dscf	0.0010	--	--	0.00100
gr/acf	0.00081	--	--	0.00081
lb/hr	0.1262	--	--	0.1262
lb/ton lead	0.0601	--	--	0.0601

Table A-29. LEAD SMELTING FACILITY H,

SUMMARY OF RESULTS				
Run number	1	2	3	Average
Date	2/9/72	2/9/72	2/10/72	
Test time, minutes	150	150	150	150
Lead production, tons/hr	2.4	2.4	2.4	2.4
Stack effluent				
Flow rate, dscfm	23,480	22,600	19,940	22,007
Flow rate, dscf/ton	587,000	565,000	498,500	550,200
Temperature, °F	124	132	117	124
Water vapor, vol. %	4.0	4.6	4.2	4.3
CO ₂ , vol. % dry	2.4	2.5	2.0	2.3
O ₂ , vol. % dry	18.2	18.0	18.2	18.1
CO emissions, vol. % dry	<0.1	<0.1	<0.1	<0.1
CO emissions, lb/hr	<102	<98	<87	<96
SO ₂ emissions, ppm dry	2060	2111	1930	2034
SO ₂ emissions, lb/hr	480	473	381	445
Visible emissions, % opacity	0	0	0	0
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0024	0.0033	0.0042	0.0033
gr/acf	0.0021	0.0027	0.0036	0.0028
lb/hr	0.4890	0.6350	0.7205	0.6148
lb/ton lead	0.2038	0.2646	0.3002	0.2562
Total catch				
gr/dscf	0.0118	0.0131	0.0164	0.0138
gr/acf	0.0100	0.0109	0.0140	0.0860
lb/hr	2.3737	2.5398	2.7950	2.5695
lb/ton lead	0.9890	1.0583	1.1646	1.071
Lead emissions				
Probe and filter catch				
gr/dscf	0.00034	0.00039	0.00041	0.00038
gr/acf	0.00029	0.00033	0.00035	0.00032
lb/hr	0.0692	0.0763	0.0695	0.0717
lb/ton lead	0.0288	0.0318	0.0289	0.0298
Total catch				
gr/dscf	0.00050	--	--	0.00050
gr/acf	0.00043	--	--	0.00043
lb/hr	0.1035	--	--	0.1035
lb/ton lead	0.0432	--	--	0.0432

Table A-30. LEAD SMELTING FACILITY I,

SUMMARY OF RESULTS ^a	
Lead production, tons/hr	0.85 (estimated)
Stack effluent	
Flow rate, dscfm	10,400
Flow rate, dscf/ton	734,100
Temperature, °F	327
SO ₂ emissions, ppm dry	1039
SO ₂ emissions, lb/hr	110
Visible emissions, % opacity	0
Particulate emissions	
Probe and filter catch	
gr/dscf	0.0022
lb/hr	0.196
lb/ton lead	0.231
Total catch	
gr/dscf	0.0130
lb/hr	1.159
lb/ton lead	1.363

^aTested by local agency using Code Method 9.

SECONDARY BRASS AND BRONZE REFINING

The data summarized herein cover 13 brass and bronze ingot production furnaces at 9 different test sites. Tests A₁, B, and D were conducted by EPA and EPA contractors. Tests C, E, F, and I were conducted as part of a 1968 study performed jointly by the Brass and Bronze Ingot Institute and the National Air Pollution Control Administration, an EPA predecessor. Tests A₂, G, and H were conducted by local control agencies.

Facilities:

- A. Gas-fired rotary (rotating reverberatory) furnace, 7.5-ton capacity, equipped with two closed suction-type manually cleaned baghouses with a total cloth area of 7181 square feet. Tested by EPA and by local agency, the latter using Code Method 10.
- B. Gas-fired reverberatory (stationary reverberatory) furnace, 100-ton capacity, equipped with a closed suction-type cyclic-cleaned baghouse with a cloth area of 9000 square feet.
- C. Gas-fired reverberatory furnace, 60-ton capacity, equipped with a closed suction-type cyclic-cleaned baghouse with a cloth area of 5940 square feet. Testing using Code Method 4.
- D. Oil-fired rotary furnace, 20-ton capacity, equipped with a closed pressure-type cyclic-cleaned baghouse with a cloth area of 18,661 square feet.
- E. Gas-fired reverberatory furnace, 100-ton capacity, equipped with a closed suction-type cyclic-cleaned baghouse with a cloth area of 7360 square feet. Tested using Code Method 4.
- F. Gas-fired rotary furnace, 17.5-ton capacity, equipped with a closed suction-type cyclic-cleaned baghouse with a cloth area of 20,866 square feet. Tested using Code Method 4.
- G. Two rotary furnaces with a total capacity of 55 tons, equipped with two closed suction-type baghouses with a total cloth area of 41,700 square feet. Probe and filter catch were not analyzed separately.
- H. Two rotary furnaces with a total capacity of 27.5 tons, equipped with three closed suction-type baghouses with a total cloth area of 9536 square feet. Probe and filter catch were not analyzed separately.
- I. One 7.5-ton rotary furnace, one 17.5-ton rotary furnace, and one blast furnace, which was being preheated. All three furnaces were ducted to a closed suction-type cyclic-cleaned baghouse with a cloth area of 20,866 square feet. Tested using Code Method 4.

Table A-31. BRASS AND BRONZE FACILITY A₁.

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	11/10/71	11/10-11/71	11/12/71	
Test time, minutes	582	771	733	695
Heat time, minutes	938	922	912	924
Ingots produced per heat, tons	6.66	7.80	7.21	7.22
Zinc in alloy produced, %	40	37	40	39
Stack effluent				
Flow rate, dscfm	13,539	13,490	13,676	13,568
Temperature, °F	84.9	103.5	106.2	98.2
Water vapor, vol. %	3.303	3.227	3.139	3.223
CO ₂ , vol. % dry	0.6	1.0	0.3	0.6
O ₂ , vol. % dry	18.4	16.8	17.4	17.5
CO, vol. % dry	N11	N11	N11	N11
Visible emissions, % opacity	<10	<10	<10	<10
Particulate emissions				
Probe and filter catch				
gr/dscf	0.002	0.0005	0.0003	0.001
gr/acf	0.001	0.0005	0.0002	0.0006
lb/hr	0.165	0.065	0.010	0.080
lb/ton of product	0.388	0.127	0.066	0.194
Total catch				
gr/dscf	0.0047	0.0011	0.0016	0.0024
gr/acf	0.0043	0.0010	0.0014	0.0022
lb/hr	0.521	0.129	0.185	0.278
lb/ton of product	1.22	0.25	0.37	0.61

Table A-32. BRASS AND BRONZE FACILITY A₂.SUMMARY OF RESULTS^a

Run number	1
Date	5/11/71
Zinc in alloy produced, % (approx.)	40
Stack effluent	
Flow rate, dscfm	15,468
Temperature, °F	125
Particulate emissions	
Total catch	
gr/dscf	0.0023
lb/hr	0.286

^aTested by local agency using Code Method 10. Probe and filter catch not analyzed separately.

Table A-33. BRASS AND BRONZE FACILITY B.

SUMMARY OF RESULTS

Run number	1	2	3	4	Average
Date	11/1/71	11/2-3/71	11/3-4/71	11/4-5/71	
Test time, minutes	120	700	747	780	656
Heat time, minutes	1140	1183	1326	1372	1255
Ingots produced per heat, tons	49.09	59.86	56.36	53.93	54.81
Zinc in alloy produced, %	9	5	5	5	6
Stack effluent					
Flow rate, dscfm	27,515	30,124	25,406	27,114	27,540
Temperature, °F	118	107	106	113	111
Water vapor, vol. %	2.66	1.86	1.85	1.75	2.03
CO ₂ , vol. % dry	0.60	0.58	0.60	0.53	0.58
O ₂ , vol. % dry	19.50	19.58	19.60	19.60	19.57
Excess air at sampling point, %	1112	1117	1205	1210	1176
Visible emissions, % opacity	<10	<10	<10	<10	<10
Particulate emissions					
Probe and filter catch					
gr/dscf	0.006	0.005	0.007	0.004	0.006
gr/acf	0.005	0.005	0.006	0.004	0.005
lb/hr	1.55	1.25	1.46	0.99	1.31
lb/ton of product	0.60	0.41	0.43	0.42	0.46
Total catch					
gr/dscf	0.022	0.007	0.008	0.006	0.011
gr/acf	0.019	0.006	0.008	0.005	0.009
lb/hr	5.081	1.692	1.789	1.356	2.479
lb/ton of product	1.98	0.51	0.68	0.51	0.92

Table A-34. BRASS AND BRONZE FACILITIES C, E, and F.

SUMMARY OF RESULTS^a

Installation	C	E	F
Run number	1	1	1
Date	10/22-23/68	7/9-10/68	7/7-8/68
Test time, minutes	--	1175	879
Heat time, minutes	1326	1174	874
Metal charged per heat, tons	72	52.7	16.7
Zinc in alloy produced, %	9	5	5
Stack effluent			
Flow rate, dscfm	18,052	27,049	33,999
Temperature, °F	--	160	150
Water vapor, vol. %	4.51	5.0	2.6
CO ₂ , vol. % dry	0.57	0.89	0.63
O ₂ , vol. % dry	19.0	17.9	18.2
Excess air at sampling point, %	791.0	484.0	535.0
Visible emissions, % opacity	--	<10	<10
Particulate emissions			
Probe and filter catch			
gr/dscf	0.013	0.014	0.005
gr/acf	--	--	--
lb/hr	1.93	3.16	1.61
lb/ton charged ^b	0.59	1.17	1.41
Total catch			
gr/dscf	0.014	0.014	0.006
gr/acf	--	--	--
lb/hr	2.17	3.32	1.78
lb/ton charged ^b	0.67	1.23	1.56

^aTested using Code Method 4.^bTons of scrap charged was used for these calculations since ingot production rates were unavailable.

Table A-35. BRASS AND BRONZE FACILITY D.

SUMMARY OF RESULTS				
Run number	1	2	3	Average
Date	11/30/71	12/1/71	12/4/71	
Test time, minutes	266	447	256	323
Heat time, minutes	534	828	540	634
Ingot produced per heat, tons	18.03	18.15	20.12	18.77
Zinc in alloy produced, %	31	25	5	20
Stack effluent				
Flow rate, dscfm	28,582	36,922	33,857	33,120
Temperature, °F	144	135	132	137
Water vapor, vol. %	1.250	1.240	1.729	1.486
CO ₂ , vol. % dry	0.300	0.15	0.700	0.383
O ₂ , vol. % dry	20.30	20.66	20.00	20.31
Excess air at sampling point, %	2474	2560	1828	2287
Visible emissions, % opacity	<10	<10	<10	<10
Particulate emissions				
Probe and filter catch				
gr/dscf	0.006	0.008	0.010	0.008
gr/acf	0.005	0.007	0.009	0.007
lb/hr	1.431	2.576	2.929	2.312
lb/ton of product	0.71	2.00	1.31	1.33
Total catch				
gr/dscf	0.009	0.012	0.012	0.011
gr/acf	0.008	0.011	0.010	0.010
lb/hr	2.237	3.826	3.412	3.158
lb/ton of product	1.10	2.92	1.53	1.85

Table A-36. BRASS AND BRONZE FACILITY G.

SUMMARY OF RESULTS ^a			
Run number	1	2	Average
Date	7/15/70	8/20/70	
Test time, minutes	60	90	75
Stack effluent			
Flow rate, dscfm	52,900	52,900	52,900
Temperature, °F	250	250	250
Particulate emissions			
Total catch			
gr/dscf	0.015	0.019	0.017
lb/hr	6.80	8.62	7.71

^aConducted by local agency. Probe and filter catch not analysed separately.

Table A-37. BRASS AND BRONZE FACILITY H.

SUMMARY OF RESULTS ^a							
Run number	1	2	3	4	5	6	Average
Date	8/17/70	8/17/70	3/11/71	3/12/71	3/11/71	3/12/71	
Test time, minutes	60	60	60	60	60	60	60
Stack effluent							
Flow rate, dscfm	8000	8000	4100	4100	--	--	--
Temperature, °F	155	155	--	--	--	--	--
Particulate emissions							
Total catch							
gr/dscf	0.009	0.015	0.019	0.001	0.016	0.012	0.012
lb/hr	0.62	1.02	0.67	0.04	--	--	--

^aConducted by local agency. Probe and filter catch not analyzed separately.

Table A-38. BRASS AND BRONZE FACILITY I.

SUMMARY OF RESULTS				
Run number	1	2	3	Average
Date	7/8/68	7/8/68	7/9/68	
Test time, minutes	60	60	60	60
Stack effluent				
Flow rate, dscfm	33,926	33,807	36,121	34,618
Temperature, °F	215	215	175	202
Water vapor, vol. %	4.5	3.1	3.2	3.6
CO ₂ , vol. % dry	0.65	0.63	1.43	9.03
O ₂ , vol. % dry	17.0	17.0	17.5	17.2
CO, vol. % dry	Nil	Nil	Nil	Nil
Particulate emissions				
Probe and filter catch				
gr/dscf	0.012	0.007	0.010	0.010
lb/hr	3.49	2.04	3.21	2.91
Total catch				
gr/dscf	0.018	0.011	0.021	0.017
lb/hr	5.18	3.32	6.39	4.96

IRON AND STEEL MILLS
BASIC OXYGEN PROCESS FURNACES

Six emission tests were performed by EPA and EPA contractors on six basic oxygen process furnace (BOPF) facilities. The particulate control systems included two electrostatic precipitator systems, one open-hood venturi scrubber system, and two movable closed-hood venturi scrubber systems. Closed-hood Facility A was tested in November 1971 and again in February 1972. There were no visible emissions from any of the plants tested except Facility D.

Each facility consists of two or three BOPFs. Normally, two furnaces are operated at any one time, with the third undergoing routine rebricking and maintenance. Each test consisted of four or six cycles of the furnaces. Testing was initiated immediately after the furnace was charged and discontinued just prior to tapping. Only one furnace was blown with oxygen during any cycle.

Facilities:

- A. Rated capacity each vessel--220 tons of steel per heat, equipped with a closed-hood venturi scrubber system.
- B. Rated capacity each vessel--200 tons of steel per heat, equipped with a closed-hood venturi scrubber system.
- C. Rated capacity each vessel--140 tons of steel per heat, equipped with an open hood ducted to a common electrostatic precipitator.

- D. Rated capacity each vessel--325 tons of steel per heat, each vessel equipped with an open hood ducted to a common venturi scrubber system. Oil is burned in the hood between oxygen blows to give a constant steam supply.
- E. Rated capacity each vessel--250 tons of steel per heat, equipped with an open hood ducted to a common electrostatic precipitator.

Table A-39. BOPF FACILITY A₁.

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	1/26/72	1/27/72	1/27/72	
Test time, minutes	173	154	156	161
Net output (six heats), tons of steel	1381.0	1372.5	1361.2	1371.6
Stack effluent				
Flow rate, dscfm	58,600	55,600	58,600	57,600
Flow rate, dscf/ton steel	7341	6239	6716	6765
Temperature, °F	123	125	129	126
Water vapor, vol. %	13.4	13.6	12.6	13.2
CO ₂ , vol. % dry		Orsat not run		
O ₂ , vol. % dry		Orsat not run		
CO, vol. % dry ^a		Orsat not run		
Visible emissions, % opacity	0	0	0	0
Particulate emissions				
Probe and filter catch				
gr/dscf	0.002	0.002	0.005	0.003
gr/acf	0.002	0.001	0.004	0.002
lb/ton of steel	0.0021	0.0015	0.0048	0.0028
Total catch				
gr/dscf	0.005	0.004	0.006	0.005
gr/acf	0.004	0.003	0.005	0.004
lb/ton of steel	0.0048	0.0034	0.0061	0.0047

^aStack gases analyzed at point downstream of scrubber but upstream of flare.Table A-40. BOPF FACILITY A₂.

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	11/16/71	11/16-17/71	11/18/71	
Test time, minutes	162	149	168	160
Net output (six heats), tons of steel	1331.0	1321.3	1298.5	1316.9
Stack effluent				
Flow rate, dscfm	58,880	57,808	59,621	58,769
Flow rate, dscf/ton steel	7166	6519	7714	7133
Temperature, °F	119	117	125	120
Water vapor, vol. %	12.9	12.9	9.8	11.9
CO ₂ , vol. % dry	13.0	19.2	20.8	17.7
O ₂ , vol. % dry	8.0	7.3	7.6	7.6
CO, vol. % dry ^a	27.0	22.0	19.0	22.7
Visible emissions, % opacity	0	0	0	0
Particulate emissions				
Probe and filter catch				
gr/dscf	0.002	0.009	0.003	0.005
gr/acf	0.002	0.007	0.002	0.004
lb/ton of steel	0.0020	0.0083	0.0031	0.0044
Total catch				
gr/dscf	0.005	0.014	0.005	0.004
gr/acf	0.004	0.011	0.004	0.006
lb/ton of steel	0.0052	0.0135	0.0052	0.0039

^aStack gases analyzed at point downstream of scrubber but upstream of flare.

Table A-41. BOPF FACILITY B,

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	10/20/71	10/21/71	10/23/71	
Test time, minutes	222	255	224	234
Net output (six heats), tons of steel	1214.3	1202.7	1223.8	1213.6
Stack effluent				
Flow rate, dscfm	37,154	32,020	48,787	39,300
Flow rate, dscf/ton steel	6792	6788	8930	7503
Temperature, °F	154	161	128	148
Water vapor, vol. %	10.5	12.7	13.4	12.2
CO ₂ , vol. % dry	10.4	9.4	10.8	10.2
O ₂ , vol. % dry	8.7	9.7	7.5	8.6
CO, vol. % dry ^a	27.2	25.2	36.7	29.7
Visible emissions, % opacity	0	0	0	0
Particulate emissions				
Probe and filter catch				
gr/dscf	0.012	0.014	0.011	0.012
gr/acf	0.009	0.011	0.009	0.010
lb/ton of steel	0.0116	0.0141	0.0141	0.0133
Total catch				
gr/dscf	-- ^b	0.016	0.012	0.014
gr/acf	--	0.012	0.010	0.011
lb/ton of steel	--	0.0159	0.0158	0.0158

^aStack gases analyzed at point downstream of scrubber but upstream of flare.

^bThe impinger catch of Run 1 was contaminated with stopcock grease.

Table A-42. BOPF FACILITY C,

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	11/10/71	11/10/71	11/11/71	
Test time, minutes	141	148	164	151
Net output (four heats), tons of steel	569.2	601.5	586.0	585.6
Stack effluent				
Flow rate, dscfm	219,120	215,571	201,071	211,921
Flow rate, dscf/ton steel	54,279	53,042	56,272	54,531
Temperature, °F	238	246	234	238
Water vapor, vol. %	14.6	14.8	15.0	14.8
CO ₂ , vol. % dry	6.2	1.8	5.1	4.4
O ₂ , vol. % dry	16.6	19.2	17.4	17.7
CO, vol. % dry	<1	<1	<1	<1
Visible emissions, % opacity	0	0	0	0
Particulate emissions				
Probe and filter catch				
gr/dscf	0.009	0.005	0.006	0.007
gr/acf	0.006	0.003	0.004	0.004
lb/ton of steel	0.0730	0.0370	0.0471	0.0524
Total catch				
gr/dscf	0.014	0.008	0.010	0.011
gr/acf	0.009	0.005	0.006	0.007
lb/ton of steel	0.1070	0.0631	0.0779	0.0826

Table A-43. BOPF FACILITY D,

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	12/8-9/71	12/10/71	12/10/71	
Test time, minutes	130	126	158	138
Net output (four heats), tons of steel	1376.6	1357.2	1368.1	1367.3
Stack effluent				
Flow rate, dscfm	224,900	217,982	214,100	218,994
Flow rate, dscf/ton steel	21,239	20,237	24,726	22,067
Temperature, °F	134	144	137	138
Water vapor, vol. %	16.2	15.4	12.6	14.7
CO ₂ , vol. % dry	1.2	1.0	1.0	1.1
O ₂ , vol. % dry	19.3	19.9	19.9	19.7
CO, vol. % dry	<1	<1	<1	<1
Visible emissions, % opacity	0 to 20	0 to 20	0 to 20	0 to 20
Particulate emissions				
Probe and filter catch				
gr/dscf	0.035	-- ^a	-- ^a	--
gr/acf	0.026	--	--	--
lb/ton of steel	0.106	--	--	--
Total catch				
gr/dscf	0.042	0.040	0.028	0.0368
gr/acf	0.031	0.029	0.021	0.027
lb/ton of steel	0.1270	0.1160	0.0996	0.1142

^aThe filter in Runs 2 and 3 leaked, and it is impossible to separate the front half catch from the total catch for these runs.

Table A-44. BOPF FACILITY E,

SUMMARY OF RESULTS

Run number	1	2	3	Average
Date	1/12/72	1/12-13/72	1/13-14/72	
Test time, minutes	122	121	115	119
Net output (four heats), tons of steel	1101.5	1102.9	1087.9	1097.4
Stack effluent				
Flow rate, dscfm	522,332	496,657	461,571	493,920
Flow rate, dscf/ton steel	57,852	54,486	48,792	53,742
Temperature, °F	198	196	206	200
Water vapor, vol. %	16.0	19.1	20.8	18.6
CO ₂ , vol. % dry	4.3	4.9	4.9	4.7
O ₂ , vol. % dry	17.6	16.7	16.7	17.0
CO, vol. % dry	<1	<1	<1	<1
Visible emissions, % opacity	0	0	0	0
Particulate emissions				
Probe and filter catch				
gr/dscf	0.020	0.045	0.016	0.027
gr/acf	0.014	0.030	0.010	0.018
lb/ton of steel	0.169	0.352	0.109	0.210
Total catch				
gr/dscf	0.029	0.052	0.023	0.035
gr/acf	0.020	0.034	0.015	0.023
lb/ton of steel	0.244	0.402	0.161	0.269

SEWAGE TREATMENT PLANTS
SEWAGE SLUDGE INCINERATORS

Stack tests were conducted on five sludge incinerators including three multiple hearth units and two fluid bed reactors. One installation was tested both by EPA and a State agency. Four of the incinerators were controlled by impingement-type scrubbers, one was controlled by a venturi scrubber. Pressure drops across the scrubbers ranged from 2.5 to 18 inches of water.

Facilities:

- A. Fluidized bed reactor, 1100-lb/hr dry solids design capacity, operated at 100 percent capacity during test, equipped with a 20-inch-of-water pressure-drop venturi scrubber operated at 18 inches water pressure drop. Tested by EPA and by a State agency, latter using Code Method 8.
- B. Multiple hearth (six hearths) Herreshoff incinerator, 750-lb/hr dry solids design capacity, operated at 64 percent capacity during test, equipped with a 6.0 inch-of-water-pressure-drop single-cross-flow perforated-plate impinjet scrubber.
- C. Multiple hearth (six hearths) Herreshoff incinerator, 900-lb/hr dry solids design capacity, operated at 35 percent capacity during test, equipped with a 6.0-inch-water-pressure-drop single-cross-flow perforated-plate impinjet scrubber.
- D. Fluidized bed reactor, 500-lb/hr dry solids design capacity, operated at 95 percent capacity during test, equipped with a 4.0-inch-water-pressure-drop single-cross-flow perforated-plate impinjet scrubber.

- E. Multiple hearth Herreshoff incinerator, 2500-lb/hr dry solids design capacity, operated at about 50 percent capacity during tests, equipped with a 2.5-inch-water-pressure-drop cyclonic inertial jet scrubber.

Table A-45. SLUDGE INCINERATOR FACILITY A₁.

SUMMARY OF RESULTS				
Run number	1	2	3	Average
Date	1-11-72	1-12-72	1-12-72	
Test time, minutes	108	108	108	108
Furnace feed rate, ton/hr dry solids	0.550	0.560	0.560	0.557
Stack effluent				
Flow rate, dscfm	2880	2550	2660	2700
Flow rate, dscf/ton feed	314,000	273,000	285,000	291,000
Temperature, °F	59	59	59	59
Water vapor, vol. %	1.93	1.92	2.23	2.03
CO ₂ , vol. % dry	12.8	12.6	11.5	12.3
O ₂ , vol. % dry	4.8	4.7	6.4	5.3
CO, vol. % dry	0.0	0.0	0.0	0.0
SO ₂ emissions, ppm	<0.3	<0.3	<0.3	<0.3
NO _x emissions, ppm	4.2	5.7	6.4	5.4
HCl emissions, ppm	<3.8	<2.9	<4.1	<3.6
Visible emissions, % opacity	<10	<10	<10	<10
Particulate emissions				
Probe and filter catch				
gr/dscf	0.024	0.005	0.004	0.011
gr/acf	0.023	0.005	0.004	0.011
lb/hr	0.583	0.116	0.099	0.266
lb/ton of feed	1.06	0.207	0.177	0.481
Total catch				
gr/dscf	0.032	0.007	0.010	0.0163
gr/acf	0.031	0.007	0.010	0.016
lb/hr	0.779	0.160	0.227	0.389
lb/ton of feed	1.42	0.286	0.405	0.704

Table A-46. SLUDGE INCINERATOR FACILITY A₂.

SUMMARY OF RESULTS ^a				
Run number	1	2	3	Average
Date	5-3-71	5-4-71	5-4-71	
Test time, minutes	60	60	60	60
Furnace feed rate, ton/hr dry solids	0.325	0.325	0.325	0.325
Stack effluent				
Flow rate, dscfm	3480	3600	3320	3470
Flow rate, dscf/ton feed	642,500	664,600	612,900	640,600
Temperature, °F	80	80	78	79
Water vapor, vol. %	3.4	3.4	3.4	3.4
CO ₂ , vol. % dry (less aux. fuel)	4.0	5.1	4.0	4.4
SO ₂ emissions ^b	--	--	--	--
Visible emissions Ringelmann No. ^c	<1	<1	<1	<1
Particulate emissions				
Total catch				
gr/dscf (cor. to 12% CO ₂)	0.020	0.031	0.048	0.033
gr/acf	0.019	0.029	0.047	0.032
lb/hr	0.596	0.956	1.365	0.972
lb/ton of feed	1.84	2.94	4.20	2.99

^aTested by local agency using Code Method 1. Probe and filter catch not analyzed separately.

^bNo SO₂ detected.

^cOpacity was not recorded.

Table A-47. SLUDGE INCINERATOR FACILITY B.

SUMMARY OF RESULTS				
Run number	1	2	3	Average
Date	10-13-71	10-14-71	10-14-71	
Test time, minutes	120	120	120	120
Furnace feed rate, tons/hr dry solids	0.237	0.236	0.249	0.241
Stack effluent				
Flow rate, dscfm	3300	2950	2120	2790
Flow rate, dscf/ton feed	835,000	750,000	511,000	699,000
Temperature, °F	198	196	199	198
Water vapor, vol. %	3.64	4.02	3.65	3.77
CO ₂ , vol. % dry	3.8	4.7	2.7	3.7
O ₂ , vol. % dry	17.3	1.40	15.8	15.7
CO, vol. % dry	0.0	0.0	0.0	0.0
SO ₂ emissions, ppm	2.29 to 2.57	2.75	--	2.53
NO _x emissions, ppm	--	--	44.2 to 24.3	27.6
			14.3	
HCl emissions, ppm	--	--	0.624 to 1.33	0.858
			0.621	
Visible emissions, % opacity	<10	<10	<10	<10
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0245	0.0196	0.0173	0.0205
gr/acf	0.0187	0.0155	0.0132	0.0158
lb/hr	0.690	0.495	0.315	0.500
lb/ton of feed	2.91	2.10	1.26	2.09
Total catch				
gr/dscf	0.0374	0.0374	0.0457	0.0402
gr/acf	0.0289	0.0287	0.0348	0.0308
lb/hr	1.06	0.945	0.832	0.946
lb/ton of feed	4.47	4.00	3.34	3.94

Table A-48. SLUDGE INCINERATOR FACILITY C.

SUMMARY OF RESULTS				
Run number	1	2	3	Average
Date	7-15-71	7/15/71	7-16-71	
Test time, minutes	80	80	80	80
Furnace feed rate, tons/hr dry solids	0.111	0.149	0.146	0.135
Stack effluent				
Flow rate, dscfm	1230	1490	1400	1373
Flow rate, dscf/ton feed	665,000	600,000	575,000	613,000
Temperature, °F	80	80	77	79
Water vapor, vol. %	3.23	3.00	2.95	3.06
CO ₂ , vol. % dry	10.0	10.1	10.2	10.1
O ₂ , vol. % dry	7.7	7.3	7.4	7.5
CO, vol. % dry	0.0	0.0	0.0	0.0
SO ₂ emissions, ppm	15.9 to 11.9	14.5 to 14.6	14.6 to 13.3	14.2
NO _x emissions, ppm	402 to 140	90.8 to 74.3	14.5 to 142	163
			50.6 to 61.8	
HCl emissions, ppm	3.50 to 2.62	2.33 to 2.62	2.52 to 2.62	2.72
Visible emissions, % opacity	<10	<10	<10	<10
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0127	0.0620	0.0196	0.0314
gr/acf	0.00985	0.0477	0.0152	0.0242
lb/hr	0.127	0.620	0.196	0.314
lb/ton of feed	1.14	4.16	1.34	2.21
Total catch				
gr/dscf	0.0195	0.0696	0.0260	0.0384
gr/acf	0.0150	0.0535	0.0201	0.0295
lb/hr	0.206	0.889	0.312	0.469
lb/ton of feed	1.86	5.97	2.14	3.23

Table A-49. SLUDGE INCINERATOR FACILITY D.

SUMMARY OF RESULTS				
Run number	1	2	3	Average
Date	7-21-71	7-21-71	7-22-71	
Test time, minutes	120	96	96	104
Furnace feed rate, tons/hr dry solids	0.255	0.237	0.202	0.231
Stack effluent				
Flow rate, dscfm	1190	1170	1240	1200
Flow rate, dscf/ton feed	280,000	296,000	368,000	315,000
Temperature, °F	99	99	95	98
Water vapor, vol. %	3.92	4.09	3.48	3.83
CO ₂ , vol. % dry	8.8	9.9	9.1	9.3
O ₂ , vol. % dry	6.3	7.4	8.2	7.3
CO, vol. % dry	0.0	0.0	0.0	0.0
SO ₂ emissions, ppm	8.29 to 11.2	14.8 to 14.8	14.2 to 15.4	13.8
			17.8	
NO _x emissions, ppm	154 to 168	41.2 to 42.9	187 to 170	132
			161	
HCl emissions, ppm	0.780 to 260	4.16 to 1.56	2.35 to 2.09	2.26
Visible emissions, % opacity	<10	<10	<10	<10
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0551	0.0766	0.0545	0.0621
gr/acf	0.0468	0.0650	0.0467	0.0528
lb/hr	0.562	0.768	0.579	0.636
lb/ton of feed	2.20	3.24	2.87	2.77
Total catch				
gr/dscf	0.0665	0.0859	0.0653	0.0726
gr/acf	0.0565	0.0729	0.0559	0.0618
lb/hr	0.678	0.861	0.694	0.744
lb/ton of feed	2.66	3.63	3.43	3.24

Table A-50. SLUDGE INCINERATOR FACILITY E.

SUMMARY OF RESULTS				
Run number	1	2	3	Average
Date	8-5-71	8-5-71	8-5-71	
Test time, minutes	96	96	96	96
Furnace feed rate, tons/hr dry solids	0.689	0.855	0.290	0.611
Stack effluent				
Flow rate, dscfm	9840	8510	10,290	9547
Flow rate, dscf/ton feed	--	--	--	--
Temperature, °F	135	145	145	142
Water vapor, vol. %	16.3	18.6	14.8	16.6
CO ₂ , vol. % dry	4.2	4.3	2.2	3.6
O ₂ , vol. % dry	14.9	14.9	16.9	15.6
CO, vol. % dry	0.0	0.0	0.0	0.0
SO ₂ emissions, ppm	2.01	2.07	2.12	2.07
NO _x emissions, ppm	62.8 to 46.0	83.5 to 75.8	44.3 to 54.7	61.2
HCl emissions, ppm	11.9	6.83	10.9	9.88
Visible emissions, % opacity	<10	<10	<10	<10
Particulate emissions				
Probe and filter catch				
gr/dscf	0.0260	0.0136	0.0134	0.0177
gr/acf	0.0196	0.0099	0.0101	0.0132
lb/hr	2.19	0.99	1.18	1.45
lb/ton of feed	3.18	1.16	4.07	2.80
Total catch				
gr/dscf	0.0335	0.0221	0.0170	0.0242
gr/acf	0.0252	0.0159	0.0128	0.0180
lb/hr	2.83	1.61	1.50	1.98
lb/ton of feed	4.11	1.88	5.17	3.72