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

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

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RESULTS OF THE MAY 5-7, 1987, ATMOSPHERIC EMISSION TESTS ON THE INDURATION FURNACES AT THE HIBBING TACONITE COMPANY IN HIBBING, MINNESOTA

Submitted to:

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Attention: Bob Ives

Approved by:

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President

Report Number 7-2364
May 14, 1987

TABLE OF CONTENTS

	ABBREVIATIONS	iii
1	INTRODUCTION	1
2	SUMMARY AND DISCUSSION	4
3	RESULTS	12
	3.1 Results of Orsat and Moisture Analyses	13
	3.2 Results of Particulate Loading Determinations	22
	3.3 Results of Sulfur Dioxide Determinations	39
	3.4 Results of Oxides of Nitrogen Determinations	48
	3.5 Results of Carbon Monoxide Determinations	73
	3.6 Results of Lead Determinations	82
	3.7 Results of Beryllium Determinations	91

APPENDICES:

A - Sampling Train Calibration Data
B - Location of Test Ports
C - Methods 2-5 Field Data Sheets for Indurating Line No. 1
D - Methods 2-5 Field Data Sheets for Indurating Line No. 2
E - Method 7 Field Data Sheets
F - Laboratory Data Sheets for Indurating Line No. 1
G - Laboratory Data Sheets for Indurating Line No. 2
H - Method 7 Laboratory Data Sheets
I - Process Rate Information
J - Laboratory Results for Lead and Beryllium Analyses
K - Procedures
L - Calculation Equations

Source category: Taconite ore processing Date: 10/24/96
Plant name : Hibbing Taconite Co. Location: Hibbing, MN
Test date : May 5-7, 1987 Ref. No.: 31
Process : Traveling grate Basis for process rate : production

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	Volumetric flow rate, DSCFM	Concen. %
Traveling grate (natural gas fired) Line 1 Stack 4	Multi-cyclone and wet venturi scrubber	filt. PM	1	10.33	421.00	0.012	0.025		
		filt. PM	2	19.08	416.00	0.023	0.046		
		filt. PM	3	12.97	402.00	0.016	0.032		
				AVERAGE		0.017	0.034	RATING:	
		SO2	1	13.77	421.00	0.016	0.033		
		SO2	2	12.28	416.00	0.015	0.030		
		SO2	3	11.96	402.00	0.015	0.030		
				AVERAGE		0.015	0.031	RATING:	
		NOx	1	91.91	421.00	0.11	0.22		
		NOx	2	80.79	416.00	0.097	0.19		
		NOx	3	69.49	402.00	0.086	0.17		
				AVERAGE		0.098	0.20	RATING:	
		CO	1	7.36	421.00	0.0087	0.017		
		CO	2	6.57	416.00	0.0079	0.016		
		CO	3	6.45	402.00	0.0080	0.016		
				AVERAGE		0.0082	0.016	RATING:	
		Lead	1	0.00935	421.00	1.11E-05	2.22E-05		
		Lead	2	0.01264	416.00	1.52E-05	3.04E-05		
		Lead	3	0.00867	402.00	1.08E-05	2.16E-05		
				AVERAGE		1.24E-05	2.47E-05	RATING:	
		Beryllium	1	3.00E-05	421.00	3.56E-08	7.13E-08		
		Beryllium	2	2.76E-05	416.00	3.32E-08	6.64E-08		
		Beryllium	3	6.70E-05	402.00	8.33E-08	1.67E-07		
				AVERAGE		5.07E-08	1.01E-07	RATING:	
		CO2	1	5797.76	421.00	6.8857	13.7714	140,777	0.60
		CO2	2	8457.20	416.00	10.165	20.330	136,901	0.90
		CO2	3	7377.76	402.00	9.176	18.353	134,356	0.80
				AVERAGE		8.7423	17.485	RATING:	
Traveling grate (natural gas fired) Line 1 Stack 3	Multi-cyclone and wet venturi scrubber	filt. PM	1	10.86	450.00	0.012	0.024		
		filt. PM	2	4.39	389.00	0.0056	0.011		
		filt. PM	3	7.06	441.00	0.0080	0.016		
				AVERAGE		0.0086	0.017	RATING:	
		SO2	1	12.30	450.00	0.014	0.027		
		SO2	2	12.04	389.00	0.015	0.031		
		SO2	3	7.77	441.00	0.009	0.018		
				AVERAGE		0.013	0.025	RATING:	
		NOx	1	70.97	450.00	0.079	0.158		
		NOx	2	73.94	389.00	0.095	0.190		
		NOx	3	53.26	441.00	0.060	0.121		
				AVERAGE		0.078	0.156	RATING:	
		CO	1	3.63	450.00	0.0040	0.0081		
		CO	2	2.96	389.00	0.0038	0.0076		
		CO	3	2.97	441.00	0.0034	0.0067		
				AVERAGE		0.0037	0.0075	RATING:	
		Lead	1	0.01019	450.00	1.13E-05	2.26E-05		
		Lead	2	0.00554	389.00	7.12E-06	1.42E-05		
		Lead	3	0.00706	441.00	8.00E-06	1.60E-05		
				AVERAGE		8.82E-06	1.76E-05	RATING:	
		Beryllium	1	2.51E-05	450.00	2.79E-08	5.57E-08		
		Beryllium	2	1.58E-05	389.00	2.03E-08	4.07E-08		
		Beryllium	3	3.06E-05	441.00	3.47E-08	6.93E-08		
				AVERAGE		2.76E-08	5.52E-08	RATING:	
		CO2	1	5624.79	450.00	6.2498	12.4995	136,577	0.60
		CO2	2	5688.58	389.00	7.312	14.624	138,126	0.60
		CO2	3	5709.91	441.00	6.474	12.948	138,644	0.60
				AVERAGE		6.6785	13.357	RATING:	

Source category: Taconite ore processing Date: 10/24/96
Plant name : Hibbing Taconite Co. Location: Hibbing, MN
Test date : May 5-7, 1987 Ref. No.: 31
Process : Traveling grate Basis for process rate : production

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	Volumetric flow rate, DSCFM	Concen. %
Traveling grate (natural gas fired) Line 1 Stack 2	Multi-cyclone and wet venturi scrubber	filt. PM	1	11.00	396.00	0.014	0.028		
		filt. PM	2	8.59	441.00	0.010	0.019		
		filt. PM	3	9.92	413.00	0.012	0.024		
		AVERAGE				0.012	0.024	RATING:	
		SO2	1	9.43	396.00	0.012	0.024		
		SO2	2	9.27	441.00	0.011	0.021		
		SO2	3	8.62	413.00	0.010	0.021		
		AVERAGE				0.011	0.022	RATING:	
		NOx	1	49.89	396.00	0.063	0.126		
		NOx	2	52.68	441.00	0.060	0.119		
		NOx	3	53.60	413.00	0.065	0.130		
		AVERAGE				0.063	0.125	RATING:	
		CO	1	2.41	396.00	0.003	0.006		
		CO	2	3.09	441.00	0.004	0.007		
		CO	3	3.10	413.00	0.004	0.008		
		AVERAGE				0.003	0.007	RATING:	
		Lead	1	0.00560	396.00	7.07E-06	1.41E-05		
		Lead	2	0.00591	441.00	6.70E-06	1.34E-05		
		Lead	3	0.00553	413.00	6.69E-06	1.34E-05		
		AVERAGE				6.82E-06	1.36E-05	RATING:	
		Beryllium	1	2.08E-05	396.00	2.63E-08	5.25E-08		
		Beryllium	2	1.97E-05	441.00	2.23E-08	4.46E-08		
		Beryllium	3	9.48E-06	413.00	1.15E-08	2.30E-08		
		AVERAGE				2.00E-08	4.00E-08	RATING:	
		CO2	1	3854.85	396.00	4.8672	9.7345	140,401	0.40
		CO2	2	3961.49	441.00	4.491	8.983	144,285	0.40
		CO2	3	3967.45	413.00	4.803	9.606	144,502	0.40
		AVERAGE				4.7206	9.441	RATING:	
Traveling grate (natural gas fired) Line 1 Stack 1	Multi-cyclone and wet venturi scrubber	filt. PM	1	9.58	433.00	0.011	0.022		
		filt. PM	2	10.45	447.00	0.012	0.023		
		filt. PM	3	9.86	382.00	0.013	0.026		
		AVERAGE				0.012	0.024	RATING:	
		SO2	1	15.68	433.00	0.018	0.036		
		SO2	2	9.81	447.00	0.011	0.022		
		SO2	3	9.08	382.00	0.012	0.024		
		AVERAGE				0.014	0.027	RATING:	
		NOx	1	48.03	433.00	0.055	0.111		
		NOx	2	52.47	447.00	0.059	0.117		
		NOx	3	51.11	382.00	0.067	0.134		
		AVERAGE				0.060	0.121	RATING:	
		CO	1	3.90	433.00	0.0045	0.0090		
		CO	2	3.27	447.00	0.0037	0.0073		
		CO	3	3.24	382.00	0.0042	0.0085		
		AVERAGE				0.0041	0.0083	RATING:	
		Lead	1	0.00392	433.00	4.53E-06	9.05E-06		
		Lead	2	0.00554	447.00	6.20E-06	1.24E-05		
		Lead	3	0.00543	382.00	7.11E-06	1.42E-05		
		AVERAGE				5.94E-06	1.19E-05	RATING:	
		Beryllium	1	1.33E-05	433.00	1.54E-08	3.08E-08		
		Beryllium	2	1.98E-06	447.00	2.21E-09	4.43E-09		
		Beryllium	3	1.05E-05	382.00	1.37E-08	2.74E-08		
		AVERAGE				1.04E-08	2.09E-08	RATING:	
		CO2	1	4031.04	433.00	4.6548	9.3095	146,818	0.40
		CO2	2	4193.55	447.00	4.691	9.382	152,737	0.40
		CO2	3	4148.44	382.00	5.430	10.860	151,094	0.40
		AVERAGE				4.9251	9.850	RATING:	

Source category: Taconite ore processing
Plant name : Hibbing Taconite Co.
Test date : May 5-7, 1987
Process : Traveling grate

Date: 10/24/96
Location: Hibbing, MN
Ref. No.: 31
Basis for process rate : production

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	Volumetric flow rate, DSCFM	Concen. %
Traveling grate (petroleum coke and natural gas-fired) Line 2 Stack 4	Multi-cyclone and wet venturi scrubber	filt. PM	1	11.53	427.00	0.014	0.027		
		filt. PM	2	11.62	431.00	0.013	0.027		
		filt. PM	3	12.24	431.00	0.014	0.028		
				AVERAGE		0.014	0.027	RATING:	
		SO2	1	112.20	427.00	0.131	0.263		
		SO2	2	115.52	431.00	0.134	0.268		
		SO2	3	116.52	431.00	0.135	0.270		
				AVERAGE		0.134	0.267	RATING:	
		NOx	1	30.94	427.00	0.036	0.072		
		NOx	2	29.55	431.00	0.034	0.069		
		NOx	3	32.30	431.00	0.037	0.075		
				AVERAGE		0.036	0.072	RATING:	
		CO	1	21.20	427.00	0.025	0.050		
		CO	2	17.40	431.00	0.020	0.040		
		CO	3	22.20	431.00	0.026	0.052		
				AVERAGE		0.024	0.047	RATING:	
		Lead	1	0.03057	427.00	3.58E-05	7.16E-05		
		Lead	2	0.00952	431.00	1.10E-05	2.21E-05		
		Lead	3	0.00666	431.00	7.73E-06	1.55E-05		
				AVERAGE		1.82E-05	3.64E-05	RATING:	
		Beryllium	1	3.92E-05	427.00	4.59E-08	9.18E-08		
		Beryllium	2	3.01E-05	431.00	3.50E-08	6.99E-08		
		Beryllium	3	3.84E-05	431.00	4.46E-08	8.91E-08		
				AVERAGE		4.18E-08	8.36E-08	RATING:	
		CO2	1	8573.82	427.00	10.0396	20.0792	124,910	1.00
		CO2	2	8815.64	431.00	10.227	20.454	128,433	1.00
		CO2	3	8711.17	431.00	10.106	20.212	126,911	1.00
				AVERAGE		10.1241	20.248	RATING:	
Traveling grate (petroleum coke and natural gas-fired) Stack 3 Line 2	Multi-cyclone and wet venturi scrubber	filt. PM	1	10.49	460.00	0.011	0.023		
		filt. PM	2	10.38	399.00	0.013	0.026		
		filt. PM	3	13.60	454.00	0.015	0.030		
				AVERAGE		0.013	0.026	RATING:	
		SO2	1	94.95	460.00	0.103	0.206		
		SO2	2	43.20	399.00	0.054	0.108		
		SO2	3	95.14	454.00	0.105	0.210		
				AVERAGE		0.087	0.175	RATING:	
		NOx	1	29.55	460.00	0.032	0.064		
		NOx	2	33.86	399.00	0.042	0.085		
		NOx	3	37.74	454.00	0.042	0.083		
				AVERAGE		0.039	0.077	RATING:	
		CO	1	26.30	460.00	0.029	0.057		
		CO	2	28.60	399.00	0.036	0.072		
		CO	3	26.10	454.00	0.029	0.057		
				AVERAGE		0.031	0.062	RATING:	
		Lead	1	0.00391	460.00	4.25E-06	8.50E-06		
		Lead	2	0.00546	399.00	6.84E-06	1.37E-05		
		Lead	3	0.00854	454.00	9.41E-06	1.88E-05		
				AVERAGE		6.83E-06	1.37E-05	RATING:	
		Beryllium	1	9.00E-05	460.00	9.78E-08	1.96E-07		
		Beryllium	2	1.72E-05	399.00	2.15E-08	4.30E-08		
		Beryllium	3	3.42E-05	454.00	3.76E-08	7.53E-08		
				AVERAGE		5.23E-08	1.05E-07	RATING:	
		CO2	1	9302.79	460.00	10.1117	20.2234	150,589	0.90
		CO2	2	9629.40	399.00	12.067	24.134	155,876	0.90
		CO2	3	9235.70	454.00	10.171	20.343	149,503	0.90
				AVERAGE		10.7834	21.567	RATING:	

Source category: Taconite ore processing
Plant name : Hibbing Taconite Co.
Test date : May 5-7, 1987
Process : Traveling grate
Date: 10/24/96
Location: Hibbing, MN
Ref. No.: 31
Basis for process rate : production

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	Volumetric flow rate, DSCFM	Concen. %
Traveling grate (petroleum coke and natural gas-fired) Stack 2 Line 2	Multi-cyclone and wet venturi scrubber	filt. PM	1	12.62	400.00	0.016	0.032		
		filt. PM	2	11.52	449.00	0.013	0.026		
		filt. PM	3	11.97	416.00	0.014	0.029		
		AVERAGE				0.014	0.029	RATING:	
		SO2	1	59.43	400.00	0.074	0.149		
		SO2	2	56.61	449.00	0.063	0.126		
		SO2	3	53.68	416.00	0.065	0.129		
		AVERAGE				0.067	0.135	RATING:	
		NOx	1	25.58	400.00	0.032	0.064		
		NOx	2	31.44	449.00	0.035	0.070		
		NOx	3	30.77	416.00	0.037	0.074		
		AVERAGE				0.035	0.069	RATING:	
		CO	1	8.21	400.00	0.010	0.021		
		CO	2	8.99	449.00	0.010	0.020		
		CO	3	7.79	416.00	0.009	0.019		
		AVERAGE				0.010	0.020	RATING:	
		Lead	1	0.00721	400.00	9.01E-06	1.80E-05		
		Lead	2	0.00550	449.00	6.12E-06	1.22E-05		
		Lead	3	0.00551	416.00	6.62E-06	1.32E-05		
		AVERAGE				7.25E-06	1.45E-05	RATING:	
		Beryllium	1	3.68E-05	400.00	4.60E-08	9.21E-08		
		Beryllium	2	1.97E-06	449.00	2.19E-09	4.39E-09		
		Beryllium	3	1.54E-05	416.00	1.84E-08	3.69E-08		
		AVERAGE				2.22E-08	4.45E-08	RATING:	
		CO2	1	3983.92	400.00	4.9799	9.9598	145,102	0.40
		CO2	2	4053.99	449.00	4.514	9.029	147,654	0.40
		CO2	3	4089.27	416.00	4.915	9.830	148,939	0.40
		AVERAGE				4.8031	9.606	RATING:	
Traveling grate (petroleum coke and natural gas-fired) Stack 1 Line 2	Multi-cyclone and wet venturi scrubber	filt. PM	1	11.14	441.00	0.013	0.025		
		filt. PM	2	11.18	454.00	0.012	0.025		
		filt. PM	3	9.89	388.00	0.013	0.025		
		AVERAGE				0.013	0.025	RATING:	
		SO2	1	43.12	441.00	0.049	0.098		
		SO2	2	40.98	454.00	0.045	0.090		
		SO2	3	40.18	388.00	0.052	0.104		
		AVERAGE				0.049	0.097	RATING:	
		NOx	1	25.83	441.00	0.029	0.059		
		NOx	2	24.28	454.00	0.027	0.053		
		NOx	3	20.65	388.00	0.027	0.053		
		AVERAGE				0.028	0.055	RATING:	
		CO	1	12.70	441.00	0.014	0.029		
		CO	2	8.83	454.00	0.010	0.019		
		CO	3	9.88	388.00	0.013	0.025		
		AVERAGE				0.012	0.025	RATING:	
		Lead	1	0.00582	441.00	6.60E-06	1.32E-05		
		Lead	2	0.00588	454.00	6.48E-06	1.30E-05		
		Lead	3	0.00386	388.00	4.97E-06	9.95E-06		
		AVERAGE				6.02E-06	1.20E-05	RATING:	
		Beryllium	1	3.10E-05	441.00	3.52E-08	7.04E-08		
		Beryllium	2	2.08E-05	454.00	2.29E-08	4.57E-08		
		Beryllium	3	1.27E-05	388.00	1.64E-08	3.28E-08		
		AVERAGE				2.48E-08	4.96E-08	RATING:	
		CO2	1	4179.90	441.00	4.7391	9.4782	152,240	0.40
		CO2	2	4285.20	454.00	4.719	9.439	156,075	0.40
		CO2	3	4162.88	388.00	5.365	10.729	151,620	0.40
		AVERAGE				4.9410	9.882	RATING:	

Source category: Taconite ore processing
Plant name : Hibbing Taconite Co.
Test date : May 5-7, 1987
Process : Traveling grate

Date: 10/24/96
Location: Hibbing, MN
Ref. No.: 31
Basis for process rate : production

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	Volumetric flow rate, DSCFM	Concen. %
Traveling grate (natural gas fired) Line 1 TOTAL	Multi-cyclone and wet venturi scrubber	filt. PM	1	41.77	425.00	0.049	0.10		
		filt. PM	2	42.51	423.00	0.050	0.10		
		filt. PM	3	39.81	410.00	0.049	0.10		
		AVERAGE				0.049	0.10	RATING:	
		SO2	1	51.18	425.00	0.060	0.12		
		SO2	2	43.40	423.00	0.051	0.10		
		SO2	3	37.43	410.00	0.046	0.091		
		AVERAGE				0.052	0.10	RATING:	
		NOx	1	260.80	425.00	0.31	0.61		
		NOx	2	259.88	423.00	0.31	0.61		
		NOx	3	227.46	402.00	0.28	0.57		
		AVERAGE				0.30	0.60	RATING:	
		CO	1	17.30	425.00	0.020	0.041		
		CO	2	15.89	423.00	0.019	0.038		
		CO	3	15.76	410.00	0.019	0.038		
		AVERAGE				0.019	0.039	RATING:	
		Lead	1	0.03	425.00	3.42E-05	6.84E-05		
		Lead	2	0.03	423.00	3.50E-05	7.00E-05		
		Lead	3	0.03	410.00	3.25E-05	6.51E-05		
		AVERAGE				3.39E-05	6.78E-05	RATING:	
		Beryllium	1	0.0001	425.00	1.05E-07	2.10E-07		
		Beryllium	2	0.0001	423.00	7.70E-08	1.54E-07		
		Beryllium	3	0.0001	410.00	1.43E-07	2.87E-07		
		AVERAGE				1.08E-07	2.17E-07	RATING:	
		CO2	1	19308	425.00	23	45	140,777	0.60
		CO2	2	22301	423.00	26	53	136,901	0.90
		CO2	3	21204	410.00	26	52	134,356	0.80
		AVERAGE				25	50	RATING:	
Traveling grate (petroleum coke and natural gas-fired) TOTAL Line 2	Multi-cyclone and wet venturi scrubber	filt. PM	1	45.78	432.00	0.053	0.11		
		filt. PM	2	44.70	433.00	0.052	0.10		
		filt. PM	3	47.70	422.00	0.057	0.11		
		AVERAGE				0.054	0.11	RATING:	
		SO2	1	309.70	432.00	0.36	0.72		
		SO2	2	256.31	433.00	0.30	0.59		
		SO2	3	305.52	422.00	0.36	0.72		
		AVERAGE				0.34	0.68	RATING:	
		NOx	1	111.90	432.00	0.13	0.26		
		NOx	2	119.13	433.00	0.14	0.28		
		NOx	3	121.46	402.00	0.15	0.30		
		AVERAGE				0.14	0.28	RATING:	
		CO	1	68.41	432.00	0.079	0.16		
		CO	2	63.82	433.00	0.074	0.15		
		CO	3	65.97	422.00	0.078	0.16		
		AVERAGE				0.077	0.15	RATING:	
		Lead	1	0.05	432.00	5.50E-05	1.10E-04		
		Lead	2	0.03	433.00	3.04E-05	6.09E-05		
		Lead	3	0.02	422.00	2.91E-05	5.82E-05		
		AVERAGE				3.82E-05	7.64E-05	RATING:	
		Beryllium	1	0.0002	432.00	2.28E-07	4.56E-07		
		Beryllium	2	0.0001	433.00	8.09E-08	1.62E-07		
		Beryllium	3	0.0001	422.00	1.19E-07	2.39E-07		
		AVERAGE				1.43E-07	2.85E-07	RATING:	
		CO2	1	26040	432.00	30	60	140,777	0.60
		CO2	2	26784	433.00	31	62	136,901	0.90
		CO2	3	26199	422.00	31	62	134,356	0.80
		AVERAGE				31	61	RATING:	

ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (^{o}F)	degrees Fahrenheit
DIA.	diameter
FT/SEC	feet per second
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g	gram
HP	horsepower
HRS	hours
IN.	inches
IN. HG.	inches of mercury
IN. WC.	inches of water
LB	pound
LB/DSCF	pounds per dry standard cubic foot
LB/HR	pounds per hour
LB/10^{6}BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
MW	megawatt
mg/DSCM	milligrams per dry standard cubic meter
microns (µm)	micrometer
MIN.	minutes
ohm-cm	ohm-centimeter
PPH	pounds per hour
PPM	parts per million
PSI	pounds per square inch
SQ. FT.	square feet
v/v	percent by volume
w/w	percent by weight

Standard conditions are defined as 68 ^{o}F (20 ^{o}C) and 29.92 IN. of mercury pressure.

1 INTRODUCTION

During the Period of May 5-7, 1987, Interpoll Inc. personnel conducted a series of emission tests on each of the Indurating Line 1 four wet scrubber stacks and each of the Indurating Line 2 four wet scrubber stacks at the Hibbing Taconite Company Plant located in Hibbing, Minnesota. In order to provide needed emission rate data, the Line 1 Induration Furnace was fired with natural gas and Line 2 with petroleum coke. Both furnaces were operated at maximum attainable capacity. Particulate, sulfur dioxide, oxides of nitrogen, carbon monoxide, lead and beryllium emissions were measured on each furnace. On-site testing was performed by E. Trowbridge, R. Rosenthal, C. Mosser and R. Downs. Coordination between plant operation and testing activities was provided by Bob Ives of Hibbing Taconite. The tests were witnessed by Bob Beresford and Dave Beil of the Minnesota Pollution Control Agency.

The induration furnaces tested are of the traveling grate type and heat the green pellets to 2450 ^{o}F to effect hardening. Bentonite is used as the binder in the process. The maximum capacity of each furnace ranges from 380-410 LTON/HR. The pollution control system on each of the indurating machines consists of a Zurn multicyclone dust collector followed by four Environeering, Inc. venturi rod wet scrubbers. The Zurn multicyclone is a mechanical collector and has 364 tubes. This collector has a rated flow capacity is 266,400 SCFM. The mechanical collector is located upstream of the windbox exhaust fan to protect the fan by removing 95% of the dust. The discharge from the windbox exhaust fan feeds into a common header where it is joined with the discharge from the hood exhaust fan. The combined effluent is mixed in the header prior to introduction to the four venturi rod scrubbers. Each of the four venturi rod scrubbers has a rated flow capacity of 171,675 SCFM.

Evaluations were performed in accordance with EPA Methods 1-7, 10, 12 and 104, CFR title 40, Part 60, Appendix A (revised July 1, 1986). Previously collected data was used to select the appropriate nozzle diameter required for isokinetic sample withdrawal. Interpoll sampling trains which meets or exceeds specifications in the above-cited reference were used to collect the samples by means of a heated stainless steel-lined probe.

The sampling trains were modified slightly to allow simultaneous collection of particulates, SO_2, lead and beryllium. The modification consisted of an extra impinger in the impinger section. The first two impingers each contained 100 cc of 3% H_2O_2 to collect SO_2. The last two impingers contained 100 cc of 0.1 N HNO_3 to collect any residual volatile lead or beryllium compounds. The peroxide and nitric acid catches were separately recovered. A 5 cc aliquot was taken from the peroxide catch and titrated as per Method 6 for SO_2. The peroxide and nitric acid catches were then combined for metal analyses.

For the metal analysis, the particulate catches (filter + probe rinse) were acid extracted. The combined wet catches from above were evaporated, combined with the particulate catch extract and the entire combined sample analyzed for lead by ICP in accordance with EPA Method 12. These extracts were also analyzed for beryllium after concentration to 10 cc by furnace atomic absorption at maximum sensitivity.

Oxides of nitrogen samples were collected with a separate sampling system in two-liter flasks with on-site evacuation of the flasks. The probe was purged with flue gas before each sample was collected.

An integrated flue gas sample was extracted simultaneously with each particulate and sulfur dioxide sample using a specially designed gas sampling system. Integrated flue gas samples were

collected in 44-liter Tedlar bags. After sampling was complete, the bags were sealed and returned to the laboratory for Orsat analysis and carbon monoxide analysis by NDIR. Prior to sampling, the Tedlar bags are leak checked at 15 IN.HG. vacuum with an in-line rotameter. Bags with any detectable inleakage are discarded.

Testing on each of the scrubber stacks was conducted from two test ports oriented at 90 degrees, more than eight stack diameters downstream of a transition breeching and approximately two stack diameters upstream of the stack outlet. A 12-point traverse was used to collect representative flyash samples from the scrubber stack. Each traverse point was sampled five minutes to give a total sampling time of 60 minutes per run.

The important results of the tests are summarized in Section 2. Detailed results are presented in Section 3. Field data and all other supporting information are presented in the appendices.

2 SUMMARY AND DISCUSSION

An upset in the petroleum coke feed system on Line 2 occurred during the second run of the test on the No. 3 Scrubber Stack which is indicated by the 49.2 percent replacement rate (see Appendix I). The upset was not noted until near the end of the run but apparently was affecting the petroleum coke feed prior to notice. Testing was delayed for over an hour while the problem was diagnosed and remedied. The coke replacement rate of 76.5 percent for the third run was less than that attained during the other tests but is not considered an abnormal operating condition. The decrease in petroleum coke feed did effect the SO_2 emission rate (see Table 2: No. 3 Scrubber Stack - Run 5 - this value was not used in the average).

During the tests, the pressure drop across the venturi rod deck of the four scrubbers averaged 6 IN.WC. and varied from a high of 6.1 to a low of 5.9 IN.WC. The water addition to each of the scrubbers is orifice controlled to 1000 GPM.

The results of the particulate, sulfur dioxide, oxides of nitrogen, carbon monoxide, lead and beryllium emission tests are summarized in Tables 1-6, respectively. The average for natural firing and petroleum coke firing is also presented on a per stack basis as well as a per furnace basis (four stacks per furnace).

As will be noted (Table 1), particulate emissions only increased slightly when petroleum coke was fired. The particulate emission rate from scrubber to scrubber appears to be quite constant. In the case of sulfur dioxide, oxides of nitrogen and carbon monoxide, the respective emission rates all increased with ascending scrubber number. No such trend was observed in the case of the lead or beryllium emissions.

Sulfur dioxide emissions (Table 2) increased dramatically with petroleum coke firing. This is not unexpected as the sulfur content of petroleum coke is quite high and natural gas contains almost no sulfur. The sulfur dioxide emitted by the natural gas-fired furnace is attributable to native pyrite in the taconite ore itself.

Oxides of nitrogen emission rates decreased significantly when petroleum coke was fired. This is apparently due to ammonia emissions from the petroleum coke which affect a disproportionation reaction of the thermally produced nitric oxide. This technique of NO_x control has been demonstrated in a number of EPA-sponsored studies.

Carbon monoxide emissions, although quite low (Table 4), are seen to increase when petroleum coke is fired. CO emissions are seen to be about four times higher for petroleum coke firing. Only a modest increase in lead and beryllium emissions (Tables 5 and 6) is seen to occur when petroleum coke is fired. Evidently most of the lead and beryllium emissions stem from the pellets themselves rather than the combustion of petroleum coke.

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of this fact and a complete review of the entire data and results, it is our opinion that the results reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

Table 1. Summary of the May 1987 Particulate Emission Measurements of the Hibbing Taconite Induration Furnaces when Fired with Natural Gas and when Fired with Petroleum Coke.

	Emission Rate (LB/HR)	
	Natural Gas-Fired	Pet Coke-Fired
SCRUBBER NO. 1 STACK		
Run 1	9.58 0.008	11.14 0.009
Run 2	10.45 0.008	11.18 0.008
Run 3	9.86 0.007	9.89 0.008
SCRUBBER NO. 2 STACK		
Run 1	11.00 0.009	12.62 0.010
Run 2	8.59 0.007	11.52 0.009
Run 3	9.92 0.008	11.97 0.009
SCRUBBER NO. 3 STACK		
Run 1	10.86 0.009	10.49 0.008
Run 2	4.39 0.004	10.38 0.008
Run 3	7.06 0.006	13.60 0.011
SCRUBBER NO. 4 STACK		
Run 1	10.33 0.009	11.53 0.011
Run 2	19.08 0.016	11.62 0.011
Run 3	12.97 0.011	12.24 0.011
Average per Stack:	10.3	11.5
Average per Furnace:	41.2	46

Table 2. Summary of the May 1987 **Sulfur Dioxide** Emission Measurements of the Hibbing Taconite Induration Furnaces when Fired with Natural Gas and when Fired with Petroleum Coke.

	Emission Rate (LB/HR)	
	Natural Gas-Fired	Pet Coke-Fired
SCRUBBER NO. 1 STACK		
Run 1	15.68	43.12
Run 2	9.81	40.98
Run 3	9.08	40.18
SCRUBBER NO. 2 STACK		
Run 1	9.43	59.43
Run 2	9.27	56.61
Run 3	8.62	53.68
SCRUBBER NO. 3 STACK		
Run 1	12.30	94.95
Run 2	12.04	43.20*
Run 3	7.77	95.14
SCRUBBER NO. 4 STACK**		
Run 1	13.77	112.20
Run 2	12.28	115.52
Run 3	11.96	116.52
Average per Stack:	11.0	75.2
Average per Furnace:	44.0	300.8

*Run excluded from average - decreased pet coke feed rate.

**Stack No. 4 was the only stack tested in the August 5, 1986, emission test and was used in the draft applicability analysis to estimate the total SO_2 emissions for the No. 2 Line.

Table 3. Summary of the May 1987 **Oxides of Nitrogen** Emission Measurements of the Hibbing Taconite Induration Furnaces when Fired with Natural Gas and when Fired with Petroleum Coke.

	Emission Rate (LB/HR)	
	Natural Gas-Fired	Pet Coke-Fired
SCRUBBER NO. 1 STACK		
Run 1	48.0	25.8
Run 2	52.5	24.3
Run 3	51.1	20.6
SCRUBBER NO. 2 STACK		
Run 1	49.9	25.6
Run 2	52.7	31.4
Run 3	53.6	30.8
SCRUBBER NO. 3 STACK		
Run 1	71.0	29.6
Run 2	73.9	33.9
Run 3	53.3	37.7
SCRUBBER NO. 4 STACK		
Run 1	91.9	30.9
Run 2	80.8	29.5
Run 3	69.5	32.3
Average per Stack:	62.4	29.4
Average per Furnace:	249.6	117.6

Inland:— 1012 [illegible] furnace

110 463
148 291

Note: Each run value presented above is the average of four separate two-liter gram samples.

Table 4. Summary of the May 1987 **Carbon Monoxide** Emission Measurements of the Hibbing Taconite Induration Furnaces when Fired with Natural Gas and when Fired with Petroleum Coke.

	Emission Rate (LB/HR)	
	Natural Gas-Fired	Pet Coke-Fired
SCRUBBER NO. 1 STACK		
Run 1	3.90	12.7
Run 2	3.27	8.83
Run 3	3.24	9.88
SCRUBBER NO. 2 STACK		
Run 1	2.41	8.21
Run 2	3.09	8.99
Run 3	3.10	7.79
SCRUBBER NO. 3 STACK		
Run 1	3.63	26.3
Run 2	2.96	28.6
Run 3	2.97	26.1
SCRUBBER NO. 4 STACK		
Run 1	7.36	21.2
Run 2	6.57	17.4
Run 3	6.45	22.2
Average per Stack:	4.08	16.5
Average per Furnace:	16.32	66.0

Table 5. Summary of the May 1987 Lead Emission Measurements of the Hibbing Taconite Induration Furnaces when Fired with Natural Gas and when Fired with Petroleum Coke.

	Emission Rate (LB/HR)	
	Natural Gas-Fired	Pet Coke-Fired
SCRUBBER NO. 1 STACK		
Run 1	.0039	.0058
Run 2	.0055	.0059
Run 3	.0054	.0039
SCRUBBER NO. 2 STACK		
Run 1	.0056	.0072
Run 2	.0059	.0055
Run 3	.0055	.0055
SCRUBBER NO. 3 STACK		
Run 1	.0102	.0039
Run 2	.0055	.0055
Run 3	.0071	.0085
SCRUBBER NO. 4 STACK		
Run 1	.0094	.0306
Run 2	.0126	.0095
Run 3	.0087	.0067
Average per Stack:	.0071	.0082
Average per Furnace:	.0284	.0328

Table 6. Summary of the May 1987 **Beryllium** Emission Measurements of the Hibbing Taconite Induration Furnaces when Fired with Natural Gas and when Fired with Petroleum Coke.

	Emission Rate (LB/HR)	
	Natural Gas-Fired	Pet Coke-Fired
SCRUBBER NO. 1 STACK		
Run 1	.000013	.000031
Run 2	<.000002	.000021
Run 3	.000010	.000013
SCRUBBER NO. 2 STACK		
Run 1	.000021	.000037
Run 2	.000020	<.000002
Run 3	.000009	.000015
SCRUBBER NO. 3 STACK		
Run 1	.000025	.000090
Run 2	.000016	.000017
Run 3	.000031	.000034
SCRUBBER NO. 4 STACK		
Run 1	.000030	.000039
Run 2	.000028	.000030
Run 3	.000067	.000038
Average per Stack:	.000025	.000033
Average per Furnace:	.00010	.00013

3 RESULTS

The results of all field and laboratory evaluations are presented in this section. Gas composition results (Orsat and moisture) are presented first followed by the computer printout of the particulate, sulfur dioxide, oxides of nitrogen, carbon monoxide, lead and beryllium determinations. Preliminary measurements including test port locations are given in the appendices.

The results have been calculated on a Sperry PC Computer using programs written in Extended BASIC specifically for source testing calculations. EPA-published equations have been used as the basis of the calculation techniques in these programs.

The particulate emission rate has been calculated using the product of the concentration times flow method (as recommended by the EPA) rather than the ratio of areas method.

3.1 Results of Orsat and Moisture Analyses

Test No. 1
Indurating Line #1-Scrubber Stack #4

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

Date of run	Run 1 05-05-87	Run 2 05-05-87	Run 3 05-05-87
Dry basis (orsat)			
carbon dioxide.....	0.60	0.90	0.80
oxygen.....	19.20	19.10	19.30
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	80.20	80.00	79.90
Wet basis (orsat)			
carbon dioxide.....	0.54	0.82	0.72
oxygen.....	17.20	17.35	17.44
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	71.83	72.67	72.20
water vapor.....	10.43	9.16	9.64
Dry molecular weight.....	28.86	28.91	28.90
Wet molecular weight.....	27.73	27.91	27.85
Specific gravity.....	0.958	0.964	0.962
Water mass flow.....(LB/HR)	45999	38718	40201
FO	2.833	2.000	2.000

Test No. 2
Indurating Line #1-Scrubber Stack #3

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Dry basis (orsat)			
carbon dioxide.....	0.60	0.60	0.60
oxygen.....	19.60	19.60	19.60
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.80	79.80	79.80
Wet basis (orsat)			
carbon dioxide.....	0.54	0.55	0.55
oxygen.....	17.75	18.00	17.90
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	72.26	73.28	72.89
water vapor.....	9.45	8.16	8.66
Dry molecular weight.....	28.88	28.88	28.88
Wet molecular weight.....	27.85	27.99	27.94
Specific gravity.....	0.962	0.967	0.965
Water mass flow.....(LB/HR)	39978	34445	36865
FO	2.167	2.167	2.167

Test No. 3
Indurating Line #1-Scrubber Stack #2

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Dry basis (orsat)			
carbon dioxide.....	0.40	0.40	0.40
oxygen.....	20.20	20.20	20.20
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.40	79.40	79.40
Wet basis (orsat)			
carbon dioxide.....	0.37	0.37	0.38
oxygen.....	18.82	18.83	19.00
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	73.99	74.00	74.67
water vapor.....	6.81	6.80*	5.96
Dry molecular weight.....	28.87	28.87	28.87
Wet molecular weight.....	28.13	28.13	28.22
Specific gravity.....	0.972	0.972	0.975
Water mass flow.....(LB/HR)	28796	37828	25695

* Free or condensed water in the gas stream.

FO	1.750	1.750	1.750

Test No. 4
Indurating Line #1-Scrubber Stack #1

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Dry basis (orsat)			
carbon dioxide.....	0.40	0.40	0.40
oxygen.....	20.20	20.20	20.20
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.40	79.40	79.40
Wet basis (orsat)			
carbon dioxide.....	0.38	0.38	0.38
oxygen.....	18.95	19.16	19.07
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	74.50	75.30	74.94
water vapor.....	6.17	5.17	5.62
Dry molecular weight.....	28.87	28.87	28.87
Wet molecular weight.....	28.20	28.31	28.26
Specific gravity.....	0.974	0.978	0.976
Water mass flow.....(LB/HR)	27087	23357	25220
FD	1.750	1.750	1.750

Test No. 1
Indurating Line #2-Scrubber Stack #4

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	05-05-87	05-05-87	05-05-87
Dry basis (orsat)			
carbon dioxide.....	1.00	1.00	1.00
oxygen.....	19.40	19.40	19.40
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.60	79.60	79.60
Wet basis (orsat)			
carbon dioxide.....	0.90	0.92	0.92
oxygen.....	17.52	17.79	17.77
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	71.88	73.01	72.93
water vapor.....	9.70	8.28	8.38
Dry molecular weight.....	28.94	28.94	28.94
Wet molecular weight.....	27.88	28.03	28.02
Specific gravity.....	0.963	0.968	0.968
Water mass flow.....(LB/HR)	37637	32528	32549
FO	1.500	1.500	1.500

Test No. 2
Indurating Line #2-Scrubber Stack #3

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Dry basis (orsat)			
carbon dioxide.....	0.90	0.90	0.90
oxygen.....	19.30	19.30	19.30
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.80	79.80	79.80
Wet basis (orsat)			
carbon dioxide.....	0.83	0.83	0.83
oxygen.....	17.84	17.88	17.77
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	73.78	73.93	73.47
water vapor.....	7.54	7.36	7.93
Dry molecular weight.....	28.92	28.92	28.92
Wet molecular weight.....	28.09	28.11	28.05
Specific gravity.....	0.970	0.971	0.969
Water mass flow.....(LB/HR)	34448	34720	36128
FO	1.778	1.778	1.778

Test No. 3
Indurating Line #2-Scrubber Stack #2

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

Date of run	Run 1 05-07-87	Run 2 05-07-87	Run 3 05-07-87
Dry basis (orsat)			
carbon dioxide.....	0.40	0.40	0.40
oxygen.....	20.20	20.20	20.20
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.40	79.40	79.40
Wet basis (orsat)			
carbon dioxide.....	0.37	0.37	0.38
oxygen.....	18.92	18.91	19.00
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	74.35	74.32	74.68
water vapor.....	6.36	6.40	5.94
Dry molecular weight.....	28.87	28.87	28.87
Wet molecular weight.....	28.18	28.18	28.23
Specific gravity.....	0.973	0.973	0.975
Water mass flow.....(LB/HR)	27633	28315	26390
FO	1.750	1.750	1.750

Test No. 4
Indurating Line #2-Scrubber Stack #1

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Dry basis (orsat)			
carbon dioxide.....	0.40	0.40	0.40
oxygen.....	20.20	20.20	20.20
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.40	79.40	79.40
Wet basis (orsat)			
carbon dioxide.....	0.37	0.38	0.37
oxygen.....	18.88	19.01	18.75
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	74.21	74.72	73.71
water vapor.....	6.54	5.90	7.17
Dry molecular weight.....	28.87	28.87	28.87
Wet molecular weight.....	28.16	28.23	28.09
Specific gravity.....	0.973	0.975	0.970
Water mass flow.....(LB/HR)	29879	27449	32830
FO	1.750	1.750	1.750

3.2 Results of Particulate Loading Determinations

TABLE 1. Summary of the Results of the May 5, 1987, Particulate Emission Compliance Test on the Indurating Line No. 1 Scrubber Stack No. 4 at the Hibbing Taconite Company Plant in Hibbing, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		05-05-87	05-05-87	05-05-87
Time runs were done	(HRS)	915/1020	1205/1312	1345/1450
Pellet production	(LTPH)	376 421	371 416	359 402
Volumetric flow				
actual	(ACFM)	180787	173642	171195
standard	(DSCFM)	140777	136901	134356
Gas temperature	(DEG-F)	120	121	121
Moisture content	(%V/V)	10.43	9.16	9.64
Gas composition	(%V/V,dry)			
carbon dioxide		0.60	0.90	0.80
oxygen		19.20	19.10	19.30
carbon monoxide		0.00	0.00	0.00
nitrogen		80.20	80.00	79.90
Isokinetic variation	(%)	100.6	99.3	99.5
Particulate concentration				
actual	(GR/ACF)	.00666	.0128	.00883
standard	(GR/DSCF)	.00856	.0163	.0113
Part. emission rate	(LB/HR)	10.33	19.08	12.97

LT to ST × 1.12

TON/HR

* Dry catch only
** Natural gas fired

Test No. 1
Indurating Line #1-Scrubber Stack #4

FILT. PM

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	05-05-87	05-05-87	05-05-87
Time run start/end.....(HRS)	915/1020	1205/1312	1345/1450
Static pressure.....(IN.WC)	-0.35	-0.35	-0.35
Cross sectional area (SQ.FT)	60.13	60.13	60.13
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	86.0	77.0	72.0
desiccant.....(GRAMS)	32.0	21.0	30.0
total.....(GRAMS)	118.0	98.0	102.0
Total particulate material..			
.....collected(grams)	0.0265	0.0483	0.0329
Gas meter coefficient.....	1.0064	1.0064	1.0064
Barometric pressure..(IN.HG)	28.60	28.60	28.60
Avg. orif.pres.drop..(IN.WC)	2.17	2.04	2.01
Avg. gas meter temp..(DEF-F)	77.7	91.4	97.5
Volume through gas meter....			
at meter conditions...(CF)	50.30	49.51	49.25
standard conditions.(DSCF)	47.76	45.83	45.09
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.249	.249	.249
Avg.stack gas temp ..(DEG-F)	120	121	121
Volumetric flow rate.....			
actual.....(ACFM)	180787	173642	171195
dry standard.....(DSCFM)	140777	136901	134356
Isokinetic variation.....(%)	100.6	99.3	99.5
Particulate concentration...			
actual.....(GR/ACF)	0.00666	0.01282	0.00883
dry standard.....(GR/DSCF)	0.00856	0.01626	0.01126
	0.006896		
Particle mass rate...(LB/HR)	10.33	19.08	12.97

TABLE 2. Summary of the Results of the May 6, 1987, Particulate Emission Compliance Test on the Indurating Line No. 1 Scrubber Stack No. 3 at the Hibbing Taconite Company in Hibbing, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		05-06-87	05-06-87	05-06-87
Time runs were done	(HRS)	1446/1552	1625/1729	1847/1951
Pellet production	(LTPH)	402 450	347 389	394 441
Volumetric flow				
actual	(ACFM)	171995	171363	172784
standard	(DSCFM)	136577	138126	138644
Gas temperature	(DEG-F)	113	113	112
Moisture content	(%V/V)	9.45	8.16	8.66
Gas composition	(%V/V,dry)			
carbon dioxide		0.60	0.60	0.60
oxygen		19.60	19.60	19.60
carbon monoxide		0.00	0.00	0.00
nitrogen		79.80	79.80	79.80
Isokinetic variation	(%)	100.1	99.1	100.0
Particulate concentration				
actual	(GR/ACF)	.00736	.00299	.00476
standard	(GR/DSCF)	.00927	.00371	.00594
Part. emission rate	(LB/HR)	10.86	4.39	7.06

* Dry catch only
** Natural gas fired

Test No. 2
Indurating Line #1-Scrubber Stack #3

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Time run start/end.....(HRS)	1446/1552	1625/1729	1847/1951
Static pressure.....(IN.WC)	-0.35	-0.35	-0.35
Cross sectional area (SQ.FT)	60.13	60.13	60.13
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	67.0	70.0	68.0
desiccant.....(GRAMS)	35.0	17.0	26.0
total.....(GRAMS)	102.0	87.0	94.0
Total particulate material..			
.....collected(grams)	0.0277	0.0111	0.0180
Gas meter coefficient.....	1.0064	1.0064	1.0064
Barometric pressure..(IN.HG)	28.50	28.50	28.50
Avg. orif.pres.drop..(IN.WC)	2.10	2.09	2.09
Avg. gas meter temp..(DEF-F)	91.9	89.9	77.9
Volume through gas meter....			
at meter conditions...(CF)	50.00	49.88	49.44
standard conditions.(DSCF)	46.09	46.14	46.75
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.249	.249	.249
Avg.stack gas temp ..(DEG-F)	113	113	112
Volumetric flow rate.....			
actual.....(ACFM)	171995	171363	172784
dry standard.....(DSCFM)	136577	138126	138644
Isokinetic variation.....(%)	100.1	99.1	100.0
Particulate concentration...			
actual.....(GR/ACF)	0.00736	0.00299	0.00476
dry standard.....(GR/DSCF)	0.00927	0.00371	0.00594
Particle mass rate...(LB/HR)	10.86	4.39	7.06

TABLE 3. Summary of the Results of the May 6, 1987, Particulate Emission Compliance Test on the Indurating Line No. 1 Scrubber Stack No. 2 at the Hibbing Taconite Company in Hibbing, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		05-07-87	05-07-87	05-07-87
Time runs were done	(HRS)	810/ 913	945/1048	1115/1218
Pellet production	(LTPH)	354 396	394 441	369 413
Volumetric flow				
actual	(ACFM)	169208	172839	171705
standard	(DSCFM)	140401	144285	144502
Gas temperature	(DEG-F)	103	100	101
Moisture content	(%V/V)	6.81	6.80	5.96
Gas composition	(%V/V,dry)			
carbon dioxide		0.40	0.40	0.40
oxygen		20.20	20.20	20.20
carbon monoxide		0.00	0.00	0.00
nitrogen		79.40	79.40	79.40
Isokinetic variation	(%)	98.1	99.5	99.2
Particulate concentration				
actual	(GR/ACF)	.00758	.00580	.00674
standard	(GR/DSCF)	.00914	.00695	.00801
Part. emission rate	(LB/HR)	11.00	8.59	9.92

× 1.12

* Dry catch only
** Natural gas fired

Test No. 3
Indurating Line #1-Scrubber Stack #2

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	810/ 913	945/1048	1115/1218
Static pressure.....(IN.WC)	-0.35	-0.35	-0.35
Cross sectional area (SQ.FT)	60.13	60.13	60.13
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	56.0	57.0	45.0
desiccant.....(GRAMS)	16.0	39.0	20.0
total.....(GRAMS)	72.0	96.0	65.0
Total particulate material..			
.....collected(grams)	0.0275	0.0218	0.0251
Gas meter coefficient.....	1.0064	1.0064	1.0064
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Avg. orif.pres.drop..(IN.WC)	2.05	2.30	2.26
Avg. gas meter temp..(DEF-F)	69.3	88.8	89.9
Volume through gas meter....			
at meter conditions...(CF)	48.40	52.31	52.33
standard conditions.(DSCF)	46.43	48.43	48.34
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.249	.249	.249
Avg.stack gas temp ..(DEG-F)	103	100	101
Volumetric flow rate.....			
actual.....(ACFM)	169208	172839	171705
dry standard.....(DSCFM)	140401	144285	144502
Isokinetic variation.....(%)	98.1	99.5	99.2
Particulate concentration...			
actual.....(GR/ACF)	0.00758	0.00580	0.00674
dry standard.....(GR/DSCF)	0.00914	0.00695	0.00801
Particle mass rate...(LB/HR)	11.00	8.59	9.92

TABLE 4. Summary of the Results of the May 7, 1987, Particulate Emission Compliance Test on the Indurating Line No. 1 Scrubber Stack No. 1 at the Hibbing Taconite Company in Hibbing, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		05-07-87	05-07-87	05-07-87
Time runs were done	(HRS)	1257/1401	1445/1549	1621/1725
Pellet production	(LTPH)	387 433	399 447	341 382
Volumetric flow				
actual	(ACFM)	175626	180778	179679
standard	(DSCFM)	146818	152737	151094
Gas temperature	(DEG-F)	103	103	103
Moisture content	(%V/V)	6.17	5.17	5.62
Gas composition	(%V/V,dry)			
carbon dioxide		0.40	0.40	0.40
oxygen		20.20	20.20	20.20
carbon monoxide		0.00	0.00	0.00
nitrogen		79.40	79.40	79.40
Isokinetic variation	(%)	99.9	99.1	101.1
Particulate concentration				
actual	(GR/ACF)	.00636	.00674	.00640
standard	(GR/DSCF)	.00761	.00798	.00761
Part. emission rate	(LB/HR)	9.58	10.45	9.86

× 1.12

* Dry catch only
** Natural gas fired

Test No. 4
Indurating Line #1-Scrubber Stack #1

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	1257/1401	1445/1549	1621/1725
Static pressure.....(IN.WC)	-0.35	-0.35	-0.35
Cross sectional area (SQ.FT)	60.13	60.13	60.13
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	35.0	36.0	36.0
desiccant.....(GRAMS)	34.0	23.0	29.0
total.....(GRAMS)	69.0	59.0	65.0
Total particulate material..			
.....collected(grams)	0.0244	0.0264	0.0254
Gas meter coefficient.....	1.0064	1.0064	1.0064
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Avg. orif.pres.drop..(IN.WC)	2.40	2.56	2.61
Avg. gas meter temp..(DEF-F)	90.2	90.2	91.3
Volume through gas meter....			
at meter conditions...(CF)	53.55	55.22	55.84
standard conditions.(DSCF)	49.46	51.03	51.50
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.249	.249	.249
Avg.stack gas temp ..(DEG-F)	103	103	103
Volumetric flow rate.....			
actual.....(ACFM)	175626	180778	179679
dry standard.....(DSCFM)	146818	152737	151094
Isokinetic variation.....(%)	99.9	99.1	101.1
Particulate concentration...			
actual.....(GR/ACF)	0.00636	0.00674	0.00640
dry standard.....(GR/DSCF)	0.00761	0.00798	0.00761
Particle mass rate...(LB/HR)	9.58	10.45	9.86

TABLE 5. Summary of the Results of the May 5, 1987, Particulate Emission Compliance Test on the Indurating Line No. 2 Scrubber Stack No. 4 at the Hibbing Taconite Company in Hibbing, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		05-05-87	05-05-87	05-05-87
Time runs were done	(HRS)	915/1022	1205/1310	1345/1448
Pellet production	(LTPH)	427 381	431 384	431 384
Pet coke replacement	(%)	90.5	89.9	88.8
Volumetric flow				
actual	(ACFM)	160733	162432	161500
standard	(DSCFM)	124910	128433	126911
Gas temperature	(DEG-F)	126	125	128
Moisture content	(%V/V)	9.70	8.28	8.38
Gas composition	(%V/V,dry)			
carbon dioxide		1.00	1.00	1.00
oxygen		19.40	19.40	19.40
carbon monoxide		0.00	0.00	0.00
nitrogen		79.60	79.60	79.60
Isokinetic variation	(%)	99.2	98.1	99.2
Particulate concentration				
actual	(GR/ACF)	.00836	.00834	.00884
standard	(GR/DSCF)	.0108	.0106	.0112
Part. emission rate	(LB/HR)	11.53	11.62	12.24

* Dry catch only
** Petroleum coke fired

Test No. 1
Indurating Line #2-Scrubber Stack #4

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	05-05-87	05-05-87	05-05-87
Time run start/end.....(HRS)	915/1022	1205/1310	1345/1448
Static pressure.....(IN.WC)	-0.30	-0.30	-0.30
Cross sectional area (SQ.FT)	60.13	60.13	60.13
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	80.0	66.0	70.0
desiccant.....(GRAMS)	16.0	16.0	13.0
total.....(GRAMS)	96.0	82.0	83.0
Total particulate material..			
.....collected(grams)	0.0294	0.0293	0.0312
Gas meter coefficient.....	1.0013	1.0013	1.0013
Barometric pressure..(IN.HG)	28.60	28.60	28.60
Avg. orif.pres.drop..(IN.WC)	1.74	1.84	1.87
Avg. gas meter temp..(DEF-F)	76.7	92.0	98.8
Volume through gas meter....			
at meter conditions...(CF)	44.57	46.57	47.12
standard conditions.(DSCF)	42.14	42.82	42.80
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.250	.250	.250
Avg.stack gas temp ..(DEG-F)	126	125	128
Volumetric flow rate.....			
actual.....(ACFM)	160733	162432	161500
dry standard.....(DSCFM)	124910	128433	126911
Isokinetic variation.....(%)	99.2	98.1	99.2
Particulate concentration...			
actual.....(GR/ACF)	0.00836	0.00834	0.00884
dry standard.....(GR/DSCF)	0.01077	0.01056	0.01125
Particle mass rate...(LB/HR)	11.53	11.62	12.24

TABLE 6. Summary of the Results of the May 6, 1987, Particulate Emission Compliance Test on the Indurating Line No. 2 Scrubber Stack No. 3 at the Hibbing Taconite Company in Hibbing, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		05-06-87	05-06-87	05-06-87
Time runs were done	(HRS)	1446/1555	1625/1737	1847/1953
Pellet production	(LTPH)	460 411	399 356	454 405
Pet coke replacement	(%)	89.3	49.2	76.5
Volumetric flow				
actual	(ACFM)	184706	191926	184799
standard	(DSCFM)	150589	155876	149503
Gas temperature	(DEG-F)	110	113	112
Moisture content	(%V/V)	7.54	7.36	7.93
Gas composition	(%V/V,dry)			
carbon dioxide		0.90	0.90	0.90
oxygen		19.30	19.30	19.30
carbon monoxide		0.00	0.00	0.00
nitrogen		79.80	79.80	79.80
Isokinetic variation	(%)	99.4	99.7	100.2
Particulate concentration				
actual	(GR/ACF)	.00662	.00631	.00858
standard	(GR/DSCF)	.00813	.00777	.0106
Part. emission rate	(LB/HR)	10.49	10.38	13.60

* Dry catch only
** Petroleum coke fired

Test No. 2
Indurating Line #2-Scrubber Stack #3

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Time run start/end.....(HRS)	1446/1555	1625/1737	1847/1953
Static pressure.....(IN.WC)	-0.25	-0.25	-0.25
Cross sectional area (SQ.FT)	60.13	60.13	60.13
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	69.0	70.0	74.0
desiccant.....(GRAMS)	19.0	19.0	19.0
total.....(GRAMS)	88.0	89.0	93.0
Total particulate material..			
.....collected(grams)	0.0268	0.0266	0.0350
Gas meter coefficient.....	1.0013	1.0013	1.0013
Barometric pressure..(IN.HG)	28.50	28.50	28.50
Avg. orif.pres.drop..(IN.WC)	2.58	2.79	2.58
Avg. gas meter temp..(DEF-F)	89.1	88.9	83.2
Volume through gas meter....			
at meter conditions...(CF)	55.13	57.21	54.56
standard conditions.(DSCF)	50.88	52.84	50.90
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.250	.250	.250
Avg.stack gas temp ..(DEG-F)	110	113	112
Volumetric flow rate.....			
actual.....(ACFM)	184706	191926	184799
dry standard.....(DSCFM)	150589	155876	149503
Isokinetic variation.....(%)	99.4	99.7	100.2
Particulate concentration...			
actual.....(GR/ACF)	0.00662	0.00631	0.00858
dry standard.....(GR/DSCF)	0.00813	0.00777	0.01061
Particle mass rate...(LB/HR)	10.49	10.38	13.60

TABLE 7. Summary of the Results of the May 7, 1987, Particulate Emission Compliance Test on the Indurating Line No. 2 Scrubber Stack No. 2 at the Hibbing Taconite Company in Hibbing, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		05-07-87	05-07-87	05-07-87
Time runs were done	(HRS)	810/ 915	945/1048	1115/1217
Pellet production	(LTPH)	400 357	449 401	416 371
Pet coke replacement	(%)	88.7	90.0	90.1
Volumetric flow				
actual	(ACFM)	175525	177224	178027
standard	(DSCFM)	145102	147654	148939
Gas temperature	(DEG-F)	108	104	104
Moisture content	(%V/V)	6.36	6.40	5.94
Gas composition	(%V/V,dry)			
carbon dioxide		0.40	0.40	0.40
oxygen		20.20	20.20	20.20
carbon monoxide		0.00	0.00	0.00
nitrogen		79.40	79.40	79.40
Isokinetic variation	(%)	97.1	98.9	98.8
Particulate concentration				
actual	(GR/ACF)	.00838	.00758	.00784
standard	(GR/DSCF)	.0101	.00910	.00938
Part. emission rate	(LB/HR)	12.62	11.52	11.97

× 1.12

* Dry catch only
** Petroleum Coke Fired

Test No. 3
Indurating Line #2-Scrubber Stack #2

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	810/ 915	945/1048	1115/1217
Static pressure.....(IN.WC)	-0.20	-0.20	-0.20
Cross sectional area (SQ.FT)	60.13	60.13	60.13
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	49.0	53.0	51.0
desiccant.....(GRAMS)	20.0	19.0	16.0
total.....(GRAMS)	69.0	72.0	67.0
Total particulate material..			
.....collected(grams)	0.0315	0.0293	0.0304
Gas meter coefficient.....	1.0013	1.0013	1.0013
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Avg. orif.pres.drop..(IN.WC)	2.24	2.47	2.52
Avg. gas meter temp..(DEF-F)	71.9	86.8	92.0
Volume through gas meter....			
at meter conditions...(CF)	50.43	53.69	54.58
standard conditions.(DSCF)	47.92	49.66	50.01
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.250	.250	.250
Avg.stack gas temp ..(DEG-F)	108	104	104
Volumetric flow rate.....			
actual.....(ACFM)	175525	177224	178027
dry standard.....(DSCFM)	145102	147654	148939
Isokinetic variation.....(%)	97.1	98.9	98.8
Particulate concentration...			
actual.....(GR/ACF)	0.00838	0.00758	0.00784
dry standard.....(GR/DSCF)	0.01014	0.00910	0.00938
Particle mass rate...(LB/HR)	12.62	11.52	11.97

TABLE 8. Summary of the Results of the May 7, 1987, Particulate Emission Compliance Test on the Indurating Line No. 2 Scrubber Stack No. 1 at the Hibbing Taconite Company in Hibbing, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		05-07-87	05-07-87	05-07-87
Time runs were done	(HRS)	1257/1414	1447/1550	1620/1723
Pellet production	(LTPH)	441 394	454 405	388 346
Pet coke replacement	(%)	89.0	88.8	89.6
Volumetric flow				
actual	(ACFM)	182705	185704	183243
standard	(DSCFM)	152240	156075	151620
Gas temperature	(DEG-F)	103	102	103
Moisture content	(%V/V)	6.54	5.90	7.17
Gas composition	(%V/V,dry)			
carbon dioxide		0.40	0.40	0.40
oxygen		20.20	20.20	20.20
carbon monoxide		0.00	0.00	0.00
nitrogen		79.40	79.40	79.40
Isokinetic variation	(%)	100.3	99.2	100.7
Particulate concentration				
actual	(GR/ACF)	.00711	.00702	.00629
standard	(GR/DSCF)	.00853	.00835	.00761
Part. emission rate	(LB/HR)	11.14	11.18	9.89

* Dry catch only
** Petroleum coke fired

Test No. 4
Indurating Line #2-Scrubber Stack #1

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	1257/1414	1447/1550	1620/1723
Static pressure.....(IN.WC)	-0.20	-0.20	-0.20
Cross sectional area (SQ.FT)	60.13	60.13	60.13
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	62.0	51.0	68.0
desiccant.....(GRAMS)	15.0	19.0	17.0
total.....(GRAMS)	77.0	70.0	85.0
Total particulate material..			
.....collected(grams)	0.0287	0.0285	0.0256
Gas meter coefficient.....	1.0013	1.0013	1.0013
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Avg. orif.pres.drop..(IN.WC)	2.71	2.79	2.74
Avg. gas meter temp..(DEF-F)	90.8	91.8	95.8
Volume through gas meter....			
at meter conditions...(CF)	56.48	57.39	57.02
standard conditions.(DSCF)	51.89	52.64	51.92
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.250	.250	.250
Avg.stack gas temp ..(DEG-F)	103	102	103
Volumetric flow rate.....			
actual.....(ACFM)	182705	185704	183243
dry standard.....(DSCFM)	152240	156075	151620
Isokinetic variation.....(%)	100.3	99.2	100.7
Particulate concentration...			
actual.....(GR/ACF)	0.00711	0.00702	0.00629
dry standard.....(GR/DSCF)	0.00853	0.00835	0.00761
Particle mass rate...(LB/HR)	11.14	11.18	9.89

3.3 Results of Sulfur Dioxide Determinations

Test No. 1
Indurating Line #1-Scrubber Stack #4

Results of Sulfur Dioxide Determinations----------Method 6

	Run 1	Run 2	Run 3
Date of run	05-05-87	05-05-87	05-05-87
Time run start/end.....(HRS)	0915-1020	1205-1312	1345-1450
Barometric pressure..(IN.HG)	28.60	28.60	28.60
Meter temperature....(DEG-F)	77.70	91.40	97.50
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	50.300	49.510	49.250
standard conditions..(SCF)	47.762	45.828	45.085
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	10.43	9.16	9.64
Oxygen content....(%V/V DRY)	19.20	19.10	19.30
Milliequivalents of SO4 in..			
gas sample.....	1.1030	0.9700	0.9476
Sulfur dioxide concentration			
(GR/DSCF).....	0.0114	0.0105	0.0104
(MG/DSCM).....	26	24	24
(PPM-DRY).....	10	9	9
(PPM-WET).....	9	8	8
SO2 Emission rate....(LB/HR)	13.77	12.28	11.96

Test No. 2
Indurating Line #1-Scrubber Stack #3

Results of Sulfur Dioxide Determinations----------Method 6

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Time run start/end.....(HRS)	1446-1552	1625-1729	1847-1951
Barometric pressure..(IN.HG)	28.50	28.50	28.50
Meter temperature....(DEG-F)	91.90	89.90	77.90
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	50.000	49.880	49.440
standard conditions..(SCF)	46.086	46.142	46.755
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	9.45	8.16	8.66
Oxygen content....(%V/V DRY)	19.60	19.60	19.60
Milliequivalents of SO4 in..			
gas sample.....	0.9797	0.9492	0.6187
Sulfur dioxide concentration			
(GR/DSCF).....	0.0105	0.0102	0.0065
(MG/DSCM).....	24	23	15
(PPM-DRY).....	9	9	6
(PPM-WET).....	8	8	5
SO2 Emission rate....(LB/HR)	12.30	12.04	7.77

Test No. 3
Indurating Line #1-Scrubber Stack #2

Results of Sulfur Dioxide Determinations----------Method 6

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	0810-0913	0945-1048	1115-1218
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	69.30	88.80	89.90
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	48.400	52.310	52.330
standard conditions..(SCF)	46.429	48.428	48.345
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.81	6.80	5.96
Oxygen content....(%V/V DRY)	20.20	20.20	20.20
Milliequivalents of SO4 in..			
gas sample.....	0.7362	0.7347	0.6810
Sulfur dioxide concentration			
(GR/DSCF).....	0.0078	0.0075	0.0070
(MG/DSCM).....	18	17	16
(PPM-DRY).....	7	6	6
(PPM-WET).....	6	6	6
SO2 Emission rate....(LB/HR)	9.43	9.27	8.62

Test No. 4
Indurating Line #1-Scrubber Stack #1

Results of Sulfur Dioxide Determinations----------Method 6

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	1257-1401	1445-1549	1621-1725
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	90.20	90.20	91.30
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	53.550	55.220	55.840
standard conditions..(SCF)	49.463	51.026	51.503
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.17	5.17	5.62
Oxygen content....(%V/V DRY)	20.20	20.20	20.20
Milliequivalents of SO4 in..			
gas sample.....	1.2468	0.7737	0.7308
Sulfur dioxide concentration			
(GR/DSCF).....	0.0125	0.0075	0.0070
(MG/DSCM).....	29	17	16
(PPM-DRY).....	11	6	6
(PPM-WET).....	10	6	6
SO2 Emission rate....(LB/HR)	15.68	9.81	9.08

Interpoll Report No. 7-2364
Hibbing Taconite Company
Hibbing, Minnesota

Test No. 1
Indurating Line #2-Scrubber Stack #4

Results of Sulfur Dioxide Determinations----------Method 6

	Run 1	Run 2	Run 3
Date of run	05-05-87	05-05-87	05-05-87
Time run start/end.....(HRS)	0915-1022	1205-1310	1345-1448
Barometric pressure..(IN.HG)	28.60	28.60	28.60
Meter temperature....(DEG-F)	76.70	92.00	98.80
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	44.570	46.570	47.120
standard conditions..(SCF)	42.138	42.820	42.802
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	9.70	8.28	8.38
Oxygen content....(%V/V DRY)	19.40	19.40	19.40
Milliequivalents of SO4 in..			
gas sample.....	8.9345	9.0908	9.2759
Sulfur dioxide concentration			
(GR/DSCF).....	0.1048	0.1049	0.1071
(MG/DSCM).....	240	240	245
(PPM-DRY).....	90	90	92
(PPM-WET).....	81	83	84
SO2 Emission rate....(LB/HR)	112.20	115.52	116.52

Test No. 2
Indurating Line #2-Scrubber Stack #3

Results of Sulfur Dioxide Determinations----------Method 6

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Time run start/end.....(HRS)	1446-1555	1625-1737	1847-1953
Barometric pressure..(IN.HG)	28.50	28.50	28.50
Meter temperature....(DEG-F)	89.10	88.90	83.20
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	55.130	57.210	54.560
standard conditions..(SCF)	50.877	52.845	50.898
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	7.54	7.36	7.93
Oxygen content....(%V/V DRY)	19.30	19.30	19.30
Milliequivalents of SO4 in..			
gas sample.....	7.5722	3.4572	7.6450
Sulfur dioxide concentration			
(GR/DSCF).....	0.0736	0.0323	0.0742
(MG/DSCM).....	168	74	170
(PPM-DRY).....	63	28	64
(PPM-WET).....	59	26	59
SO2 Emission rate....(LB/HR)	94.95	43.20	95.14

Test No. 3
Indurating Line #2-Scrubber Stack #2

Results of Sulfur Dioxide Determinations----------Method 6

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	0810-0915	0945-1048	1115-1217
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	71.90	86.80	92.00
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	50.430	53.690	54.580
standard conditions..(SCF)	47.919	49.656	50.010
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.36	6.40	5.94
Oxygen content....(%V/V DRY)	20.20	20.20	20.20
Milliequivalents of SO4 in..			
gas sample.....	4.6330	4.4941	4.2543
Sulfur dioxide concentration			
(GR/DSCF).....	0.0478	0.0447	0.0420
(MG/DSCM).....	109	102	96
(PPM-DRY).....	41	38	36
(PPM-WET).....	38	36	34
SO2 Emission rate....(LB/HR)	59.43	56.61	53.68

Test No. 4
Indurating Line #2-Scrubber Stack #1

Results of Sulfur Dioxide Determinations----------Method 6

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	1257-1414	1447-1550	1620-1723
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	90.80	91.80	95.80
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	56.480	57.390	57.020
standard conditions..(SCF)	51.889	52.640	51.918
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.54	5.90	7.17
Oxygen content....(%V/V DRY)	20.20	20.20	20.20
Milliequivalents of SO4 in..			
gas sample.....	3.4688	3.2626	3.2474
Sulfur dioxide concentration			
(GR/DSCF).....	0.0330	0.0306	0.0309
(MG/DSCM).....	76	70	71
(PPM-DRY).....	28	26	27
(PPM-WET).....	27	25	25
SO2 Emission rate....(LB/HR)	43.12	40.98	40.18
	0519	0481	0536

3.4 Results of Oxides of Nitrogen Determinations

Test No. 1
Indurating Line #1-Scrubber Stack #4

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run.....	05-05-87	05-05-87	05-05-87	05-05-87
Time of run.....(HRS)	915	930	945	1000
Flask number.....	1	2	3	4
Volume of flask.....(ML)	2086	2063	2055	2116
Data: time of sampling				
flask temperature..(DEG-F)	73.00	73.00	73.00	73.00
bar. press.....(IN.HG)	28.60	28.60	28.60	28.60
flask vacuum.....(IN.HG)	27.85	27.85	27.90	27.90
flask abs. press...(IN.HG)	0.75	0.75	0.70	0.70
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	28.50	28.50	28.50	28.50
flask static press.(IN.HG)	0.75	1.00	1.45	1.05
flask abs. press...(IN.HG)	29.25	29.50	29.95	29.55
Volume gas sampled....(DSML)	1948	1943	1969	2000
Oxygen content....(%V/V,DRY)	0.00	0.00	0.00	0.00
Nitrate in gas sample...(uG)	468.5	439.5	468.5	470.0
NO2 in gas sample.....(uG)	347.6	326.1	347.6	348.7
NOx Concentration				
(GR/DSCF).....	0.0780	0.0733	0.0772	0.0762
(MG/DSCM).....	178	168	177	174
(PPM-DRY).....	93	88	92	91
NOX Emission rate....(LB/HR)	94.11	88.51	93.10	91.93

Test No. 1
Indurating Line #1-Scrubber Stack #4

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run.....	05-05-87	05-05-87	05-05-87	05-05-87
Time of run.....(HRS)	1210	1225	1240	1255
Flask number.....	5	6	7	8
Volume of flask.....(ML)	2057	2100	2081	2088
Data: time of sampling				
flask temperature..(DEG-F)	81.00	81.00	81.00	81.00
bar. press.....(IN.HG)	28.60	28.60	28.60	28.60
flask vacuum.....(IN.HG)	27.95	27.95	27.90	27.85
flask abs. press...(IN.HG)	0.65	0.65	0.70	0.75
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	28.50	28.50	28.50	28.50
flask static press.(IN.HG)	0.95	1.00	0.80	0.40
flask abs. press...(IN.HG)	29.45	29.50	29.30	28.90
Volume gas sampled....(DSML)	1941	1986	1951	1926
Oxygen content....(%V/V,DRY)	0.00	0.00	0.00	0.00
Nitrate in gas sample...(uG)	418.5	409.0	399.0	430.0
NO2 in gas sample.....(uG)	310.5	303.5	296.0	319.1
NOx Concentration				
(GR/DSCF).....	0.0699	0.0668	0.0663	0.0724
(MG/DSCM).....	160	153	152	166
(PPM-DRY).....	84	80	79	87
NOX Emission rate....(LB/HR)	82.03	78.37	77.83	84.93

Test No. 1
Indurating Line #1-Scrubber Stack #4

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 3A	Run 3B	Run 3C	Run 3D
Date of run.....	05-05-87	05-05-87	05-05-87	05-05-87
Time of run.....(HRS)	1345	1400	1415	1430
Flask number.....	9	10	11	12
Volume of flask.....(ML)	2080	2063	2062	2111
Data: time of sampling				
flask temperature..(DEG-F)	77.00	77.00	78.00	80.00
bar. press.....(IN.HG)	28.60	28.60	28.60	28.60
flask vacuum.....(IN.HG)	27.85	27.80	27.85	27.80
flask abs. press...(IN.HG)	0.75	0.80	0.75	0.80
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	28.50	28.50	28.50	28.50
flask static press.(IN.HG)	1.10	-0.15	0.15	0.85
flask abs. press...(IN.HG)	29.60	28.35	28.65	29.35
Volume gas sampled....(DSML)	1966	1862	1885	1976
Oxygen content....(%V/V,DRY)	0.00	0.00	0.00	0.00
Nitrate in gas sample...(uG)	397.0	371.5	345.5	315.5
NO2 in gas sample.....(uG)	294.6	275.6	256.4	234.1
NOx Concentration				
(GR/DSCF).....	0.0655	0.0647	0.0594	0.0518
(MG/DSCM).....	150	148	136	119
(PPM-DRY).....	78	77	71	62
NOX Emission rate....(LB/HR)	75.39	74.49	68.44	59.64

Test No. 2
Indurating Line #1-Scrubber Stack #3

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run.....	05-06-87	05-06-87	05-06-87	05-06-87
Time of run.....(HRS)	1250	1305	1325	1340
Flask number.....	37	38	39	40
Volume of flask.....(ML)	2054	2075	2080	2093
Data: time of sampling				
flask temperature..(DEG-F)	70.00	70.00	72.00	72.00
bar. press.....(IN.HG)	28.50	28.50	28.50	28.50
flask vacuum.....(IN.HG)	28.00	27.95	27.95	27.95
flask abs. press...(IN.HG)	0.50	0.55	0.55	0.55
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.20	-0.40	-0.45	-0.60
flask abs. press...(IN.HG)	28.90	28.70	28.65	28.50
Volume gas sampled....(DSML)	1914	1917	1918	1920
Nitrate in gas sample...(uG)	363.5	348.5	350.5	371.5
NO2 in gas sample.....(uG)	269.7	258.6	260.1	275.6
NOx Concentration				
(GR/DSCF).....	0.0616	0.0589	0.0592	0.0627
(MG/DSCM).....	141	135	136	144
(PPM-DRY).....	74	71	71	75
NOX Emission rate....(LB/HR)	72.08	69.01	69.35	73.44

Test No. 2
Indurating Line #1-Scrubber Stack #3

Results of Oxides of Nitrogen (NOx) Determinations--------Method 7

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run.....	05-06-87	05-06-87	05-06-87	05-06-87
Time of run.....(HRS)	1630	1645	1700	1715
Flask number.....	41	42	43	44
Volume of flask.....(ML)	2076	2094	2088	2090
Data: time of sampling				
flask temperature..(DEG-F)	69.00	74.00	74.00	74.00
bar. press.....(IN.HG)	28.50	28.50	28.50	28.50
flask vacuum.....(IN.HG)	27.90	27.90	27.85	27.90
flask abs. press...(IN.HG)	0.60	0.60	0.65	0.60
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.40	-0.60	-1.10	-1.00
flask abs. press...(IN.HG)	28.70	28.50	28.00	28.10
Volume gas sampled....(DSML)	1914	1918	1875	1887
Nitrate in gas sample...(uG)	355.5	381.5	364.0	361.5
NO2 in gas sample.....(uG)	263.8	283.1	270.1	268.2
NOx Concentration				
(GR/DSCF).....	0.0602	0.0645	0.0630	0.0621
(MG/DSCM).....	138	148	144	142
(PPM-DRY).....	72	77	75	74
NOX Emission rate....(LB/HR)	71.29	76.36	74.54	73.55

Test No. 2
Indurating Line #1-Scrubber Stack #3

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 3A	Run 3B	Run 3C	Run 3D
Date of run.....	05-06-87	05-06-87	05-06-87	05-06-87
Time of run.....(HRS)	1850	1905	1920	1935
Flask number.....	45	46	47	48
Volume of flask.....(ML)	2086	2090	2090	2102
Data: time of sampling				
flask temperature..(DEG-F)	67.00	66.00	66.00	66.00
bar. press.....(IN.HG)	28.50	28.50	28.50	28.50
flask vacuum.....(IN.HG)	27.90	28.00	28.00	28.00
flask abs. press...(IN.HG)	0.60	0.50	0.50	0.50
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.40	-0.40	-0.30	-0.30
flask abs. press...(IN.HG)	28.70	28.70	28.80	28.80
Volume gas sampled....(DSML)	1924	1934	1941	1952
Nitrate in gas sample...(uG)	387.5	337.0	168.5	176.5
NO2 in gas sample.....(uG)	287.5	250.0	125.0	131.0
NOx Concentration				
(GR/DSCF).....	0.0653	0.0565	0.0281	0.0293
(MG/DSCM).....	149	129	64	67
(PPM-DRY).....	78	68	34	35
NOX Emission rate....(LB/HR)	77.62	67.14	33.45	34.84

Test No. 3
Indurating Line #1-Scrubber Stack #2

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	815	830	845	900
Flask number.....	61	62	63	64
Volume of flask.....(ML)	2100	2079	2067	2087
Data: time of sampling				
flask temperature..(DEG-F)	60.00	60.00	60.00	61.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	27.95	27.95	27.95	27.95
flask abs. press...(IN.HG)	0.50	0.50	0.50	0.50
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.55	-0.45	-0.40	-0.40
flask abs. press...(IN.HG)	28.55	28.65	28.70	28.70
Volume gas sampled....(DSML)	1933	1920	1912	1931
Nitrate in gas sample...(uG)	261.5	223.5	249.5	249.5
NO2 in gas sample.....(uG)	194.0	165.8	185.1	185.1
NOx Concentration				
(GR/DSCF).....	0.0439	0.0377	0.0423	0.0419
(MG/DSCM).....	100	86	97	96
(PPM-DRY).....	52	45	51	50
NOX Emission rate....(LB/HR)	52.79	45.42	50.91	50.42

Test No. 3
Indurating Line #1-Scrubber Stack #2

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	950	1005	1020	1035
Flask number.....	65	66	67	68
Volume of flask.....(ML)	2068	2096	2073	2101
Data: time of sampling				
flask temperature..(DEG-F)	61.00	61.00	73.00	73.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	28.00	28.00	27.90	28.00
flask abs. press...(IN.HG)	0.45	0.45	0.55	0.45
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.20	-0.25	-1.00	-0.95
flask abs. press...(IN.HG)	28.90	28.85	28.10	28.15
Volume gas sampled....(DSML)	1930	1953	1875	1910
Nitrate in gas sample...(uG)	236.5	243.5	270.5	256.0
NO2 in gas sample.....(uG)	175.5	180.7	200.7	189.9
NOx Concentration				
(GR/DSCF).....	0.0397	0.0404	0.0468	0.0434
(MG/DSCM).....	91	92	107	99
(PPM-DRY).....	48	48	56	52
NOX Emission rate....(LB/HR)	49.13	49.99	57.87	53.74

Test No. 3
Indurating Line #1-Scrubber Stack #2

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 3A	Run 3B	Run 3C	Run 3D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	1120	1135	1150	1205
Flask number.....	69	70	71	72
Volume of flask.....(ML)	2069	2084	2038	2092
Data: time of sampling				
flask temperature..(DEG-F)	66.00	67.00	67.00	67.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	27.90	27.95	27.95	27.95
flask abs. press...(IN.HG)	0.55	0.50	0.50	0.50
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.65	-0.60	-0.60	-0.50
flask abs. press...(IN.HG)	28.45	28.50	28.50	28.60
Volume gas sampled....(DSML)	1894	1915	1872	1929
Nitrate in gas sample...(uG)	244.5	257.5	249.0	265.0
NO2 in gas sample.....(uG)	181.4	191.1	184.8	196.6
NOx Concentration				
(GR/DSCF).....	0.0419	0.0436	0.0431	0.0445
(MG/DSCM).....	96	100	99	102
(PPM-DRY).....	50	52	52	53
NOX Emission rate....(LB/HR)	51.84	54.00	53.41	55.16

Test No. 4
Indurating Line #1-Scrubber #1

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	1300	1315	1330	1345
Flask number.....	1	2	3	4
Volume of flask.....(ML)	2086	2063	2055	2116
Data: time of sampling				
flask temperature..(DEG-F)	73.00	73.00	73.00	73.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	27.85	27.90	27.85	27.85
flask abs. press...(IN.HG)	0.60	0.55	0.60	0.60
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.75	-0.70	-0.80	-0.80
flask abs. press...(IN.HG)	28.35	28.40	28.30	28.30
Volume gas sampled....(DSML)	1900	1886	1868	1924
Nitrate in gas sample...(uG)	217.0	233.5	215.5	226.0
NO2 in gas sample.....(uG)	161.0	173.3	159.9	167.7
NOx Concentration				
(GR/DSCF).....	0.0370	0.0402	0.0374	0.0381
(MG/DSCM).....	85	92	86	87
(PPM-DRY).....	44	48	45	46
NOX Emission rate....(LB/HR)	46.60	50.53	47.07	47.92

Test No. 4
Indurating Line #1-Scrubber #1

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	1450	1505	1525	1540
Flask number.....	5	6	7	8
Volume of flask.....(ML)	2057	2100	2081	2088
Data: time of sampling				
flask temperature..(DEG-F)	77.00	77.00	70.00	70.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	27.90	27.90	27.85	27.85
flask abs. press...(IN.HG)	0.55	0.55	0.60	0.60
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.70	-0.50	-0.90	-0.65
flask abs. press...(IN.HG)	28.40	28.60	28.20	28.45
Volume gas sampled....(DSML)	1880	1934	1885	1909
Nitrate in gas sample...(uG)	240.0	226.5	232.0	241.5
NO2 in gas sample.....(uG)	178.1	168.1	172.1	179.2
NOx Concentration				
(GR/DSCF).....	0.0414	0.0380	0.0399	0.0410
(MG/DSCM).....	95	87	91	94
(PPM-DRY).....	50	45	48	49
NOX Emission rate....(LB/HR)	54.18	49.72	52.25	53.71

Test No. 4
Indurating Line #1-Scrubber #1

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 3A	Run 3B	Run 3C	Run 3D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	1625	1640	1655	1710
Flask number.....	9	10	11	12
Volume of flask.....(ML)	2080	2063	2062	2111
Data: time of sampling				
flask temperature..(DEG-F)	71.00	70.00	70.00	70.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	27.85	27.85	27.85	27.85
flask abs. press...(IN.HG)	0.60	0.60	0.60	0.60
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.60	-0.70	-0.70	-0.60
flask abs. press...(IN.HG)	28.50	28.40	28.40	28.50
Volume gas sampled....(DSML)	1905	1882	1881	1933
Nitrate in gas sample...(uG)	263.0	227.0	221.0	214.0
NO2 in gas sample.....(uG)	195.1	168.4	164.0	158.8
NOx Concentration				
(GR/DSCF).....	0.0448	0.0391	0.0381	0.0359
(MG/DSCM).....	102	89	87	82
(PPM-DRY).....	54	47	46	43
NOX Emission rate....(LB/HR)	57.99	50.65	49.33	46.48

Test No. 1
Indurating Line #2-Scrubber Stack #4

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run.....	05-05-87	05-05-87	05-05-87	05-05-87
Time of run.....(HRS)	1055	1110	1125	1140
Flask number.....	13	14	15	16
Volume of flask.....(ML)	2060	2048	2045	2067
Data: time of sampling				
flask temperature..(DEG-F)	65.00	65.00	65.00	65.00
bar. press.....(IN.HG)	28.60	28.60	28.60	28.60
flask vacuum.....(IN.HG)	28.20	28.15	27.98	28.00
flask abs. press...(IN.HG)	0.40	0.45	0.62	0.60
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	28.50	28.50	28.50	28.50
flask static press.(IN.HG)	1.65	1.50	0.80	0.30
flask abs. press...(IN.HG)	30.15	30.00	29.30	28.80
Volume gas sampled....(DSML)	2007	1982	1920	1909
Nitrate in gas sample...(uG)	165.5	169.5	189.5	171.5
NO2 in gas sample.....(uG)	122.8	125.8	140.6	127.2
NOx Concentration				
(GR/DSCF).....	0.0267	0.0277	0.0320	0.0291
(MG/DSCM).....	61	63	73	67
(PPM-DRY).....	32	33	38	35
NOX Emission rate....(LB/HR)	28.63	29.69	34.26	31.19

Test No. 1
Indurating Line #2-Scrubber Stack #4

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run.....	05-05-87	05-05-87	05-05-87	05-05-87
Time of run.....(HRS)	1215	1230	1245	1300
Flask number.....	17	18	19	20
Volume of flask.....(ML)	2054	2045	2069	2060
Data: time of sampling				
flask temperature..(DEG-F)	68.00	68.00	68.00	68.00
bar. press.....(IN.HG)	28.60	28.60	28.60	28.60
flask vacuum.....(IN.HG)	27.95	27.88	27.85	27.90
flask abs. press...(IN.HG)	0.65	0.72	0.75	0.70
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	28.50	28.50	28.50	28.50
flask static press.(IN.HG)	0.50	0.45	0.60	0.10
flask abs. press...(IN.HG)	29.00	28.95	29.10	28.60
Volume gas sampled....(DSML)	1907	1890	1921	1882
Nitrate in gas sample...(uG)	160.0	144.0	156.0	169.0
NO2 in gas sample.....(uG)	118.7	106.8	115.7	125.4
NOx Concentration				
(GR/DSCF).....	0.0272	0.0247	0.0263	0.0291
(MG/DSCM).....	62	57	60	67
(PPM-DRY).....	33	30	32	35
NOX Emission rate....(LB/HR)	29.95	27.19	28.99	32.05

Test No. 1
Indurating Line #2-Scrubber Stack #4

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 3A	Run 3B	Run 3C	Run 3D
Date of run.....	05-05-87	05-05-87	05-05-87	05-05-87
Time of run.....(HRS)	1355	1410	1425	1440
Flask number.....	21	22	23	24
Volume of flask.....(ML)	2068	2031	2056	2031
Data: time of sampling				
flask temperature..(DEG-F)	70.00	70.00	70.00	70.00
bar. press.....(IN.HG)	28.60	28.60	28.60	28.60
flask vacuum.....(IN.HG)	27.80	27.85	27.85	27.80
flask abs. press...(IN.HG)	0.80	0.75	0.75	0.80
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	28.50	28.50	28.50	28.50
flask static press.(IN.HG)	0.20	0.05	0.50	0.10
flask abs. press...(IN.HG)	28.70	28.55	29.00	28.60
Volume gas sampled....(DSML)	1890	1849	1902	1849
Nitrate in gas sample...(uG)	173.0	167.0	161.0	184.5
NO2 in gas sample.....(uG)	128.4	123.9	119.5	136.9
NOx Concentration				
(GR/DSCF).....	0.0297	0.0293	0.0274	0.0324
(MG/DSCM).....	68	67	63	74
(PPM-DRY).....	36	35	33	39
NOX Emission rate....(LB/HR)	32.29	31.86	29.85	35.20

Test No. 2
Indurating Line #2-Scrubber Stack #3

Results of Oxides of Nitrogen (NOx) Determinations--------Method 7

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run.....	05-06-87	05-06-87	05-06-87	05-06-87
Time of run.....(HRS)	1305	1320	1336	1350
Flask number.....	25	26	27	28
Volume of flask.....(ML)	2100	2035	2054	2031
Data: time of sampling				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
bar. press.....(IN.HG)	28.50	28.50	28.50	28.50
flask vacuum.....(IN.HG)	27.75	27.65	27.80	27.80
flask abs. press...(IN.HG)	0.75	0.85	0.70	0.70
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-1.10	-0.60	-0.40	-0.40
flask abs. press...(IN.HG)	28.00	28.50	28.70	28.70
Volume gas sampled....(DSML)	1878	1846	1887	1866
Nitrate in gas sample...(uG)	125.5	124.5	132.0	146.0
NO2 in gas sample.....(uG)	93.1	92.4	97.9	108.3
NOx Concentration				
(GR/DSCF).....	0.0217	0.0219	0.0227	0.0254
(MG/DSCM).....	50	50	52	58
(PPM-DRY).....	26	26	27	30
NOX Emission rate....(LB/HR)	27.96	28.22	29.27	32.75

Test No. 2
Indurating Line #2-Scrubber Stack #3

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run.....	05-06-87	05-06-87	05-06-87	05-06-87
Time of run.....(HRS)	1635	1650	1705	1720
Flask number.....	29	30	31	32
Volume of flask.....(ML)	2068	2071	2044	2090
Data: time of sampling				
flask temperature..(DEG-F)	72.00	72.00	72.00	70.00
bar. press.....(IN.HG)	28.50	28.50	28.50	28.50
flask vacuum.....(IN.HG)	27.80	27.75	27.80	27.85
flask abs. press...(IN.HG)	0.70	0.75	0.70	0.65
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-2.20	-2.30	-2.10	-2.10
flask abs. press...(IN.HG)	26.90	26.80	27.00	27.00
Volume gas sampled....(DSML)	1778	1771	1764	1808
Nitrate in gas sample...(uG)	157.5	156.5	149.5	92.0
NO2 in gas sample.....(uG)	116.9	116.1	110.9	68.3
NOx Concentration				
(GR/DSCF).....	0.0287	0.0287	0.0275	0.0165
(MG/DSCM).....	66	66	63	38
(PPM-DRY).....	34	34	33	20
NOX Emission rate....(LB/HR)	38.37	38.29	36.71	22.05

Test No. 2
Indurating Line #2-Scrubber Stack #3

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 3A	Run 3B	Run 3C	Run 3D
Date of run.....	05-06-87	05-06-87	05-06-87	05-06-87
Time of run.....(HRS)	1900	1915	1930	1945
Flask number.....	33	34	35	36
Volume of flask.....(ML)	2088	2071	2089	2127
Data: time of sampling				
flask temperature..(DEG-F)	70.00	70.00	68.00	68.00
bar. press.....(IN.HG)	28.50	28.50	28.50	28.50
flask vacuum.....(IN.HG)	27.90	27.90	27.95	27.85
flask abs. press...(IN.HG)	0.60	0.60	0.55	0.65
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-1.60	-1.60	-1.50	-1.50
flask abs. press...(IN.HG)	27.50	27.50	27.60	27.60
Volume gas sampled....(DSML)	1843	1828	1855	1882
Nitrate in gas sample...(uG)	169.0	174.5	173.5	155.5
NO2 in gas sample.....(uG)	125.4	129.5	128.7	115.4
NOx Concentration				
(GR/DSCF).....	0.0297	0.0309	0.0303	0.0268
(MG/DSCM).....	68	71	69	61
(PPM-DRY).....	36	37	36	32
NOX Emission rate....(LB/HR)	38.09	39.66	38.87	34.34

Test No. 3
Indurating Line #2-Scrubber Stack #2

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	820	835	850	905
Flask number.....	49	50	51	52
Volume of flask.....(ML)	2088	2084	2064	2071
Data: time of sampling				
flask temperature..(DEG-F)	65.00	65.00	65.00	65.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	27.65	27.50	27.55	27.60
flask abs. press...(IN.HG)	0.80	0.95	0.90	0.85
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.30	-0.30	-0.10	-0.20
flask abs. press...(IN.HG)	28.80	28.80	29.00	28.90
Volume gas sampled....(DSML)	1918	1904	1903	1906
Nitrate in gas sample...(uG)	126.5	112.0	131.0	114.5
NO2 in gas sample.....(uG)	93.9	83.1	97.2	85.0
NOx Concentration				
(GR/DSCF).....	0.0214	0.0191	0.0223	0.0195
(MG/DSCM).....	49	44	51	45
(PPM-DRY).....	26	23	27	23
NOX Emission rate....(LB/HR)	26.59	23.72	27.77	24.23

Test No. 3
Indurating Line #2-Scrubber Stack #2

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	955	1010	1025	1040
Flask number.....	53	54	55	56
Volume of flask.....(ML)	2083	2064	2086	2069
Data: time of sampling				
flask temperature..(DEG-F)	65.00	66.00	66.00	66.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	27.50	27.38	27.59	27.42
flask abs. press...(IN.HG)	0.95	1.07	0.86	1.03
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.40	-0.40	-0.70	-0.85
flask abs. press...(IN.HG)	28.70	28.70	28.40	28.25
Volume gas sampled....(DSML)	1896	1871	1885	1848
Nitrate in gas sample...(uG)	169.0	177.5	108.0	120.5
NO2 in gas sample.....(uG)	125.4	131.7	80.1	89.4
NOx Concentration				
(GR/DSCF).....	0.0289	0.0308	0.0186	0.0211
(MG/DSCM).....	66	70	43	48
(PPM-DRY).....	35	37	22	25
NOX Emission rate....(LB/HR)	36.57	38.93	23.51	26.76

Test No. 3
Indurating Line #2-Scrubber Stack #2

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 3A	Run 3B	Run 3C	Run 3D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	1125	1140	1155	1210
Flask number.....	57	58	59	60
Volume of flask.....(ML)	2062	2085	2077	2066
Data: time of sampling				
flask temperature..(DEG-F)	66.00	66.00	66.00	66.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	27.20	27.20	27.70	27.55
flask abs. press...(IN.HG)	1.25	1.25	0.75	0.90
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.10	-2.20	-2.30	-2.70
flask abs. press...(IN.HG)	29.00	26.90	26.80	26.40
Volume gas sampled....(DSML)	1877	1755	1775	1728
Nitrate in gas sample...(uG)	165.5	144.0	109.5	113.0
NO2 in gas sample.....(uG)	122.8	106.8	81.2	83.8
NOx Concentration				
(GR/DSCF).....	0.0286	0.0266	0.0200	0.0212
(MG/DSCM).....	65	61	46	49
(PPM-DRY).....	34	32	24	25
NOX Emission rate....(LB/HR)	36.50	33.97	25.53	27.06

Test No. 4
Indurating Line #2-Scrubber Stack #1

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	1310	1325	1340	1355
Flask number.....	73	74	75	76
Volume of flask.....(ML)	2065	2071	2066	2093
Data: time of sampling				
flask temperature..(DEG-F)	70.00	70.00	70.00	70.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	27.25	27.59	27.55	27.50
flask abs. press...(IN.HG)	1.20	0.86	0.90	0.95
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-2.15	-2.30	-2.00	-0.40
flask abs. press...(IN.HG)	26.95	26.80	27.10	28.70
Volume gas sampled....(DSML)	1745	1763	1776	1906
Nitrate in gas sample...(uG)	67.0	168.0	96.5	107.0
NO2 in gas sample.....(uG)	49.7	124.7	71.6	79.4
NOx Concentration				
(GR/DSCF).....	0.0125	0.0309	0.0176	0.0182
(MG/DSCM).....	28	71	40	42
(PPM-DRY).....	15	37	21	22
NOX Emission rate....(LB/HR)	16.25	40.32	22.99	23.75

Test No. 4
Indurating Line #2-Scrubber Stack #1

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	1455	1510	1525	1540
Flask number.....	77	78	79	80
Volume of flask.....(ML)	2104	2077	2085	2105
Data: time of sampling				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	27.52	27.49	27.42	27.53
flask abs. press...(IN.HG)	0.93	0.96	1.03	0.92
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-0.60	-3.10	-1.95	-2.25
flask abs. press...(IN.HG)	28.50	26.00	27.15	26.85
Volume gas sampled....(DSML)	1904	1707	1788	1792
Nitrate in gas sample...(uG)	88.0	92.5	84.0	137.0
NO2 in gas sample.....(uG)	65.3	68.6	62.3	101.7
NOx Concentration				
(GR/DSCF).....	0.0150	0.0176	0.0152	0.0248
(MG/DSCM).....	34	40	35	57
(PPM-DRY).....	18	21	18	30
NOX Emission rate....(LB/HR)	20.05	23.51	20.38	33.17

Test No. 4
Indurating Line #2-Scrubber Stack #1

Results of Oxides of Nitrogen (NOx) Determinations---------Method 7

	Run 3A	Run 3B	Run 3C	Run 3D
Date of run.....	05-07-87	05-07-87	05-07-87	05-07-87
Time of run.....(HRS)	1635	1650	1705	1720
Flask number.....	81	82	83	84
Volume of flask.....(ML)	2093	2090	2060	2089
Data: time of sampling				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
bar. press.....(IN.HG)	28.45	28.45	28.45	28.45
flask vacuum.....(IN.HG)	27.45	27.50	27.45	27.60
flask abs. press...(IN.HG)	1.00	0.95	1.00	0.85
Data: Time of Flask Opening				
flask temperature..(DEG-F)	71.00	71.00	71.00	71.00
lab. bar. press....(IN.HG)	29.10	29.10	29.10	29.10
flask static press.(IN.HG)	-3.10	-3.65	-1.05	-2.70
flask abs. press...(IN.HG)	26.00	25.45	28.05	26.40
Volume gas sampled....(DSML)	1718	1681	1829	1752
Nitrate in gas sample...(uG)	85.0	102.5	76.5	76.5
NO2 in gas sample.....(uG)	63.1	76.1	56.8	56.8
NOx Concentration				
(GR/DSCF).....	0.0160	0.0198	0.0136	0.0142
(MG/DSCM).....	37	45	31	32
(PPM-DRY).....	19	24	16	17
NOX Emission rate....(LB/HR)	20.85	25.70	17.63	18.40

3.5 Results of Carbon Monoxide Determinations

Test No. 1
Indurating Line #1-Scrubber Stack #4

Results of Carbon Monoxide Determinations----------Method 10

	Run 1	Run 2	Run 3
Date of run	05-05-87	05-05-87	05-05-87
Time run start/end.....(HRS)	915/1020	1205/1312	1345/1450
Barometric pressure..(IN.HG)	28.60	28.60	28.60
Total sampling time....(MIN)	60.00	60.00	60.00
Oxygen content....(%V/V DRY)	19.20	19.10	19.30
Moisture content.....(%V/V)	10.43	9.16	9.64
Volumetric flow rate.....			
actual.....(ACFM)	180787	173642	171195
dry standard.....(DSCFM)	140777	136901	134356
CO concentration.....			
(GR/DSCF).....	.0061	.0056	.0056
(PPM-DRY).....	12	11	11
CO emission rate.....(LB/HR)	7.36	6.57	6.45

Test No. 2
Indurating Line #1-Scrubber Stack #3

Results of Carbon Monoxide Determinations----------Method 10

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Time run start/end.....(HRS)	1446/1552	1625/1729	1847/1951
Barometric pressure..(IN.HG)	28.50	28.50	28.50
Total sampling time....(MIN)	60.00	60.00	60.00
Oxygen content....(%V/V DRY)	19.60	19.60	19.60
Moisture content.....(%V/V)	9.45	8.16	8.66
Volumetric flow rate.....			
actual.....(ACFM)	171995	171363	172784
dry standard.....(DSCFM)	136577	138126	138644
CO concentration.....			
(GR/DSCF).....	.0031	.0025	.0025
(PPM-DRY).....	6	5	5
CO emission rate.....(LB/HR)	3.63	2.96	2.97

Test No. 3
Indurating Line #1-Scrubber Stack #2

Results of Carbon Monoxide Determinations----------Method 10

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	810/ 913	945/1048	1115/1218
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Total sampling time....(MIN)	60.00	60.00	60.00
Oxygen content....(%V/V DRY)	20.20	20.20	20.20
Moisture content.....(%V/V)	6.81	6.80	5.96
Volumetric flow rate.....			
actual.....(ACFM)	169208	172839	171705
dry standard.....(DSCFM)	140401	144285	144502
CO concentration.....			
(GR/DSCF).....	.0020	.0025	.0025
(PPM-DRY).....	4	5	5
CO emission rate.....(LB/HR)	2.41	3.09	3.10

Test No. 4
Indurating Line #1-Scrubber Stack #1

Results of Carbon Monoxide Determinations----------Method 10

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	1257/1401	1445/1549	1621/1725
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Total sampling time....(MIN)	60.00	60.00	60.00
Oxygen content....(%V/V DRY)	20.20	20.20	20.20
Moisture content.....(%V/V)	6.17	5.17	5.62
Volumetric flow rate.....			
actual.....(ACFM)	175626	180778	179679
dry standard.....(DSCFM)	146818	152737	151094
CO concentration.....			
(GR/DSCF).....	.0031	.0025	.0025
(PPM-DRY).....	6	5	5
CO emission rate.....(LB/HR)	3.90	3.27	3.24

Interpoll Report No. 7-2364
Hibbing Taconite Company
Hibbing, Minnesota

Test No. 1
Indurating Line #2-Scrubber Stack #4

Results of Carbon Monoxide Determinations----------Method 10

	Run 1	Run 2	Run 3
Date of run	05-05-87	05-05-87	05-05-87
Time run start/end.....(HRS)	915/1022	1205/1310	1345/1448
Barometric pressure..(IN.HG)	28.60	28.60	28.60
Total sampling time....(MIN)	60.00	60.00	60.00
Oxygen content....(%V/V DRY)	19.40	19.40	19.40
Moisture content.....(%V/V)	9.70	8.28	8.38
Volumetric flow rate.....			
actual.....(ACFM)	160733	162432	161500
dry standard.....(DSCFM)	124910	128433	126911
CO concentration.....			
(GR/DSCF).....	.0198	.0158	.0204
(PPM-DRY).....	39	31	40
CO emission rate.....(LB/HR)	21.2	17.4	22.2

Test No. 2
Indurating Line #2-Scrubber Stack #3

Results of Carbon Monoxide Determinations----------Method 10

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Time run start/end.....(HRS)	1446/1555	1625/1737	1847/1953
Barometric pressure..(IN.HG)	28.50	28.50	28.50
Total sampling time....(MIN)	60.00	60.00	60.00
Oxygen content....(%V/V DRY)	19.30	19.30	19.30
Moisture content.....(%V/V)	7.54	7.36	7.93
Volumetric flow rate.....			
actual.....(ACFM)	184706	191926	184799
dry standard.....(DSCFM)	150589	155876	149503
CO concentration.....			
(GR/DSCF).....	.0204	.0214	.0204
(PPM-DRY).....	40	42	40
CO emission rate.....(LB/HR)	26.3	28.6	26.1

Test No. 3
Indurating Line #2-Scrubber Stack #2

Results of Carbon Monoxide Determinations----------Method 10

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	810/ 915	945/1048	1115/1217
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Total sampling time....(MIN)	60.00	60.00	60.00
Oxygen content....(%V/V DRY)	20.20	20.20	20.20
Moisture content.....(%V/V)	6.36	6.40	5.94
Volumetric flow rate.....			
actual.....(ACFM)	175525	177224	178027
dry standard.....(DSCFM)	145102	147654	148939
CO concentration.....			
(GR/DSCF).....	.0066	.0071	.0061
(PPM-DRY).....	13	14	12
CO emission rate.....(LB/HR)	8.21	8.99	7.79

Test No. 4
Indurating Line #2-Scrubber Stack #1

Results of Carbon Monoxide Determinations----------Method 10

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	1257/1414	1447/1550	1620/1723
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Total sampling time....(MIN)	60.00	60.00	60.00
Oxygen content....(%V/V DRY)	20.20	20.20	20.20
Moisture content.....(%V/V)	6.54	5.90	7.17
Volumetric flow rate.....			
actual.....(ACFM)	182705	185704	183243
dry standard.....(DSCFM)	152240	156075	151620
CO concentration.....			
(GR/DSCF).....	.0097	.0066	.0076
(PPM-DRY).....	19	13	15
CO emission rate.....(LB/HR)	12.7	8.83	9.88

3.6 Results of Lead Determinations

Test No. 1
Indurating Line #1-Scrubber Stack #4

Results of Lead Determinations----------Method 12

	Run 1	Run 2	Run 3
Date of run	05-05-87	05-05-87	05-05-87
Time run start/end.....(HRS)	915-1020	1205-1312	1345-1450
Barometric pressure..(IN.HG)	28.60	28.60	28.60
Meter temperature....(DEG-F)	77.70	91.40	97.50
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	50.300	49.510	49.250
standard conditions (DSCF)	47.781	45.846	45.103
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	10.43	9.16	9.64
Volumetric flow rate (DSCFM)	140777	136901	134356
Lead in sample.....(uG)	24.00	32.00	22.00
Lead concentration.....			
(GR/10^3DSCF).....	0.0078	0.0108	0.0075
(uG/DSCM).....	17.75	24.67	17.24
Lead emis. rate..(10^{-3}LB/HR)	<9.35	<12.64	<8.67
	.00935	.01264	.00867

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 2
Indurating Line #1-Scrubber Stack #3

Results of Lead Determinations----------Method 12

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Time run start/end.....(HRS)	1446-1552	1625-1729	1847-1951
Barometric pressure..(IN.HG)	28.50	28.50	28.50
Meter temperature....(DEG-F)	91.90	89.90	77.90
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	50.000	49.880	49.440
standard conditions (DSCF)	46.104	46.160	46.773
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	9.45	8.16	8.66
Volumetric flow rate (DSCFM)	136577	138126	138644
Lead in sample.....(uG)	26.00	14.00	18.00
Lead concentration.....			
(GR/10^{3}DSCF).....	0.0087	0.0047	0.0059
(uG/DSCM).....	19.93	10.72	13.60
Lead emis. rate..(10^{-3}LB/HR)	<10.19	<5.54	<7.06

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 3
Indurating Line #1-Scrubber Stack #2

Results of Lead Determinations----------Method 12

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	810-913	945-1048	1115-1218
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	69.30	88.80	89.90
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	48.400	52.310	52.330
standard conditions (DSCF)	46.448	48.447	48.364
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.81	6.80	5.96
Volumetric flow rate (DSCFM)	140401	144285	144502
Lead in sample.....(uG)	14.00	15.00	14.00
Lead concentration.....			
(GR/10^{3}DSCF).....	0.0047	0.0048	0.0045
(uG/DSCM).....	10.65	10.94	10.23
Lead emis. rate..(10^{-3}LB/HR)	05.60	05.91	05.53

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 4
Indurating Line #1-Scrubber Stack #1

Results of Lead Determinations----------Method 12

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	1257-1401	1445-1549	1621-1725
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	90.20	90.20	91.30
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	53.550	55.220	55.840
standard conditions (DSCF)	49.482	51.046	51.523
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.17	5.17	5.62
Volumetric flow rate (DSCFM)	146818	152737	151094
Lead in sample.....(uG)	10.00	14.00	14.00
Lead concentration.....			
(GR/10^{3}DSCF).....	0.0031	0.0042	0.0042
(uG/DSCM).....	7.14	9.69	9.60
Lead emis. rate..(10^{-3}LB/HR)	03.92	05.54	05.43

A trailing '<' symbol indicates that the true value
is less than or equal to the reported value

Test No. 1
Indurating Line #2-Scrubber Stack #4

Results of Lead Determinations----------Method 12

	Run 1	Run 2	Run 3
Date of run	05-05-87	05-05-87	05-05-87
Time run start/end.....(HRS)	915-1022	1205-1310	1345-1448
Barometric pressure..(IN.HG)	28.60	28.60	28.60
Meter temperature....(DEG-F)	76.70	92.00	98.80
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	44.570	46.570	47.120
standard conditions (DSCF)	42.155	42.837	42.819
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	9.70	8.28	8.38
Volumetric flow rate (DSCFM)	124910	128433	126911
Lead in sample.....(uG)	78.00	24.00	17.00
Lead concentration.....			
(GR/10^{3}DSCF).....	0.0286	0.0086	0.0061
(uG/DSCM).....	65.39	19.80	14.03
Lead emis. rate..(10^{-3}LB/HR)	030.57	009.52	006.66

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 2
Indurating Line #2-Scrubber Stack #3

Results of Lead Determinations----------Method 12

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Time run start/end.....(HRS)	1446-1555	1625-1737	1847-1953
Barometric pressure..(IN.HG)	28.50	28.50	28.50
Meter temperature....(DEG-F)	89.10	88.90	83.20
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	55.130	57.210	54.560
standard conditions (DSCF)	50.898	52.866	50.919
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	7.54	7.36	7.93
Volumetric flow rate (DSCFM)	150589	155876	149503
Lead in sample.....(uG)	10.00	14.00	22.00
Lead concentration.....			
(GR/10^{3}DSCF).....	0.0030	0.0041	0.0067
(uG/DSCM).....	6.94	9.36	15.27
Lead emis. rate..(10^{-3}LB/HR)	3.91	5.46	8.54

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 3
Indurating Line #2-Scrubber Stack #2

Results of Lead Determinations----------Method 12

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	810-915	945-1048	1115-1217
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	71.90	86.80	92.00
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	50.430	53.690	54.580
standard conditions (DSCF)	47.938	49.676	50.030
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.36	6.40	5.94
Volumetric flow rate (DSCFM)	145102	147654	148939
Lead in sample.....(uG)	18.00	14.00	14.00
Lead concentration.....			
(GR/10^3DSCF).....	0.0058	0.0043	0.0043
(uG/DSCM).....	13.27	9.96	9.89
Lead emis. rate..(10^{-3}LB/HR)	007.21	005.50	005.51

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 4
Indurating Line #2-Scrubber Stack #1

Results of Lead Determinations----------Method 12

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	1257-1414	1447-1550	1620-1723
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	90.80	91.80	95.80
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	56.480	57.390	57.020
standard conditions (DSCF)	51.910	52.661	51.939
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.54	5.90	7.17
Volumetric flow rate (DSCFM)	152240	156075	151620
Lead in sample.....(uG)	15.00	15.00	10.00
Lead concentration.....			
(GR/10^{-3}DSCF).....	0.0045	0.0044	0.0030
(uG/DSCM).....	10.21	10.07	6.80
Lead emis. rate..(10^{-3}LB/HR)	5.82	5.88	3.86

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

3.7 Results of Beryllium Determinations

Interpoll Report No. 7-2364
Hibbing Taconite Company
Hibbing, Minnesota

Test No. 1
Indurating Line #1-Scrubber Stack #4

Results of Beryllium Determinations----------Method 104

	Run 1	Run 2	Run 3
Date of run	05-05-87	05-05-87	05-05-87
Time run start/end.....(HRS)	915-1020	1205-1312	1345-1450
Barometric pressure..(IN.HG)	28.60	28.60	28.60
Meter temperature....(DEG-F)	77.70	91.40	97.50
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	50.300	49.510	49.250
standard conditions (DSCF)	47.781	45.846	45.103
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	10.43	9.16	9.64
Volumetric flow rate (DSCFM)	140777	136901	134356
Beryllium in sample.....(uG)	0.077	0.070	0.170
Beryllium concentration.....			
(GR/10^6DSCF).....	0.0249	0.0236	0.0582
(nG/DSCM).....	56.95	53.96	133.20
Beryllium emission rate.....			
(10^{-6}LB/HR).....	<30.00	<27.64	<66.97

A trailing '<' symbol indicates that the true value
is less than or equal to the reported value

Interpoll Report No. 7-2364
Hibbing Taconite Company
Hibbing, Minnesota

Test No. 2
Indurating Line #1-Scrubber Stack #3

Results of Beryllium Determinations----------Method 104

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Time run start/end.....(HRS)	1446-1552	1625-1729	1847-1951
Barometric pressure..(IN.HG)	28.50	28.50	28.50
Meter temperature....(DEG-F)	91.90	89.90	77.90
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	50.000	49.880	49.440
standard conditions (DSCF)	46.104	46.160	46.773
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	9.45	8.16	8.66
Volumetric flow rate (DSCFM)	136577	138126	138644
Beryllium in sample.....(uG)	0.064	0.040	0.078
Beryllium concentration.....			
(GR/10^6DSCF).....	0.0214	0.0134	0.0257
(nG/DSCM).....	49.06	30.62	58.93
Beryllium emission rate.....			
(10^{-6}LB/HR).....	<25.07	<15.83	<30.58

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 3
Indurating Line #1-Scrubber Stack #2

Results of Beryllium Determinations----------Method 104

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	810-913	945-1048	1115-1218
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	69.30	88.80	89.90
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	48.400	52.310	52.330
standard conditions (DSCF)	46.448	48.447	48.364
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.81	6.80	5.96
Volumetric flow rate (DSCFM)	140401	144285	144502
Beryllium in sample.....(uG)	0.052	0.050	0.024
Beryllium concentration.....			
(GR/10^{6}DSCF).....	0.0173	0.0159	0.0077
(nG/DSCM).....	39.56	36.47	17.54
Beryllium emission rate.....			
(10^{-6}LB/HR).....	20.79	19.69	9.48

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 4
Indurating Line #1-Scrubber Stack #1

Results of Beryllium Determinations----------Method 104

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	1257-1401	1445-1549	1621-1725
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	90.20	90.20	91.30
Meter correction coefficient	1.0064	1.0064	1.0064
Volume through gas meter....			
at meter conditions...(CF)	53.550	55.220	55.840
standard conditions (DSCF)	49.482	51.046	51.523
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.17	5.17	5.62
Volumetric flow rate (DSCFM)	146818	152737	151094
Beryllium in sample.....(uG)	0.034	0.005<	0.027
Beryllium concentration.....			
(GR/10^{6}DSCF).....	0.0106	0.0015<	0.0081
(nG/DSCM).....	24.28	3.46<	18.52
Beryllium emission rate.....			
(10^{-6}LB/HR).....	13.34	1.98<	10.47

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Interpoll Report No. 7-2364
Hibbing Taconite Company
Hibbing, Minnesota

Test No. 1
Indurating Line #2-Scrubber Stack #4

Results of Beryllium Determinations----------Method 104

	Run 1	Run 2	Run 3
Date of run	05-05-87	05-05-87	05-05-87
Time run start/end.....(HRS)	915-1022	1205-1310	1345-1448
Barometric pressure..(IN.HG)	28.60	28.60	28.60
Meter temperature....(DEG-F)	76.70	92.00	98.80
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	44.570	46.570	47.120
standard conditions (DSCF)	42.155	42.837	42.819
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	9.70	8.28	8.38
Volumetric flow rate (DSCFM)	124910	128433	126911
Beryllium in sample.....(uG)	0.100	0.076	0.098
Beryllium concentration.....			
(GR/10^{6}DSCF).....	0.0366	0.0274	0.0353
(nG/DSCM).....	83.83	62.70	80.88
Beryllium emission rate.....			
(10^{-6}LB/HR).....	39.19	30.13	38.41

A trailing '<' symbol indicates that the true value
is less than or equal to the reported value

Test No. 2
Indurating Line #2-Scrubber Stack #3

Results of Beryllium Determinations----------Method 104

	Run 1	Run 2	Run 3
Date of run	05-06-87	05-06-87	05-06-87
Time run start/end.....(HRS)	1446-1555	1625-1737	1847-1953
Barometric pressure..(IN.HG)	28.50	28.50	28.50
Meter temperature....(DEG-F)	89.10	88.90	83.20
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	55.130	57.210	54.560
standard conditions (DSCF)	50.898	52.866	50.919
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	7.54	7.36	7.93
Volumetric flow rate (DSCFM)	150589	155876	149503
Beryllium in sample.....(uG)	0.230	0.044	0.088
Beryllium concentration.....			
(GR/10^6DSCF).....	0.0697	0.0128	0.0267
(nG/DSCM).....	159.70	29.41	61.08
Beryllium emission rate.....			
(10^-4LB/HR).....	<90.00	<17.16	<34.17

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 3
Indurating Line #2-Scrubber Stack #2

Results of Beryllium Determinations----------Method 104

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	810-915	945-1048	1115-1217
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	71.90	86.80	92.00
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	50.430	53.690	54.580
standard conditions (DSCF)	47.938	49.676	50.030
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.36	6.40	5.94
Volumetric flow rate (DSCFM)	145102	147654	148939
Beryllium in sample.....(uG)	0.092	0.005<	0.039
Beryllium concentration.....			
(GR/10^6DSCF).....	0.0296	0.0016<	0.0120
(nG/DSCM).....	67.82	3.56<	27.55
Beryllium emission rate.....			
(10^{-6}LB/HR).....	36.83	1.97<	15.35

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 4
Indurating Line #2-Scrubber Stack #1

Results of Beryllium Determinations----------Method 104

	Run 1	Run 2	Run 3
Date of run	05-07-87	05-07-87	05-07-87
Time run start/end.....(HRS)	1257-1414	1447-1550	1620-1723
Barometric pressure..(IN.HG)	28.45	28.45	28.45
Meter temperature....(DEG-F)	90.80	91.80	95.80
Meter correction coefficient	1.0013	1.0013	1.0013
Volume through gas meter....			
at meter conditions...(CF)	56.480	57.390	57.020
standard conditions (DSCF)	51.910	52.661	51.939
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	6.54	5.90	7.17
Volumetric flow rate (DSCFM)	152240	156075	151620
Beryllium in sample.....(uG)	0.080	0.053	0.033
Beryllium concentration.....			
(GR/10^{6}DSCF).....	0.0238	0.0155	0.0098
(nG/DSCM).....	54.46	35.57	22.45
Beryllium emission rate.....			
(10^{-6}LB/HR).....	<31.03	20.77	12.74

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

APPENDIX A

SAMPLING TRAIN CALIBRATION DATA

Interpoll Inc.
(612)786-6020

Meter Box Calibration
Data Sheet

Date of Calibration: April 1, 1987
Technician: J. Buresh
Barometric Pressure: 29.05

Meter Box No.: 5
Dry Test Meter Serial No.: 649078
Wet Test Meter No.: AL-20

Delta H Actual (in. WC)	Gas Volume Wet Meter	Cal. Index	Diff. Wet Test Meter (in. WC)	Gas Volume Dry Test Meter Vde (cf)	Gas Volume Dry Test Meter Vdf (cf)	Gas Temperature of Meters Tw (deg-F)	Gas Temperature of Meters Tdi (deg-F)	Gas Temperature of Meters Tdo (deg-F)	Time (min)	Meter Coef.	Orifice Constant (in. WC)
.5	2	99.87	.04	629.00	631.00	71.1	74	80	7.59	1.0084	1.74
1.2	3	99.88	.06	625.50	628.50	71.3	73	82	7.50	1.0072	1.79
2.0	3	99.89	.07	619.50	622.48	71.3	73	75	5.75	1.0054	1.81
3.3	5	99.90	.085	632.00	637.02	71.0	74	89	7.62	1.0061	1.85
4.7	5	99.93	.12	639.00	644.03	70.9	76	91	6.86	1.0048	1.87
									Average:	1.0064	1.81

Interpoll Inc.
(612)786-6020

Meter Box Calibration and Usage Status

Date of Report: May 7, 1987

Meter Box No.: 5 (Rockwell Dry Test Meter Serial No. 649078)

Date of Last Calibration: April 1, 1987
Calibration Technician: J. Buresh
Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
April 16, 1987	7-2361	644.40	914.46	270.06	270.06
April 30-May 1, 1987	7-2362	915.60	1236.19	320.59	590.65
May 5-7, 1987	7-2364	236.50	906.24	669.74	1260.39

*Total volume through meter since last calibration

Interpoll Inc.
(612)786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: May 5, 1987 Nozzle Number 7-4
Technician: E. Trowbridge

Nozzle rotated by 60 degree increments and diameter measured to nearest 0.001 inch. Observed readings and average:

Position	Diameter (inches)
1	.249
2	.248
3	.251
Average:	.249

Interpoll Inc.
(612)786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: May 6, 1987 Nozzle Number 7-4
Technician: E. Trowbridge

Nozzle rotated by 60 degree increments and diameter measured to nearest 0.001 inch. Observed readings and average:

Position	Diameter (inches)
1	.250
2	.248
3	.249
Average:	.249

Interpoll Inc.
(612)786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: May 7, 1987 Nozzle Number 7-4
Technician: E. Trowbridge

Nozzle rotated by 60 degree increments and diameter measured to nearest 0.001 inch. Observed readings and average:

Position	Diameter (inches)
1	.250
2	.248
3	.249
Average:	.249

Interpoll Inc.
(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 10-10

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .464 IN.
3. Base to Side B opening plane (P_B) .462 IN.

Alignment:

4. $\alpha_1 < 10^o$ 0
5. $\alpha_2 < 10^o$ 0

6. $B_1 < 5^o$ 0
7. $B_2 < 5^o$ 1°

8. Z <.125" .01
9. W <.0625" .01

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .760 IN.
11. Pitot to probe sheath 3 IN.
12. Pitot to thermocouple (parallel to probe) _____ IN.
13. Pitot to thermocouple (perpendicular to probe) _____ IN.

Date of Inspection: January 3, 1986

Inspected by: E. Trowbridge

S-348(1)

Interpoll Inc.
(612)786-6020

Meter Box Calibration
Data Sheet

Date of Calibration: March 19, 1987
Technician: E. Trowbridge
Barometric Pressure: 29.14

Meter Box No.: 8
Dry Test Meter Serial No.: 949230
Wet Test Meter No.: AL-20

Delta H Actual (in. WC)	Gas Volume Wet Meter	Cal. Index	Diff. Wet Test Meter (in. WC)	Gas Volume Dry Test Meter Vde (cf)	Gas Volume Dry Test Meter Vdf (cf)	Gas Temperature of Meters Tw (deg-F)	Gas Temperature of Meters Tdi (deg-F)	Gas Temperature of Meters Tdo (deg-F)	Time (min)	Meter Coef.	Orifice Constant (in. WC)
.5	2	99.87	.04	132.000	134.020	71	78	70	8.36	.9930	1.82
1.2	3	99.88	.06	128.000	131.004	71	78	70	7.54	.9999	1.83
2.0	3	99.89	.07	135.000	137.995	71	82	70	5.84	1.0047	1.88
3.3	5	99.90	.085	139.000	143.985	71	88	71	7.66	1.0094	1.88
4.7	5	99.95	.12	145.000	150.040	71	92	72	6.90	.9999	1.91
									Average:	1.0013	1.86

Interpoll Inc.
(612)786-6020

Meter Box Calibration and Usage Status

Date of Report: May 7, 1987

Meter Box No.: 8

Date of Last Calibration: March 19, 1987
Calibration Technician: E. Trowbridge
Wet Test Meter No.: AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
March 24-26, 1987	7-2352	150.05	575.11	425.06	425.06
May 5-7, 1987	7-2364	575.40	1270.27	649.87	1119.93

*Total volume through meter since last calibration

Interpoll Inc.
(612)786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: May 5, 1987 Nozzle Number 4-4
Technician: R. Rosenthal

Nozzle rotated by 60 degree increments and diameter measured to nearest 0.001 inch. Observed readings and average:

Position	Diameter (inches)
1	.248
2	.251
3	.252
Average:	.250

Interpoll Inc.
(612)786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: May 6, 1987 Nozzle Number 4-4
Technician: R. Rosenthal

Nozzle rotated by 60 degree increments and diameter measured to nearest 0.001 inch. Observed readings and average:

Position	Diameter (inches)
1	.248
2	.251
3	.252
Average:	.250

Interpoll Inc.
(612)786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: May 7, 1987 Nozzle Number 4-4
Technician: R. Rosenthal

Nozzle rotated by 60 degree increments and diameter measured to nearest 0.001 inch. Observed readings and average:

Position	Diameter (inches)
1	.248
2	.251
3	.252
Average:	.250

Interpoll Inc.
(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 8-10

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .460 IN.
3. Base to Side B opening plane (P_B) .462 IN.

Alignment:

4. α_1 <10° 0
5. α_2 <10° 0

6. B_1 < 5° 1°
7. B_2 < 5° 1°

8. Z <.125" .03
9. W <.0625" .01

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .762 IN.
11. Pitot to probe sheath 3 IN.
12. Pitot to thermocouple (parallel to probe) _____ IN.
13. Pitot to thermocouple (perpendicular to probe) _____ IN.

Date of Inspection: January 3, 1986

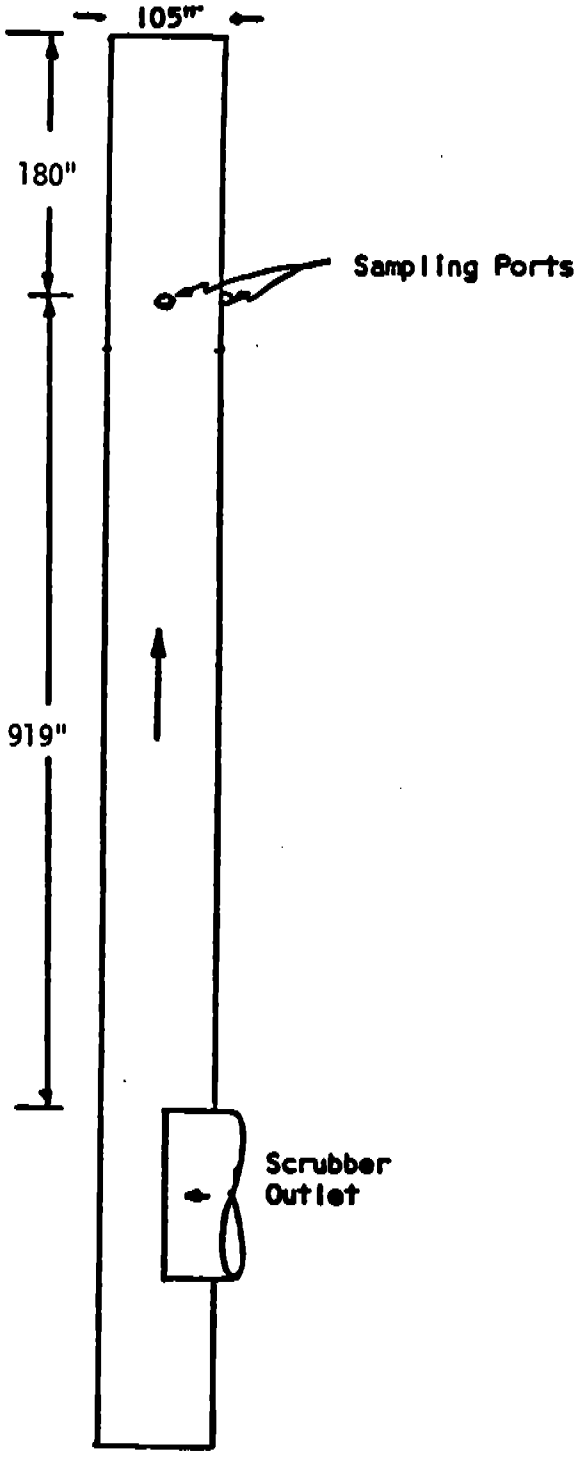
Inspected by: E. Trowbridge

S-348(1)

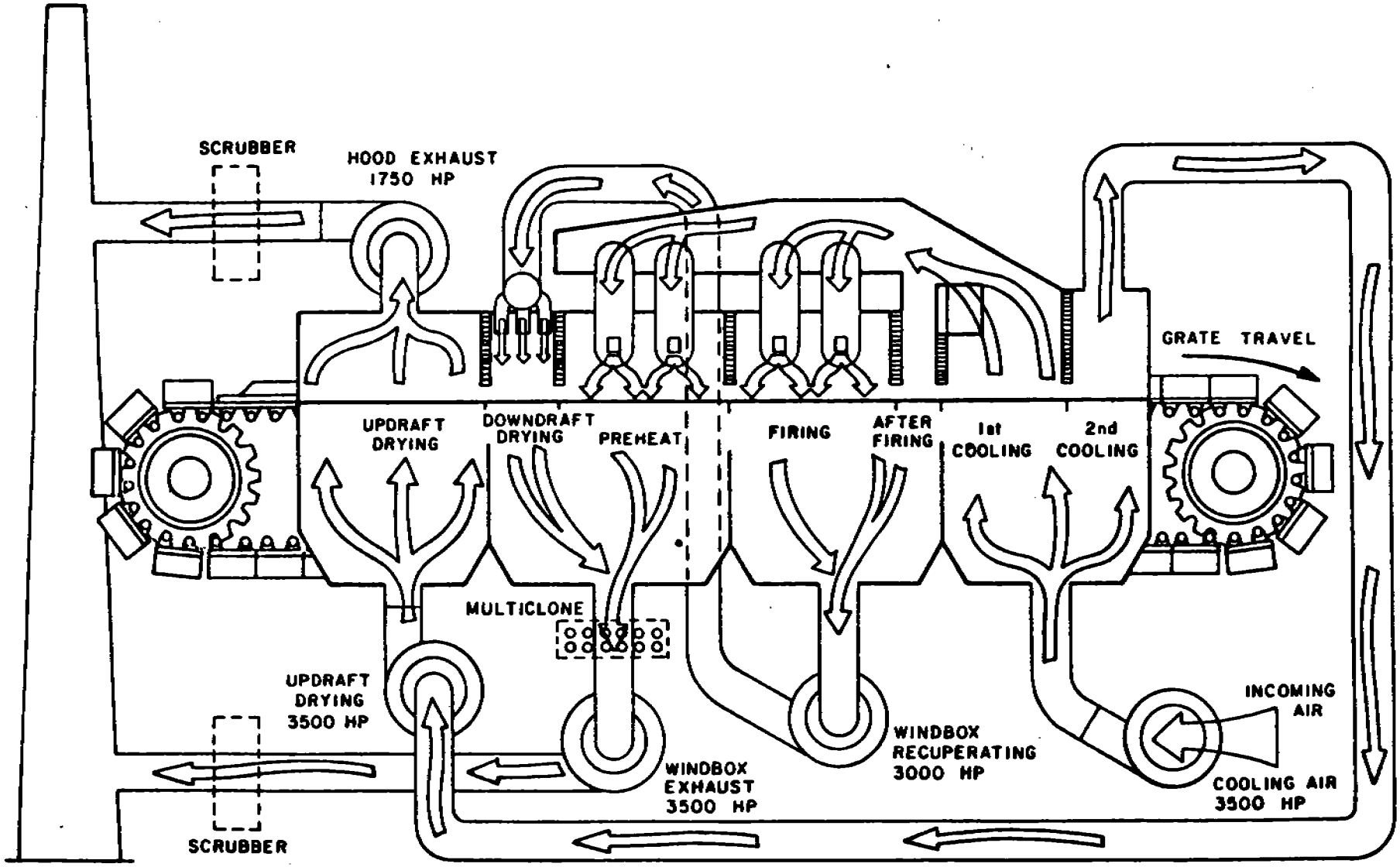
APPENDIX B

LOCATION OF TEST PORTS

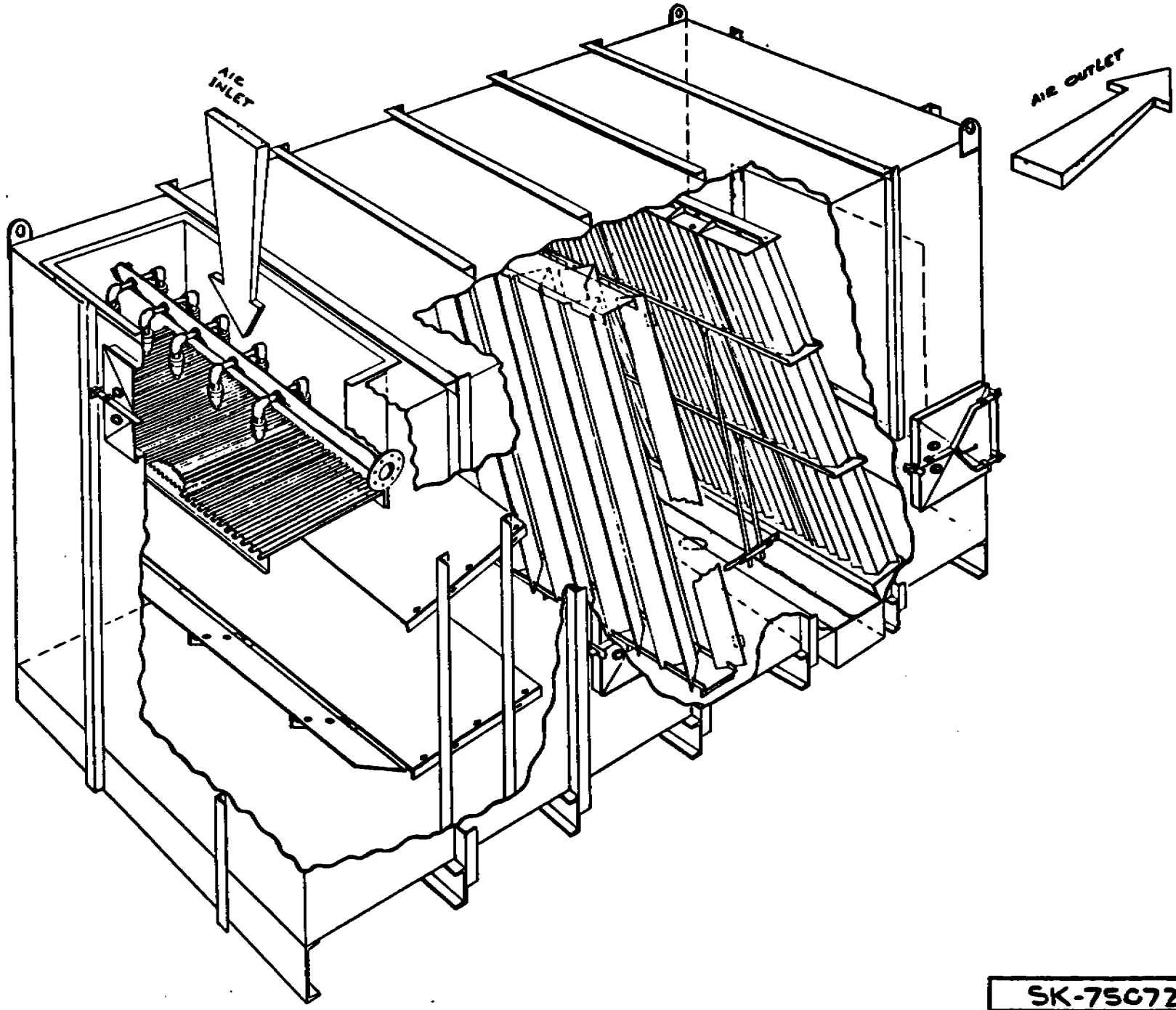
HIBBING TACONITE



NOT TO SCALE



PROCESS GAS FLOW



SK-750729
ENVIRONEERING INC.

APPENDIX C

METHODS 2-6 FIELD DATA SHEETS FOR INDURATING LINE NO. 1

Preliminary Data – Method 2

— Interpoll Inc. —

Job HIBBING TACONITE CO.

Source INDURATING LINE #1 (SCRUBBER STACK #4) Date 5-5-97

Test No. 1 Run No. 1

Stack dimensions: 105 in.

Dry bulb 116 °F Wet bulb 104 °F

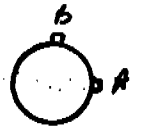
Rel. hum. ____ % B_{wo} ____ %

Barometric pressure (P_b) 28.60 in. Hg

Static pressure (P_g) -.35 in. WC ____ in. Hg

Operators E. TROWBRIDGE – C. MOSSOR

Pitot No. 10-10 C_p .840 Por Length 6½



Schematic of Stack Cross Section

Traverse Point No.	Distance from Stack wall	Distance from End of Port	(0830) Velocity Head (in. WC)	Temperature (°F)
A-1	4.62	11.12	.52	
2	15.33	21.83	.46	
3	30.98	37.48	.80	
4	73.92	80.42	.75	
5	89.67	96.17	.67	
6	100.38	106.88	.62	
B 1			.44	
2			.70	
3			.70	
4			.66	
5			.65	
6			.64	
25				avg. 116

S-0034R

Sample Log Sheet

Job NIBBING TACONITE CO

Unit and Sampling Location INDURATING LINE #1, SCRUBBER STACK # 4

Date 4-5-91 Test 1 Run 1

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☑
posttest: 0 cfm at 14 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 8113			
PW			
Total (M_n)			g

Impinger ☑ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
1, 2, 3, 4	486	400	86
DESICCANT	1349	1317	32
Total (M_{wo})			118 g

Integrated Flue Gas Sampling Data

FG Train No. B3 Box No. 10 Bag No. 1

Bag Material Tedlar Bag Volume 44 L

Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(0916)			
	400		
(1019)	400		

Operator ET 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE CO — Operators E. TROWBRIDGE - C. MOSSAK — Pitot No. 10-10 — C_p .840

Source INDURATING LINE #1, SCRUBBER STACK #4 — Sampling Train No. 5 — $\Delta H_@$ 1.81 — Bar. Press. 28.60 in.Hg. — B_{ws} 9 %

Date 5-5-87 — Test 1 — Run 1 — Gasmeter coeff. 1.0164 — Amb. Temp. ___ °F — Nozzle No. 7-4 — Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (in Hg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(0915)	(236.50)										
A 6	5	240.62	.66	2.14	0.63	10.5	119	250	250/56	20.0	70	66
5	10	244.78	.67	2.16	4.79	11.0	119			20.0	72	68
4	15	249.11	.73	2.42	9.21	12.0	119			19.8	77	70
3	20	254.03	.96	3.12	4.22	15.0	119	250	250/57	19.5	80	71
2	25	258.60	.66	2.16	8.41	12.9	119			19.4	80	72
1	30	261.95	.52	1.70	2.12	9.0	119			19.3	82	74
86	35	266.14	.65	2.14	6.29	10.3	119	250	250/57	19.1	83	76
5	40	270.53	.65	2.17	0.50	11.8	121			19.0	86	76
4	45	274.85	.66	2.14	4.69	11.7	121			19.0	86	78
3	50	278.93	.71	2.34	9.07	10.5	121	250	250/57	18.9	86	78
2	55	283.16	.71	2.01	3.13	10.4	121			19.0	88	80
1	60	286.80	.46	1.52	6.68	9.0	121			18.9	88	80
	(1020)											
		V_m = 50.30		$\overline{\Delta H}$ = 2.17							$\overline{T_{GM}}$ = 77.7	

Sample Log Sheet

Job NIBBING TACONITE CO

Unit and Sampling Location INDURATING LINE #1, SCRUBBER STACK # 4

Date 5-5-97 Test 1 Run 2

Sample Train: Leak check pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☑
posttest: 0 cfm at 14 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER #8118			
PW			
Total (M_n)			g

Impinger ☑ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
1,2,3 4 4	477	900	77
DESICCANT	1381	1360	21
Total (M_{wo})			98 g

Integrated Flue Gas Sampling Data

FG Train No. B 3 Box No. 10 Bag No. 2

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(1204)			
	400		
(1311)	400		

Operator ET 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE CO Operators ETVCM Pitot No. 16-10 C_p .840

Source INDURATING LINE #1, SCRUBBER STACK #4 Sampling Train No. 5 $\Delta H_@$ 1.81 Bar. Press. 28.60 in.Hg. B_{wo} 10 %

Date 5-5-87 Test 1 Run 2 Gasmeter coeff. 1.0064 Amb. Temp. °F Nozzle No. 7-4 Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in.WC)	Orifice Meter (in.WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1205)	(287.00)										
B 6	5	290.82	.55	1.91	0.88	9.0	121	250	250/56	19.1	94	84
5	10	295.12	.67	2.18	5.12	10.5	121			19.1	90	84
4	15	299.30	.66	2.16	9.35		121			19.1	92	84
3	20	303.70	.70	2.29	3.71	12.2	121	250	250/58	19.1	94	84
2	25	308.00	.70	2.30	8.07		121			19.0	94	86
1	30	311.39	.40	1.32	1.39	8.1	121			19.0	94	86
A 6	35	315.35	.58	1.91	5.37	9.8	121	250	250/60	19.4	94	86
5	40	319.51	.65	2.14	9.59	11.0	121			19.4	98	90
4	45	324.97	.71	2.35	4.03	11.9	121			19.4	99	90
3	50	328.31	.66	2.19	8.31	11.4	121	250	250/60	19.4	100	92
2	55	332.58	.64	2.13	2.54	11.0	121			19.4	102	92
1	60	336.51	.52	1.73	6.36	11.0	121			19.4	103	94
	(1312)											
	0-60	V_m = 49.51		$\bar{\Delta H}$ = 2.04							$\bar{T}_m$ = 91.4	

C-5

Sample Log Sheet

Job HIBBING TACONITE CO

Unit and Sampling Location INDURATING LINE #1, SCRUBBER STACK #4

Date 5-5-87 Test 1 Run 3

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☑
posttest: 0 cfm at 12 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER #8119			
PW			
Total (M_n)			g

Impinger ☑ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
1,2,3 & 4	472	400	72
DESICCANT	1471	1441	30
Total (M_{wo})			102 g

Integrated Flue Gas Sampling Data

FG Train No. B-3 Box No. 10 Bag No. 3

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(1346)			
	400		
(1450)	400		

Operator ET 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE CO — Operators ET + CM — Pitot No. 10-10 C_p .840

Source INDURATING LINE #1, SCRUBBER STACK #4 — Sampling Train No. 5 — $\Delta H_@$ 1.81 — Bar. Press. 28.60 in.Hg. — B_{wo} 9 %

Date 5-5-97 — Test 1 — Run 3 — Gasmeter coeff. 1.0064 — Amb. Temp. ___ °F — Nozzle No. 2-4 — Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (in Hg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1345)	(336.70)										
A 6	√	340.69	.57	1.91	0.69	9.8	121	250	250/58	19.5	102	92
√	10	344.83	.59	2.01	4.81	10.0	121			19.5	102	93
4	√	348.89	.61	2.04	8.95	10.1	121			19.5	102	95
3	20	353.35	.69	2.35	3.40	11.0	121	250	250/58	19.5	100	94
2	25	357.63	.64	2.17	7.68	11.6	121			19.5	100	94
1	30	361.48	.60	1.70	1.47	9.8	121			19.5	100	94
B 6	35	364.94	.43	1.46	4.98	7.9	121	250	250/58	19.5	98	94
√	40	369.00	.58	1.97	9.05	10.0	120			19.5	100	94
4	45	373.32	.65	2.21	3.36	11.0	120			19.4	100	94
3	50	377.65	.65	2.21	7.67	11.0	120	250	250/62	19.4	102	94
2	55	382.	.70	2.38	2.16	12.0	120			19.4	102	94
1	60	385.95	.50	1.70	5.45		120			19.4	104	94
	(1450)											
		Σ = 49.25		Δ̄H = 2.01							Σ = 97.5	

C-7

Preliminary Data – Method 2

— Interpoll Inc. —

Job HIBBING TACONITE CO

Source EVAPORATING UNITS 1, 2 STACKS 3 Date 5-6-87

Test No. 2 Run No. 1

Stack dimensions: 105 in.

Dry bulb 112 °F Wet bulb 104 °F

Rel. hum. ____ % B_{wo} ____ %

Barometric pressure (P_b) 28.50 in. Hg

Static pressure (P_g) −.35 in. WC ____ in. Hg

Operators E. TROWBRIDGE – C. MOSSER

Pitot No. 10-10 C_p .848 Port Length 6½

Schematic of Stack Cross Section

Traverse Point No.	Distance from Stack wall	Distance from End of Port	Velocity Head (in. WC)	Temperature (°F)
A-1	4.62	11.12	.50	
2	15.53	21.83	.65	
3	30.98	37.48	.70	
4	75.92	90.42	.70	
5	89.67	96.17	.66	
6	100.38	106.88	.35	
B 1			.55	
2			.65	
3			.70	
4			.70	
5			.65	
6			.55	
25				avg. 113

S-0034R

Sample Log Sheet

Job HIBBING TACONITE CO

Unit and Sampling Location INDURATING LINE #1 SCRUBBER STACK #3

Date 5-6-87 Test 2 Run 1

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☑
posttest: 0 cfm at 12 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER #123			
PW			
Total (M_n)			g

Impinger ☑ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
1,2,3 & 4	467	400	67
DESICCANT	1317	1282	35 ✓
Total (M_{wo})			102 g

Integrated Flue Gas Sampling Data

FG Train No. B-3 Box No. 11 Bag No. 1

Bag Material Tedlar Bag Volume 44 L

Pretest leak check 100 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(1446)			
	400		
(1551)	400		

Operator EJ 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE — Operators ET & CM — Pitot No. 10-10 — C_p .840

Source ~~INDURATING LINE #1~~ SCRUBBER STACK #3 — Sampling Train No. 5 — $\Delta H_@$ 1.81 — Bar. Press. 28.50 in.Hg. — B_{wo} 9 %

Date 5-4-87 — Test 2 — Run 1 — Gasmeter coeff. 1.0064 — Amb. Temp. ___ °F — Nozzle No. 7-4 — Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (in Hg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1446)	(437.20)										
B 6	5	441.10	.55	1.89	1.08	9.0	113	250	225/58	19.5	82	90
5	10	445.45	.65	2.21	5.38	10.0	113			19.5	84	90
4	15	449.90	.70	2.39	9.85	11.0	113			19.5	84	90
3	20	454.34	.70	2.39	4.32	11.0	113	250	230/60	19.5	84	90
2	25	458.70	.66	2.25	8.66		113			19.5	84	90
1	30	462.58	.52	1.77	2.52	9.0	113			19.5	84	90
A 6	35	465.82	.36	1.23	5.73		113	250	230/62	19.5	84	90
5	40	470.12	.67	2.28	0.10	10.8	113			19.5	84	90
4	45	474.60	.71	2.42	4.60	11.0	113			19.6	84	90
3	50	479.12	.71	2.42	9.10	11.2	113	250	250/64	19.6	84	90
2	55	483.46	.65	2.22	3.41	11.0	113			19.6	84	90
1	60	487.20	.50	1.71	7.20	9.0	113			19.7	84	90
	(1552)											
	θ = 60	V_M = 50.00		ΔH = 2.10							$\bar{T}_m$ = 91.9	

C-10

— Interpoll Inc —

S-8037R

Sample Log Sheet

Job HIBBING TACONITE CO

Unit and Sampling Location INDURATING LINE #1, SCRUBBER STACK #3

Date 5-6-87 Test 2 Run 2

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☑
posttest: 0 cfm at 12 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER #8124			
PW			
Total (Mn)			g

Impinger ☑ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
1, 2, 3 & 4	470	400	70
DESICCANT	1386	1369	17
Total (M_{wo})			87 g

Integrated Flue Gas Sampling Data

FG Train No. B-3 Box No. 11 Bag No. 2

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check 00 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(1626)			
	400		
(1716)	400		

Operator ET 320-P Reading _____ % v/v

[redacted] A Method 5 Field Data Sheet

Job HIBBING TACONITE CO Operators ET & CM Pitot No. 10-10 C_p .840

Source INDURATING LINE #1, SCRUBBER STACK #3 Sampling Train No. 5 $\Delta H_@$ 1.81 Bar. Press. 28.50 in.Hg. B_{wo} 9 %

Date 5-6-87 Test 2 Run 2 Gasmeter coeff. 1.0044 Amb. Temp. ___ °F Nozzle No. 7-K Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in.WC)	Orifice Meter (in.WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1625)	(487.40)										
A 6	5	490.65	.35	1.19	0.56	6.5	113	250	250/58	19.5	90	88
5	10	494.85	.65	2.20	4.84	10.2	113			19.6	92	88
4	15	499.32	.70	2.38	9.30	11.0	113			19.6	92	88
3	20	503.80	.72	2.44	3.81	11.1	113	250	250/59	19.6	92	88
2	25	508.12	.65	2.21	8.10		113			19.6	92	88
1	30	511.95	.52	1.77	1.95	9.0	113			19.7	92	88
B 6	35	515.80	.55	1.87	5.90	9.0	112	250	250/60	19.7	92	88
5	40	520.10	.65	2.21	0.20	10.8	112			19.7	92	88
4	45	524.60	.70	2.38	4.65	11.7	112			19.7	92	88
3	50	529.14	.71	2.41	9.14	11.9	112	250	250/62	19.7	92	88
2	55	533.45	.65	2.21	3.44		112			19.7	92	88
1	60	537.28	.52	1.77	7.28	9.2	112			19.7	92	88
	(1729)											
	θ = 60	$\sqrt{\Delta H}$ = 49.88		$\overline{\Delta H}$ = 2.09							$\overline{t_m}$ = 91.9	

C-12

Sample Log Sheet

Job HIBBING TACONITE CO

Unit and Sampling Location INDURATING LINE #1 SCRUBBER STACK #3

Date 5-6-97 Test 2 Run 3

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☑

posttest: 0 cfm at 13 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 6125			
PW			
Total (M_n)			g

Impinger ☑ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
1, 2, 3 + 4	468	400	68
DESICCANT	1343	1317	26
Total (M_{wo})			94 g

Integrated Flue Gas Sampling Data

FG Train No. 53 Box No. 11 Bag No. 3

Bag Material Tedlar Bag Volume 44 L

Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(1646)			
	400		
(1950)	400		

Operator EL 320-P Reading _____ % v/v

[redacted]A M[redacted]d 5[redacted]d D[redacted]Shee[redacted]

Job HIBBING TACONITE CO Operators ET & CM Pitot No. 10-10 C_p .840

Source INDURATING LINE #1, SCRUBBER STACK #3 Sampling Train No. 5 $\Delta H_@$ 1.81 Bar. Press. 28.50 in.Hg. B_{wo} 9 %

Date 5-6-87 Test 2 Run 3 Gasmeter coeff. 1.0064 Amb. Temp. ___ °F Nozzle No. 7-4 Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft³)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1847)	(537.70)										
B 6	5	541.45	.50	1.69	1.43	9.0	112	250	250/56	19.5	78	76
5	10	545.60	.65	2.18	5.64	10.5	112			19.5	80	76
4	15	549.92	.69	2.32		11.9	112			19.5	80	76
3	20	554.40	.71	2.38	4.40	12.1	112	250	250/58	19.5	80	76
2	25	556.70	.67	2.25	8.69	11.8	112			19.5	80	76
1	30	562.40	.50	1.68	2.39	9.0	112			19.6	80	76
A 6	35	566.00	.48	1.61	6.03		112	250	250/60	19.5	80	76
5	40	570.25	.65	2.18	0.25	11.[illegible]	112			19.5	80	76
4	45	574.70	.72	2.42	4.69	12.0	112			19.6	80	76
3	50	579.10	.70	2.35	9.07		112	250	250/60	19.6	80	76
2	55	583.30	.65	2.18	3.29	11.5	112			19.6	80	76
1	60	587.14	.54	1.81	7.14		112			19.6	80	76
	(1951)											
		VM = 49.04		ΔH = 2.09							tm = 77.9	

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S-0037R

Preliminary Data – Method 2

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Job HIBBING TACONITE CO
INDURATING LINE #1
Source SCRUBBER STACK #2 Date 5-7-97

Test No. 3 Run No. 1

Stack dimensions: 105 in.

Dry bulb 105 °F Wet bulb 95 °F

Rel. hum. ____ % B_{wo} ____ %

Barometric pressure (P_b) 24.45 in. Hg

Static pressure (P_g) -.35 in. WC ____ in. Hg

Operators E. TROWBRIDGE - C. MOSSOR

Pitot No. 10-10 C_p .840 Port Length 6 1/2

Schematic of Stack Cross Section

Traverse Point No.	Distance from Stack wall	Distance from End of Port	Velocity Head (in. WC)	Temperature (°F)
A 1	4.62	11.12	.32	
2	15.33	21.83	.48	
3	30.98	37.48	.68	
4	73.92	80.42	.70	
5	89.67	96.17	.47	
6	100.38	106.88	.50	
B 1			.42	
2			.67	
3			.72	
4			.72	
5			.68	
6			.56	
25				avg.

S-0034R

Sample Log Sheet

Job HIBBING TACONITE CO

Unit and Sampling Location INDURATING LINE #1 SCRUBBER STACK #2

Date 5-7-97 Test 3 Run 1

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☑

posttest: 0 cfm at 13 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER #8140			
PW			
Total (M_n)			g

Impinger ☑ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
1, 2, 3 & 4	456	400	56
DESICCANT	1322	1306	16
Total (M_{wo})			72 g

Integrated Flue Gas Sampling Data

FG Train No. B-3 Box No. 12 Bag No. 1

Bag Material Tedlar Bag Volume 44 L

Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(0811)			
	400		
(0917)	400		

Operator ET 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE CO
Source INDURATING LINE #1, BE RUBBER STACK # 2
Date 5-7-87 Test 3 Run 1

Operators ET + CM
Sampling Train No. 5 $\Delta H_@$ 1.81
Gasmeter coeff. 1.0064 Amb. Temp. ___ °F

Pitot No. 10-10 C_p .840
Bar. Press. 28.45 in.Hg. B_{wo} 8.5 %
Nozzle No. 7-H Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft³)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(0810)	(587.60)										
A 6	5	591.30	.52	1.73	1.31	8.3	105	250	250/56	19.8	60	58
5	10	595.42	.67	2.20	5.47	9.0	105			19.8	62	58
4	15	599.70	.70	2.30	9.74	10.8	105			19.8	64	59
3	20	603.95	.68	2.24	3.95		105	250	250/58	19.8	70	60
2	25	608.16	.67	2.22	8.16	10.7	105			19.8	72	62
1	30	611.00	.30	1.00	11.0		105			19.7	74	64
B 6	35	614.84	.55	1.84	4.85	8.4	105	250	250/59	19.7	76	66
5	40	619.10	.67	2.25	9.11		105			19.7	76	66
4	45	623.50	.72	2.44	3.54	11.8	100			19.7	80	70
3	50	628.10	.76	2.59	8.13	12.0	100	250	250/60	19.7	82	70
2	55	632.50	.67	2.29	2.45		100			19.7	84	72
1	60	636.00	.45	1.54	6.00	8.0	100			19.7	86	74
	(0913)											
	θ=60	VM=48.40		ΔH=2.05							Tm=69.3	

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S-0037R

Sample Log Sheet

Job HIBBING TACONITE CO

Unit and Sampling Location INDURATING LINE #1 SCRUBBER STACK #2

Date 5-7-87 Test 3 Run 2

Sample Train: Leak check pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☑
posttest: 0 cfm at 13 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 4134			
PW			
Total (M_n)			g

Impinger ☑ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
1, 2, 3 & 4	457	400	57
DESICCANT	1297	1258	39
Total (M_{wo})			96 g

Integrated Flue Gas Sampling Data

FG Train No. B-3 Box No. 12 Bag No. 2

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check 100 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(0646)			
	400		
(1047)	400		

Operator ET 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE CO — Operators ET & CM — Pitot No. 10-10 — C_p .840

Source INDURATING LINE #1, SCRUBBER STACK #2 — Sampling Train No. 5 — $\Delta H_@$ 1.81 — Bar. Press. 28.45 in.Hg. — B_{wo} 7 %

Date 5-7-87 — Test 3 — Run 2 — Gasmeter coeff. 1.0164 — Amb. Temp. ___ °F — Nozzle No. 7-4 — Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in.WC)	Orifice Meter (in.WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(0945)	(636.20)										
B 6	5	640.24	.55	1.97	0.24	10.0	100	250	250/58	19.8	82	80
5	10	644.70	.68	2.41	4.70	11.7	100			19.8	88	82
4	15	649.24	.70	2.50	9.25	12.0	100			19.7	90	82
3	20	653.86	.72	2.57	3.86	12.3	100	250	250/60	19.7	92	84
2	25	658.60	.74	2.65	8.56	12.5	100			19.7	92	84
1	30	662.11	.42	1.51	2.11		100			19.7	92	86
A 6	35	666.00	.52	1.87	6.06	9.2	100	250	255/61	9.7	92	86
5	40	670.60	.67	2.41	0.54		100			9.7	94	88
4	45	675.20	.72	2.60	5.20	12.3	100			9.7	94	88
3	50	679.95	.74	2.67	4.93		100	250	255/62	9.7	96	88
2	55	684.53	.70	2.50	4.53	12.0	100			9.8	96	90
1	60	688.57	.52	1.88	3.51		100			9.8	96	90
	(1048)											
	1-60	V_m=52.81		ΔH=8.31							Avg 88.8	

C-19

Sample Log Sheet

Job HIBBING TACONITE CO

Unit and Sampling Location INDURATING LINE #1 SCRUBBER STACK #2

Date 5-7-87 Test 3 Run 3

Sample Train: Leak check pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☑
posttest: 0 cfm at 13 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # C135			
PW			
Total (Mn)			9

Impinger ☑ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
1, 2, 3 & 4	445	400	45
DESICCANT	1342	1322	20
Total (M_{wo})			65 9

Integrated Flue Gas Sampling Data

FG Train No. B 3 Box No. 12 Bag No. 3

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check 100 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(1116)			
	400		
	|		
	|		
	|		
	|		
(1217)	400		

Operator ET 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job Hibbing Taconite Co
Source Indurating Line #1, Scrubber Stack #2
Date 5-7-87 Test 3 Run 3

Operators ET & CM
Sampling Train No. 5 $\Delta H_@$ 1.81
Gasmeter coeff. 1.0064 Amb. Temp. ___ °F

Pitot No. 10-10 C_p .840
Bar. Press. 28.45 in.Hg. B_{wo} 7.5 %
Nozzle No. 7-4 Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft³)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen 4 (% v/v)	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1115)	(688.50)										
A 6	A 5	692.28	.50	1.79	2.76	8.8	100	250	250/58	19.6	90	88
5	10	697.22	.68	2.42	7.26	10.9	100			19.6	92	88
4	15	701.90	.72	2.57	1.89	11.5	100			19.6	92	88
3	20	706.60	.74	2.64	6.58	12.0	100	250	250/60	19.6	92	88
2	25	711.18	.69	2.46	1.12		100			19.6	92	88
1	30	714.98	.50	1.79	4.98		100			19.6	92	88
B 6	B 35	719.10	.55	1.96	9.04	8.9	100	250	250/60	19.6	92	88
5	40	723.60	.69	2.46	3.57		100			19.6	92	88
4	45	728.25	.73	2.60	8.23	11.8	100			19.7	92	88
3	50	732.80	.70	2.50	2.80		100	250	255/62	19.6	92	88
2	55	737.30	.68	2.41	7.29	11.2	103			19.6	92	88
1	60	740.83	.42	1.49	0.83	8.2	103			19.7	92	88
	(1218)											
	θ=60	V_m=52.33		$\overline{\Delta H}$=2.26							$\overline{t_m}$=89.9	

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S-0037R

Preliminary Data – Method 2

— Interpoll Inc. —

Job HIBBING TACONITE CO
Circulating Line #1
Source SCRUBBER STACK #1 Date 5-7-87

Test No. 4 Run No. 1

Stack dimensions: 105 in.

Dry bulb 103 °F Wet bulb 95 °F

Rel. hum. ____ % B_{wo} ____ %

Barometric pressure (P_b) 29.45 in. Hg

Static pressure (P_g) -.35 in. WC ____ in. Hg

Operators E. TROWBRIDGE - C. MISSAL

Pitot No. 10-10 C_p .840 Port Length 6 1/2

Schematic of Stack Cross Section

Traverse Point No.	Distance from Stack wall	Distance from End of Port	Velocity Head (in. WC)	Temperature (°F)
A 1	4.62	11.12	.50	
2	15.33	21.83	.67	
3	30.99	37.48	.80	
4	73.92	80.42	.76	
5	89.67	96.17	.68	
6	100.38	106.88	.50	
B 1			.50	
2			.70	
3			.80	
4			.80	
5			.68	
6			.56	
25				avg. 103

S-0034R

Sample Log Sheet

Job HIBBING TACONITE CO

Unit and Sampling Location INDURATING LINE #1 SCRUBBER STACK #1

Date 5-7-87 Test 4 Run 1

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☑

posttest: 0 cfm at 15 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 6129			
RW			
Total (M_n)			g

Impinger ☑ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
1, 2, 3 + 4	435	400	35
DESICCANT	1331	1297	34
Total (M_{wo})			69 g

Integrated Flue Gas Sampling Data

FG Train No. B3 Box No. 6 Bag No. 1

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check 100 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(1258)			
	400		
(1401)	400		

Operator ET 320-P Reading _____ % v/v

S-8046R

[redacted]A M[redacted]d 5[redacted]d D[redacted]hee[redacted]

Job HIBBING TACONITE CO Operators ET & CM Pitot No. 10-10 C_p .840

Source INDURATING LINE #1 SCRUBBER STACK #1 Sampling Train No. 5 $\Delta H_@$ 1.81 Bar. Press. 28.45 in.Hg. B_{wo} 4 %

Date 5-7-87 Test 4 Run 1 Gasmeter coeff. 1.0064 Amb. Temp. ___ °F Nozzle No. 7-4 Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft³)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen 4 (% v/v)	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1257)	(741.10)										
A 6	5	745.02	.50	1.82	5.00	9.2	103	250	250/58	19.7	90	88
5	10	749.50	.68	2.47	9.54	11.9	103			19.7	90	88
4	15	754.40	.78	2.83	4.40	13.4	103			19.7	92	88
3	20	759.40	.80	2.91	9.33	14.0	103	250	250/60	19.7	92	88
2	25	763.86	.67	2.44	3.85	12.0	103			19.7	92	88
1	30	767.70	.48	1.75	7.68	9.2	103			19.7	92	88
B 6	35	771.80	.55	2.01	1.77	9.8	103	250	240/60	19.7	92	88
5	40	776.30	.70	2.55	6.39	12.0	103			19.8	92	88
4	45	781.20	.78	2.84	1.25	14.0	103			19.8	92	89
3	50	786.10	.80	2.91	6.19	14.1	103	250	250/62	19.8	92	89
2	55	790.90	.70	2.55	0.81		103			19.8	93	90
1	60	794.65	.48	1.76	4.65		103			19.7	94	90
	(1401)											
	θ = 60	VM = 53.55		$\bar{\Delta H}$ 2.40							$\bar{t}_m$ = 90.2	

— Interpoll Inc —

S-0037R

Sample Log Sheet

Job HIBBING TACONITE

Unit and Sampling Location INDURATING LINE #1 SCRUBBER STACK #1

Date 1-7-87 Test 4 Run 2

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☑
posttest: 0 cfm at 14 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER# 8130			
PW			
Total (M_n)			g

Impinger ☑ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
1, 2, 3, + 4	436	400	36
DESICCANT	1357	1329	23
Total (M_{wo})			59 g

Integrated Flue Gas Sampling Data

FG Train No. 53 Box No. 6 Bag No. 2

Bag Material Tedlar Bag Volume 44 L

Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(1446)			
	400		
(1548)	400		

Operator ET 320-P Reading _____ % v/v

[redacted]A [redacted]od 5[redacted]d D[redacted]Shee[redacted]

Job HIBBING TACONITE CO. Operators ET & CM Pitot No. 10-10 C_p .840

Source INDURATING LINE #1, SCRUBBER STACK #1 Sampling Train No. 5 $\Delta H_@$ 1.81 Bar. Press. 28.45 in.Hg. B_{wo} 6 %

Date 5-7-87 Test 4 Run 2 Gasmeter coeff. 1.0064 Amb. Temp. ___ °F Nozzle No. 7-4 Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft³)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1445)	(794.90)										
B 6	5	799.10	.58	2.12	9.10	10.0	103	250	250/58	19.8	90	88
5	10	803.90	.75	2.73	3.87	12.5	103			19.8	90	88
4	15	808.80	.82	2.98	8.85	13.3	103			19.7	92	88
3	20	813.70	.80	2.91	3.78		103	250	250/60	19.6	92	89
2	25	818.44	.72	2.62	8.46	12.5	103			19.7	92	89
1	30	822.61	.55	2.01	2.56	10.0	103			19.8	92	89
A 6	35	826.72	.58	2.12	6.77	10.0	103	250	250/61	19.7	92	88
5	40	831.66	.80	2.91	1.70	13.4	103			19.7	92	89
4	45	836.60	.82	2.99	6.69	14.0	103			19.8	92	89
3	50	841.60	.82	2.99	1.68		103	250	250/62	19.8	92	90
2	55	846.40	.73	2.66	6.40	12.3	103			19.8	92	90
1	60	850.12	.45	1.64	0.12	8.3	103			19.7	92	90
	(1549)											
	θ=60	Vm=55.22		$\bar{\Delta H}$=2.56							$\bar{\Delta H}$=90.2	

— Interpoll Inc —

S-0037R

Sample Log Sheet

Job HIBBING TACONITE CO

Unit and Sampling Location PELLETIZING LINE #1 SCRUBBER STACK #1

Date 5-7-97 Test 4 Run 3

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☑

posttest: 0 cfm at 15 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 9139			
PW			
Total (M_n)			g

Impinger ☑ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
1, 2, 3, 4	436	400	36
DESICCANT	1353	1324	29
Total (M_{wo})			65 g

Integrated Flue Gas Sampling Data

FG Train No. B3 Box No. 6 Bag No. 3

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 2

Time	cc/min.	Time	cc/min.
(1622)			
	400		
(1724)	400		

Operator ET 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE CO Operators ETACM Pitot No. 10-10 C_p .840

Source INDURATING LINE #1 SCRUBBER STACK #1 Sampling Train No. 5 $\Delta H_@$ 1.81 Bar. Press. 29.45 in.Hg. B_{wo} 5.5 %

Date 5-7-87 Test 4 Run 3 Gasmeter coeff. 1.0064 Amb. Temp. ___ °F Nozzle No. 7-4 Nozzle Dia. .249 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft³)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1621)	(850.40)										
A 6	5	854.40	.52	1.91	4.40	9.2	103	250	250/58	19.5	90	88
5	10	859.30	.78	2.86	9.28	13.1	103			19.6	90	88
4	15	864.34	.84	3.08	9.34	14.0	103			19.7	92	90
3	20	869.40	.84	3.08	9.42	14.1	103	250	250/60	19.7	92	90
2	25	874.23	.76	2.80	4.25		103			19.7	92	90
1	30	878.18	.50	1.84	8.18	10.0	103			19.7	92	90
B 6	35	882.30	.55	2.03	2.51		103	250	250/62	19.7	92	90
5	40	887.20	.78	2.87	7.20	13.0	103			19.7	94	90
4	45	892.20	.82	3.02	2.23	14.0	103			19.7	94	90
3	50	897.2	.80	2.95	7.20		103	250	255/63	19.7	94	92
2	55	901.93	.72	2.66	1.92		103			19.7	94	92
1	60	906.24	.60	2.22	6.24	11.3	103			19.7	94	92
	(1725)											
	θ=60	Vm=55.84		$\overline{\Delta H}$=2.61							$\overline{T_m}$=91.3	

S-0037R

APPENDIX D

METHODS 2-6 FIELD DATA SHEETS FOR INDURATING LINE NO. 2

Preliminary Data -- Method 2

— Interpoll Inc. —

Job HIBBING TACONITE Co.

Source INDURATING LINE #2 Date 5-5-87

Test No. 1 Run No. 1,2,3

Stack dimensions: 105 in.

Dry bulb ____ °F Wet bulb ____ °F

Rel. hum. ____ % B_{wo} ____ %

Barometric pressure(P_b) 28.60 in. Hg

Static pressure(P_g) -.30 in. WC ____ in. Hg

Operators R. Rosenthal, D. Downs

Pitot No. 10-8 C_p .84 Por Length 9"

Schematic of Stack Cross Section

Traverse Point No.		Distance from Stack wall	Distance from End of Port	Velocity Head (in. WC)	Temperature (°F)
A	1	4.62	13.62	.62	
	2	15.33	24.33	.62	
	3	30.98	39.98	.64	
	4	73.92	82.92	.70	
	5	89.67	98.67	.58	
	6	100.38	109.38	.45	
B	1				
	2				
	3				
	4				
	5				
	6				
25					avg.

S-0834R

Sample Log Sheet

Job HIBBING TACONITE Co.
Unit and Sampling Location INDURATING LINE #2 STACK #4
Date 5-5-87 Test 1 Run 1

Sample Train: Leak check pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☑
posttest: .00 cfm at 9 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 8075			
PW			
Total (Mn)			g

Impinger ☒ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
Impinger 1 & 2	563	496	67
Impinger 3 & 4	507	494	13
Desiccant	1356	1340	16
Total (M_{wo})			96 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 2 Bag No. 1
Bag Material TEDLAR Bag Volume 44 L
Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(915)			
	(400)		
(1022)	(400)		

Operator R. Rosenthal 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE Co. Operators RR & DD Pitot No. 10-8v C_p .84

Source Indurating Line 2 Stack 4 Sampling Train No. 8 $\Delta H_@$ 1.86 Bar. Press. 28.60 in.Hg. B_{wo} 10 %

Date 5-5-87 Test 1 Run 1 Gasmeter coeff. 1.0013 Amb. Temp. ___ °F Nozzle No. 4-4 Nozzle Dia. .250 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (in Hg)	Stack Temp 1 (°F)	Probe Temp 2 (°F)	Oven Temp 3 (°F)	Oxygen 4 (% v/v)	Gasmeter temp IN 5 (°F)	Gasmeter temp OUT 6 (°F)
	(915)	(575.40)										
B- 6	5	578.72	.45	1.45	3.75	5.3	126	250	250/53	19.2	66	64
5	10	582.47	.54	1.76	2.45	6.5	126			19.4	70	64
4	15	586.45	.57	1.86	6.27	7.5	126			19.3	74	65
3	20	590.40	.61	2.00	0.24	8.0	126			19.2	80	68
2	25	594.05	.54	1.79	4.01	6.5	126	250	250/55	19.5	80	68
1	30	597.48	.42	1.39	7.34	6.4	126	250		19.5	84	70
A- 6	35	600.08	.46	1.53	0.84	5.9	126			19.9	84	71
5	40	604.90	.55	1.83	4.67	6.0	126	250		19.5	90	72
4	45	608.67	.58	1.94	8.63	7.0	126	250	250/57	19.9	90	74
3	50	612.54	.59	1.98	2.62	6.1	126			19.0	90	76
2	55	616.60	.54	1.82	6.45	7.9	126			19.0	92	78
1	60	619.97	.45	1.52	9.97	6.0	126				94	78
	(1022)											
	Θ=60	V_m=44.57		ΔH=1.74							$\bar{t}_m$ = 76.7	

D-3

Sample Log Sheet

Job HIBBING TACONITE CO.
Unit and Sampling Location INDURATING LINE #2 STACK #4
Date 5-5-87 Test 1 Run 2

Sample Train: Leak check pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☒
posttest: .00 cfm at 10 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER #8078			
PW			
Total (M_n)			g

Impinger ☒ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
IMPINGER 1&2	563	498	65
IMPINGER 3&4	511	510	1
DESICCANT	1394	1378	16
Total (M_{wo})			82 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 2 Bag No. 2
Bag Material TEDLAR Bag Volume 44 L
Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(1205)			
(	(400)		
	(		
(1310)	(400)		

Operator R. Rosenthal 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job Hibbing Taconite Co. Operators RR & D.D. Pitot No. 10-8v C_p .84

Source Endurating Liner Stack Sampling Train No. 8 $\Delta H_@$ 1.86 Bar. Press. 28.60 in.Hg. B_{wo} 10 %

Date 5-5-87 Test 1 Run 2 Gasmeter coeff. 1.0013 Amb. Temp. ___ °F Nozzle No. 4-4 Nozzle Dia. .250 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1205)	(622.00)										
A 6	5	625.53	.45	1.50	5.46	5.7	125	250	250/53	19.0	86	84
5	10	629.33	.53	1.79	9.27	6.2	125	250		18.5	90	84
4	15	633.79	.58	1.97	3.28	7.1	125			18.6	94	84
3	20	637.46	.62	2.11	7.43	7.1	125			18.5	96	84
2	25	641.45	.54	1.84	1.31	7.8	125	250	250/54	18.5	98	86
1	30	644.91	.43	1.47	4.79	7.6	125			18.5	98	86
B 6	35	648.21	.45	1.54	8.36	5.0	125			18.9	97	87
5	40	652.18	.55	1.88	7.29	7.0	125			18.9	100	88
4	45	656.37	.60	2.06	6.41	8.2	125	250	250/56	18.9	102	88
3	50	660.59	.59	2.03	0.51	8.2	125			18.8	102	88
2	55	664.77	.58	2.00	1.57	8.0	125			18.5	102	90
1	60	668.57	.56	1.93	8.57	7.5	125	250	250/57	18.4	104	90
	(1310)											
	Θ = 60	V_m = 46.57		$\overline{\Delta H}$ = 1.84							t_m = 92.0	

Sample Log Sheet

Job HIBBING TACONITE Co.
Unit and Sampling Location INDURATING LINE #2 STACK #4
Date 5-5-87 Test 1 Run 3

Sample Train: Leak check pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☒
posttest: .00 cfm at 10 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER #8077			
DW			
Total (M_n)			g

Impinger ☒ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
Impinger 1&2	562	495	67
Impinger 3&4	509	506	3
DESICCANT	1369	1356	13
Total (M_{wo})			83 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 2 Bag No. 3
Bag Material TEDLAR Bag Volume 44 L
Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(1345)			
	(400)		
	)		
(1448)	(400)		

Operator R Rosenthal 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job Hibbing Taconite Co. Operators RR & O.D. Pitot No. 10-8v C_p .84

Source Induration Line 2 stack 4 Sampling Train No. 8 $\Delta H_@$ 1.96 Bar. Press. 28.60 in.Hg. B_{wo} 10 %

Date 5-5-87 Test 1 Run 3 Gasmeter coeff. 1.0013 Amb. Temp. °F Nozzle No. 4-4 Nozzle Dia. .25 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (in Hg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1345)	(669.28)										
B 6	5	672.93	.45	1.56	2.86	6.0	128	250	250/151	18.0	94	91
5	10	677.01	.55	1.91	6.82	6.8	128			17.9	98	92
4	15	681.15	.62	2.16	1.05	7.0	128			17.7	102	97
3	20	684.95	.62	2.17	5.29	7.0	128			18.0	103	92
2	25	689.03	.53	1.86	9.21	7.5	128	250	250/54	18.2	104	94
1	30	692.81	.41	1.44	2.68	6.5	128			18.9	105	94
A 6	35	696.54	.48	1.69	6.43	6.0	128			18.0	104	90
5	40	700.47	.52	1.83	0.33	7.0	128			18.4	106	95
4	45	704.53	.57	2.01	4.42	7.5	128	250	250/57	18.5	107	96
3	50	708.73	.63	2.22	8.73	7.9	128			18.4	108	96
2	55	712.96	.57	2.01	2.83	8.2	128			18.5	108	96
1	60	716.40	.43	1.52	6.40	6.0	128	250	250/56	18.5	106	96
	(1448)											
	Θ = 60	V_m = 47.12		$\overline{\Delta H}$ = 1.87							t_m =	98

D-7

Preliminary Data — Method 2

— Interpoll Inc. —

Job HIBBING TACONITE Co.

Source INDURATING LINE #2 Date 5-6-87

Test No. 2 Run No. 1, 2, 3

Stack dimensions: 105 in.

Dry bulb _____ °F Wet bulb _____ °F

Rel. hum. _____ % B_{wo} _____ %

Barometric pressure(P_b) 28.50 in. Hg

Static pressure(P_s) -.25 in. WC _____ in. Hg

Operators Ron Rosenthal Dick Downs

Pitot No. 10-8V C_p .84 Por Length 9"

Schematic of Stack Cross Section

Traverse Point No.	Distance from Stack wall	Distance from End of Port	Velocity Head (in. WC)	Temperature (°F)
A 1	4.62	13.62		
2	15.33	24.33		
3	30.98	39.98		
4	73.92	82.92		
5	89.67	98.67		
6	100.38	109.38		
B 1				
2				
3				
4				
5				
6				
25				avg.

S-0034R

Sample Log Sheet

Job HIBBING TACONITE Co.

Unit and Sampling Location INDURATING LINE #2 STACK #3

Date 5-6-87 Test 2 Run 1

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☒
posttest: .005 cfm at 13 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 8086			
PW			
Total (Mn)			g

Impinger ☒ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
IMPINGER #1&2	552	496	56
IMPINGER #3&4	511	498	13
DESICCANT	1388	1369	19
Total (M_{wo})			88 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 1 Bag No. 2

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(1446)			
	(400)		
(1555)	(400)		

Operator _____ 320-P Reading _____ % v/v

[redacted] Method 5 [redacted] Data Sheet [redacted]

Job HIBBING TACONITE Co. Operators DD & R.R. Pitot No. 10-8V C_p .84

Source INDURATING LINE #2 / STACK #3 Sampling Train No. 8 $\Delta H_@$ 1.86 Bar. Press. 28.50 in.Hg. B_{wo} 8.0 %

Date 5-6-87 Test 2 Run 1 Gasmeter coeff. 1.003 Amb. Temp. ___ °F Nozzle No. 4-4 Nozzle Dia. .250 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (in Hg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	44/46	(768.27)										
A 6	5	772.45	.65	2.32	2.16	8.0	110	250	250/53	19.5	86	84
5	10	777.42	.85	3.02	2.61	7.0	110			19.5	90	84
4	15	782.53	.85	3.03	2.61	12.2	110			19.5	90	84
3	20	787.48	.80	2.85	2.46	12.2	110			18.5	91	84
2	25	791.90	.67	2.42	1.90	10.0	110	250	250/56	18.5	92	85
1	30	796.11	.55	1.99	5.94	8.2	110			18.6	94	85
B 6	35	800.38	.65	2.36	6.33	8.2	110			18.9	93	85
5	40	804.97	.72	2.61	4.95	9.6	110			18.5	96	86
4	45	809.88	.74	2.69	9.65	10.8	110	250	250/55	18.5	96	86
3	50	814.62	.81	2.94	4.56	11.9	110			19.0	96	86
2	55	819.95	.73	2.65	9.23	11.5	110			19.3	95	88
1	60	823.40	.58	2.11	3.40	8.5	110	250	250/57	19.5	94	88
	(1555)											
	Θ=60	V_m=55.13		ΔH=2.58							T_m=89.1	

D-10

Sample Log Sheet

Job HIBBING TACONITE Co.
Unit and Sampling Location INDURATING LINE #2 / STACK #3
Date 5-6-87 Test 2 Run 2

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☒
posttest: .005 cfm at 13 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 8087			
PW			
Total (M_n)			g

Impinger ☒ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
IMPINGER #1 & 2	555	497	58
IMPINGER #3 & 4	513	501	12
DESICCANT	1372	1353	19
Total (M_{wo})			89 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 1 Bag No. 3
Bag Material TEDLAR Bag Volume 44 L
Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(1625)			
	(400)		
(1637)	(400)		

Operator R Downs 320-P Reading _____ % v/v

[redacted] Method 5 [redacted] Data Sheet

Job Hibbing Taconite Co. Operators DO & RR Pitot No. 10-8V C_p .84

Source Indurating Line #2 / Stack #3 Sampling Train No. 8 $\Delta H_@$ 1.86 Bar. Press. 28.50 in.Hg. B_{wo} 2.5 %

Date 5-6-87 Test 2 Run 2 Gasmeter coeff. 1.0013 Amb. Temp. ___ °F Nozzle No. 4-4 Nozzle Dia. .250 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (in Hg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(16.25)	(823.96)										
B 6	5	828.43	-.65	2.36	8.35	9.0	115	250	250/53	18.0	84	84
5	10	833.08	.76	2.73	8.05	10.0	115			18.0	90	85
4	15	837.93	.83	3.00	7.99	10.5	115			19.0	94	85
3	20	842.94	.84	3.04	7.97	13.0	115			19.5	94	86
2	25	847.87	.77	2.79	7.76	12.3	115	250	250/55	19.0	94	88
1	30	852.47	.73	2.65	7.42	11.0	115			19.3	92	86
A 6	35	857.20	.77	2.79	7.20	11.0	115			18.5	90	86
5	40	862.21	.85	3.07	7.20	12.5	115			18.5	93	86
4	45	867.45	.89	3.25	7.35	14.0	110	250	250/56	19.0	93	86
3	50	872.41	.85	3.11	7.39	13.5	110			19.0	93	86
2	55	877.46	.73	2.67	7.06	13.5	110			19.0	93	86
1	60	881.17	.56	2.05	1.17	8.0	110	250	250/57	19.0	94	86
	(737)											
	θ=60	V_m=57.21		$\overline{\Delta H}$=2.79							$\overline{T_m}$	88.9

879.12

— Interpoll Inc —

D-12

S-0037R

Sample Log Sheet

Job HIRBING TACONITE Co.
Unit and Sampling Location INDURATING LINE #2 STACK #3
Date 5-6-87 Test 2 Run 3

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☒
posttest: .00 cfm at 13 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 8088			
PW			
Total (M_n)			g

Impinger ☒ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
IMPINGER # 1&2	553	495	58
IMPINGER # 3&4	512	496	16
DESSICCANT	1312	1293	19
Total (M_{wo})			93 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 5 Bag No. 1
Bag Material TEDLAR Bag Volume 44 L
Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(1847)			
	(400)		
(1955)	(400)		

Operator R. ROSENTHAL 320-P Reading _____ % v/v

S-0046R

EPA [redacted] Method [redacted] Field [redacted] Sheet [redacted]

Job Hibbing Concrete CO Operators RR + RD Pitot No. 10-80 C_p .84

Source Finishing Line #2 Stack Sampling Train No. 8 $\Delta H_@$ 1.86 Bar. Press. 28.50 in.Hg. B_{wo} 25 %

Date 5-6-87 Test 2 Run 3 Gasmeter coeff. 1.0013 Amb. Temp. ___ °F Nozzle No. 4-9 Nozzle Dia. .250 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (in Hg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1847)	(881.83)										
A 6	5	886.20	.61	1.22	6.09	8.5	112	250	250/253	19.5	80	80
5	10	890.82	.83	2-97	0.98	9.5	112			19.0	83	80
4	15	895-84	.86	3.09	5.96	12	112			19.0	84	80
3	20	900.89	.87	2.95	0.84	12.5	112	250	250/56	19.0	85	80
2	25	905.82	.74	2.66	5.47	12.5	112			19.0	85	80
1	30	909.20	.45	1.62	3.10	8 2	112			19.0	86	80
B 6	35	913.92	.65	2.34	3.45	9.1	112			19.2	86	80
5	40	918.03	.72	2.59	8.03	7.0	112	250	250/55	19.5	88	80
4	45	922.75	.76	2.74	2.75	11.	112			19.5	90	80
3	50	927.50	.75	2.71	7.44	11	112			19.5	90	80
2	55	932.26	.73	2.64	2.06	11	112			19.5	90	80
1	60	936.39	.66	2.39	6.97	9.6	112	250	250/56	19.5	90	80
	(1955)	...										
	Θ=60	Vm=54.58		ΔH=2.58							$\bar{t}_m$	83.2

Preliminary Data – Method 2

— Interpoll Inc. —

Job HIBBING TACONITE Co.

Source INDURATING LINE #2 Date 5-7-87

Test No. 3 Run No. 1,2,3

Stack dimensions: 105 in.

Dry bulb ____ °F Wet bulb ____ °F

Rel. hum. ____ % B_{wo} ____ %

Barometric pressure (P_b) 28.45 in. Hg

Static pressure (P_g) -.20 in. WC ____ in. Hg

Operators R. Rosenthal D. Downs

Pitot No. .84 C_p 10-84 Port Length 9"

Schematic of Stack Cross Section

Traverse Point No.	Distance from Stack wall	Distance from End of Port	Velocity Head (in. WC)	Temperature (°F)
A 1	4.62	13.62		
2	15.33	24.33		
3	30.98	39.98		
4	73.92	82.92		
5	89.67	98.67		
6	100.38	109.38		
B 1				
2				
3				
4				
5				
6				
25				avg.

S-0034R

Sample Log Sheet

Job HIBBING TACONITE CO.
Unit and Sampling Location INDURATING LINE #2 STACK #2
Date 5-7-87 Test 3 Run 1

Sample Train: Leak check pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☒
posttest: .01 cfm at 11 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 8089			
PW			
Total (Mn)			g

Impinger ☒ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
IMPINGER #1&2	543	497	46
IMPINGER #3&4	498	495	3
DESICCANT	1392	1372	20
Total (M_{wo})			69 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 5 Bag No. 1
Bag Material TEDLAR Bag Volume 44 L
Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(810)			
	(400)		
(915)	(400)		

Operator R ROSENTHAL 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE Co. Operators DD & RR Pitot No. 10-8Y C_p .84

Source INDURATING LINE #2 STACK #2 Sampling Train No. 8 $\Delta H_@$ 1.86 Bar. Press. 28.45 in.Hg. B_{wo} 9.0 %

Date 5-7-87 Test 3 Run 1 Gasmeter coeff. 1.0013 Amb. Temp. ___ °F Nozzle No. 4-4 Nozzle Dia. .250 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (in Hg)	Stack Temp 1 (°F)	Probe Temp 2 (°F)	Oven Temp 3 (°F)	Oxygen 4 (% v/v)	Gasmeter temp IN 5 (°F)	Gasmeter temp OUT 6 (°F)
	(810)	(937.05)										
B-6	5	940.96	.55	1.84	0.83	7.5	115	250	250/51	19.8	64	63
5	10	945.05	.66	2.22	5.00	8.5	115			19.8	69	64
4	15	949.31	.67	2.29	9.24	9.5	110.			20.0	73	64
3	20	953.70	.74	2.53	3.71	10.0	110	250	250/52	20.0	75	65
2	25	958.11	.72	2.47	8.13	10.0	110			19.9	77	65
1	30	962.15	.58	2.00	2.12	9.5	110			20.0	78	66
A-6	35	966.49	.68	2.35	6.43	9.0	110	250	250/54	19.7	76	67
5	40	971.05	.73	2.54	0.92	10.0	105			19.8	79	68
4	45	975.44	.72	2.51	5.39	11.0	105			19.6	80	68
3	50	979.89	.70	2.44	9.81	10.5	105	250	250/55	19.5	81	69
2	55	983.97	.60	2.11	3.91	8.5	103			19.5	82	70
1	60	987.48	.45	1.58	7.48	6.0	103			19.5	84	80
	(915)											
	Θ=60	V_m=30.43		ΔH=2.24							T_{avg}=	71.9

Sample Log Sheet

Job HIBBING TACONITE
Unit and Sampling Location INDURATING LINE #2 STACK #2
Date 5-7-87 Test 3 Run 2

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☒
posttest: .00 cfm at 13 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 8092			
PW			
Total (M_n)			g

Impinger ☒ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
IMPINGER 1 & 2	534	494	40
IMPINGER 3 & 4	508	495	13
DESICCANT	1329	1310	19
Total (M_{wo})			72 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 5 Bag No. 2
Bag Material TEDIAR Bag Volume 44 L
Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(945)			
	(400)		
(1048)	(400)		

Operator R. Rosenthal 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE Co. Operators DD & RR Pitot No. 10-81 C_p .84

Source INDURATING LINE #2 Sampling Train No. 8 $\Delta H_@$ 1.86 Bar. Press. 28.45 in.Hg. B_{wo} 2.0 %

Date 5-7-82 Test 3 Run 2 Gasmeter coeff. 1.0013 Amb. Temp. ___ °F Nozzle No. 4-4 Nozzle Dia. .250 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (in Hg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(945)	(987.85)										
A-6	5	992.36	.69	2.50	2.30	9.0	101	250	250/52	19.7	77	74
5	10	996.85	.71	2.58	6.85	10.0	104			19.6	82	74
4	15	1001.40	.72	2.63	1.44	10.5	104			19.5	87	75
3	20	1005.94	.68	2.50	5.93	11.0	104	250	250/54	19.5	90	76
2	25	1010.35	.64	2.36	0.31	10.0	104			19.5	92	78
1	30	1014.29	.52	1.93	4.27	9.0	104			19.5	95	79
B-6	35	1018.61	.60	2.23	8.54	9.0	104	250	250/56	20.0	94	80
5	40	1023.04	.67	2.49	3.04	9.5	104			20.0	100	83
4	45	1027.65	.72	2.69	7.75	10.0	104			20.0	102	84
3	50	1032.48	.74	2.78	2.54	11.5	104	250	250/56	20.0	102	85
2	55	1037.20	.73	2.74	7.29	12.0	104			20.0	101	86
1	60	1041.54	.58	2.18	1.54	11.5	104			20.1	101	87
	(1048)											
	Θ=60	V_m=53.69		ΔH=2.47							T_m=	86.8

Sample Log Sheet

Job HIBBING TACONITE Co.

Unit and Sampling Location INDURATING LINE #2 STACK #2

Date 5-7-87 Test 3 Run 3

Sample Train: Leak check pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☒
posttest: .005 cfm at 13 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 8093			
PW			
Total (Mn)			g

Impinger ☒ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
IMPINGER # 1&2	537	497	40
IMPINGER # 3&4	506	495	11
DESICCANT	1428	1412	16
Total (M_{wo})			67 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 5 Bag No. 3

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(1115)			
	(400)		
(1217)	(400)		

Operator R ROSENTHAL 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE Operators DD & RR Pitot No. 10-84 C_p .84

Source INDURATING LINE #2 STACK 3 Sampling Train No. 8 $\Delta H_@$ 1.86 Bar. Press. 28.45 in.Hg, B_{wo} 2.0 %

Date 5-7-87 Test 3 Run 3 Gasmeter coeff. 1.0013 Amb. Temp. ___ °F Nozzle No. 4-4 Nozzle Dia. .250 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in.WC)	Orifice Meter (in.WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1115)	(42.10)										
B-6	5	46.24	.58	2.15	6.29	7.0	104	250	250/52	20.0	88	88
5	10	50.70	.66	2.46	0.77	8.5	104			19.4	92	88
4	15	55.30	.68	2.54	5.34	10.0	104			19.5	95	88
3	20	60.03	.74	2.77	0.11	11.5	104	250	250/53	19.2	97	88
2	25	64.86	.73	2.74	4.86	12.0	104			19.4	97	88
1	30	69.34	.65	2.44	9.34	11.0	104			19.5	97	88
A-6	35	73.96	.68	2.55	3.93	9.5	104	250	250/53	19.6	96	87
5	40	78.79	.75	2.81	8.73	11.5	104			19.6	98	88
4	45	83.54	.73	2.74	3.49	11.5	104			19.6	98	88
3	50	88.17	.69	2.59	8.11	10.5	104	250	250/55	19.4	98	88
2	55	92.70	.67	2.51	2.66	10.0	105			19.4	99	88
1	60	96.68	.52	1.95	6.68	8.0	105			19.5	99	88
	(1217)											
	Θ=60	V_m=54.58		$\overline{\Delta H}$=2.52							T_m=92.0	

D-21

Preliminary Data – Method 2

— Interpoll Inc. —

Job HIBBING TACONITE Co.

Source INDURATING LINE #2 Date 5-7-87

Test No. 4 Run No. 1, 2, 3

Stack dimensions: 105 in.

Dry bulb ____ °F Wet bulb ____ °F

Rel. hum. ____ % B_{wo} ____ %

Barometric pressure (P_b) 28.45 in. Hg

Static pressure (P_g) -.20 in. WC ____ in. Hg

Operators R. ROSENTHAL P. LOUWES

Pitot No. 10-8V C_p .84 Port Length 9"

Schematic of Stack Cross Section

Traverse Point No.	Distance from Stack wall	Distance from End of Port	Velocity Head (in. WC)	Temperature (°F)
A - 1	4.62	13.62		
2	15.33	24.33		
3	30.98	39.98		
4	73.92	82.92		
5	89.67	98.67		
6	100.38	109.38		
B - 1				
2				
3				
4				
5				
6				
25				avg.

S-0034R

Sample Log Sheet

Job HIBBING TACONITE Co.

Unit and Sampling Location INDURATING LINE #2 STACK #1

Date 5-7-87 Test 4 Run 1

Sample Train: Leak check pretest :< 0.02 cfm at 15 in. Hg. (vac.) ☒
posttest: .005 cfm at 13 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 8094			
PW			
Total (M_n)			g

Impinger ☒ Condenser ☐

Impinger Number.	Weights		
	Final	Tare	Difference
IMPINGER #1&2	311	265	46
IMPINGER #3&4	512	496	16
DESICCANT	1328	1313	15
Total (M_{wo})			77 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 9 Bag No. 1

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(1257)			
	(400)		
(1414)	(400)		

Operator R. ROSENTHAL 320-P Reading _____ % v/v

Job HIBBING TACONITE Co. Operators RD & RR Pitot No. 10-8v C_p .84

Source INDURATING LINE #2 STACK #1 Sampling Train No. 8 $\Delta H_@$ 1.0013 Bar. Press. 28.45 in.Hg. B_{wo} 6.0 %

Date 5-7-87 Test 4 Run 1 Gasmeter coeff. 1.0013 Amb. Temp. ___ °F Nozzle No. 4-4 Nozzle Dia. .250 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (in Hg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1259)	(97.00)										
A 6	5	101.02	.50	1.91	0.96	7.0	104	250	250/51	20.0	86	85
5	10	105.47	.68	2.56	5.53	8.5	104			20.0	90	85
4	15	110.35	.78	2.95	0.44	12.0	104			19.8	94	85
3	20	115.42	.82	3.11	5.48	12.5	104	250	250/53	19.5	98	85
2	25	120.34	.77	2.93	0.39	11.5	104			19.5	98	86
1	30	124.85	.66	2.53	4.95	11.0	102			19.5	99	86
B 6	35	129.58	.67	2.57	9.55	10.0	102	250	250/55	20.0	98	87
5	40	134.57	.78	2.98	4.51	11.5	102			20.0	100	88
4	45	139.54	.80	3.07	9.54	12.0	102			20.0	95	89
3	50	144.53	.79	3.02	4.53	12.0	102	250	250/57	20.0	92	89
2	55	149.25	.70	2.67	9.21	11.0	102			20.0	93	89
1	60	153.48	.58	2.22	3.48	8.0	102			20.0	94	89
	(1414)											
	Θ = 60	V_m = 56.48		$\sqrt{\Delta H}$ = 2.71							T_m =	90.8

Sample Log Sheet

Job HIBBING TACONITE Co.
Unit and Sampling Location INDURATING LINE #2 STACK #1
Date 5-7-87 Test 4 Run 2

Sample Train: Leak check pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☒
posttest: .005 cfm at 14 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 8095			
PW			
Total (M_n)			g

Impinger ☒ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
IMPINGER #1 & 2	306	264	42
IMPINGER #3 & 4	510	501	9
DESICCANT	1447	1428	19
Total (M_{wo})			70 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 9 Bag No. 2
Bag Material TEDLAR Bag Volume 44 L
Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(1447)			
	(400)		
(1550)	(400)		

Operator R. Rosenthal 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE Co. Operators RR & RD Pitot No. 10-8v C_p .84

Source INDURATING LINE #2 STACK / Sampling Train No. 8 $\Delta H_@$ 1.86 Bar. Press. 28.45 in.Hg. B_{wo} 6.5 %

Date 5-7-87 Test 4 Run 2 Gasmeter coeff 1.0013 Amb. Temp. ___ °F Nozzle No. 4-4 Nozzle Dia. .250 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in. WC)	Orifice Meter (in. WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1447)	(155.50)										
B-6	5	159.91	.64	2.42	9.96	8.0	103	250	250/52	19.5	87	86
5	10	164.86	.80	3.00	4.90	11.0	103			19.5	94	87
4	15	169.99	.84	3.17	7.99	12.0	103			19.8	95	87
3	20	175.08	.82	3.10	5.03	12.0	103	250	250/54	19.7	95	88
2	25	179.78	.71	2.68	9.20	10.0	103			99.8	95	88
1	30	184.06	.60	2.27	4.06	8.5	103			19.7	95	88
A-6	35	188.38	.59	2.24	8.36	9.0	101	250	250/55	19.8	95	88
5	40	193.22	.75	2.85	3.19	11.0	101			19.6	97	88
4	45	198.30	.81	3.08	8.23	12.0	101			19.5	98	89
3	50	203.39	.83	3.16	3.33	13.0	101	250	250/57	19.7	98	90
2	55	208.34	.77	2.94	8.20	12.5	100			19.8	98	90
1	60	212.89	.68	2.60	2.89	11.0	100			19.8	98	90
	(1550)											
	Θ=60	V=57.39		ΔH=2.79							T_m=	91.8

D-26

Sample Log Sheet

Job HIBBING TACONITE CO.

Unit and Sampling Location INDURATING LINE #2 STACK #1

Date 5-7-87 Test 4 Run 3

Sample Train: Leak check pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☒
posttest: .00 cfm at 15 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 8120			
PW			
Total (Mn)			g

Impinger ☑ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
IMPINGER # 1&2	318	265	53
IMPINGER # 3&4	510	495	15
DESICCANT	1343	1326	17
Total (Mwo)			85 g

Integrated Flue Gas Sampling Data

FG Train No. B4 Box No. 9 Bag No. 3

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check .00 cc/min at 15 in. Hg. 320-P No. 4

Time	cc/min.	Time	cc/min.
(1620)			
	(400)		
(1723)	(400)		

Operator R. Rosenthal 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE Operators RR & D.D. Pitot No. 10-8V C_p .84

Source INDURATING LINE #2 STACK #1 Sampling Train No. 8 $\Delta H_@$ 1.86 Bar. Press. 28.45 in.Hg. B_{wo} 6.0 %

Date 5-7-87 Test 4 Run 3 Gasmeter coeff. 1.0013 Amb. Temp. °F Nozzle No. 4-4 Nozzle Dia. .250 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (ft^3)	Velocity Head (in.WC)	Orifice Meter (in.WC)	ΔV (mcf)	Vac. (inHg)	Stack Temp (°F) 1	Probe Temp (°F) 2	Oven Temp (°F) 3	Oxygen (% v/v) 4	Gasmeter temp IN (°F) 5	Gasmeter temp OUT (°F) 6
	(1620)	(213.25)										
A 6	5	217.09	.46	1.76	7.06	6.5	103	250	250/53	19.5	90	90
5	10	221.62	.68	2.59	1.66	9.5	103			20.0	97	90
4	15	226.62	.78	2.98	6.63	11.0	103			20.0	100	90
3	20	231.75	.82	3.15	1.73	12.0	103	250	250/54	20.0	100	90
2	25	236.70	.76	2.92	6.64	11.5	103			20.0	100	91
1	30	241.26	.67	2.57	1.26	10.5	103			20.0	100	92
B 6	35	246.04	.70	2.69	5.99	10.0	103	250	250/55	20.0	99	92
5	40	251.18	.84	3.22	1.15	12.0	103			19.8	103	92
4	45	256.28	.80	3.08	6.21	11.5	103			19.8	103	93
3	50	261.23	.78	3.01	1.21	11.5	103	250	250/56	19.7	103	93
2	55	266.08	.72	2.78	6.02	10.0	103			19.6	103	93
1	60	270.27	.56	2.16	0.27	10.0	103			19.7	103	93
	(1723)											
	Θ=60	V_m=52.02		$\overline{\Delta H}$=2.74							T_m= 95.8	

APPENDIX E

METHOD 7 FIELD DATA SHEETS

Interpoll Inc.
(612)786-6020

EPA Method 7 Sample Collection
Field Data Sheet

Job HIBBING TACONITE CO Date 5-5-87 Bar. Pressure 25.60 IN.HG.

Test Location INDURATING LINE #1, SCRUBBER STACK #4 Fuel Type NAT. GAS Sample Train No. NOx

Technician C. MOSSER Pump No. NOx

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.
1	1-1-A	1	0915	27.85	73	☑ Yes ☐ No
2	1-1-B	2	0930	27.85	73	☑ Yes ☐ No
3	1-1-C	3	0945	27.90	73	☑ Yes ☐ No
4	1-1-D	4	1000	27.90	73	☑ Yes ☐ No
5	1-2-A	5	1210	27.95	81	☑ Yes ☐ No
6	1-2-B	6	1225	27.95	81	☑ Yes ☐ No
7	1-2-C	7	1240	27.90	81	☑ Yes ☐ No
8	1-2-D	8	1255	27.85	81	☑ Yes ☐ No
9	1-3-A	9	1345	27.85	77	☑ Yes ☐ No
10	1-3-B	10	1400	27.80	77	☑ Yes ☐ No
11	1-3-C	11	1415	27.85	78	☑ Yes ☐ No
12	1-3-D	12	1430	27.80	80	☑ Yes ☐ No
13						☐ Yes ☐ No
14						☐ Yes ☐ No
15						☐ Yes ☐ No
16						☐ Yes ☐ No
17						☐ Yes ☐ No
18						☐ Yes ☐ No
19						☐ Yes ☐ No
20						☐ Yes ☐ No
21						☐ Yes ☐ No
22						☐ Yes ☐ No
23						☐ Yes ☐ No
24						☐ Yes ☐ No
25						☐ Yes ☐ No
26						☐ Yes ☐ No
27						☐ Yes ☐ No

Interpoll Inc.
(612)786-6020

EPA Method 7 Sample Collection
Field Data Sheet

Job Hibbing Taconite Co. Date 5-6-87 Bar. Pressure 28.50 IN.HG.

Test Location ENDURATING LINE #1, SCRUBBER STACK #3 Fuel Type GAS Sample Train No. NOx

Technician C. MOSSER Pump No. NOx

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.
1	2-1-A	37	1250	28.00	70	☑ Yes ☐ No
2	2-1-B	38	1305	27.95	70	☑ Yes ☐ No
3	2-1-C	39	1325	27.95	72	☑ Yes ☐ No
4	2-1-D	40	1340	27.95	72	☑ Yes ☐ No
5	2-2-A	41	1630	27.90	69	☑ Yes ☐ No
6	2-2-B	42	1645	27.90	74	☑ Yes ☐ No
7	2-2-C	43	1700	27.85	74	☑ Yes ☐ No
8	2-2-D	44	1715	27.90	74	☑ Yes ☐ No
9	2-3-A	45	1890	27.90	67	☑ Yes ☐ No
10	2-3-B	46	1905	28.00	66	☑ Yes ☐ No
11	2-3-C	47	1920	28.00	66	☑ Yes ☐ No
12	2-3-D	48	1935	28.00	66	☑ Yes ☐ No
13						☐ Yes ☐ No
14						☐ Yes ☐ No
15						☐ Yes ☐ No
16						☐ Yes ☐ No
17						☐ Yes ☐ No
18						☐ Yes ☐ No
19						☐ Yes ☐ No
20						☐ Yes ☐ No
21						☐ Yes ☐ No
22						☐ Yes ☐ No
23						☐ Yes ☐ No
24						☐ Yes ☐ No
25						☐ Yes ☐ No
26						☐ Yes ☐ No
27						☐ Yes ☐ No

Interpoll Inc.
(612)786-6020

EPA Method 7 Sample Collection
Field Data Sheet

Job Hibbing Taconite Co. Date 5-7-87 Bar. Pressure 28.45 IN.HG.
Test Location Indurating Line #1, Scrubber Stack #2 Fuel Type GAS Sample Train No. NOx
Technician C. Mosser Pump No. NOx

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.
1	3-1-A	61	0815	27.95	60	☑ Yes ☐ No
2	3-1-B	62	0830	27.95	60	☑ Yes ☐ No
3	3-1-C	63	0845	27.95	60	☑ Yes ☐ No
4	3-1-D	64	0900	27.95	61	☑ Yes ☐ No
5	3-2-A	65	0950	28.00	61	☑ Yes ☐ No
6	3-2-B	66	1005	28.00	61	☑ Yes ☐ No
7	3-2-C	67	1020	27.90	73	☑ Yes ☐ No
8	3-2-D	68	1035	28.00	73	☑ Yes ☐ No
9	3-3-A	69	1120	27.90	66	☑ Yes ☐ No
10	3-3-B	70	1135	27.95	67	☑ Yes ☐ No
11	3-3-C	71	1150	27.95	67	☑ Yes ☐ No
12	3-3-D	72	1205	27.95	67	☑ Yes ☐ No
13						☐ Yes ☐ No
14						☐ Yes ☐ No
15						☐ Yes ☐ No
16						☐ Yes ☐ No
17						☐ Yes ☐ No
18						☐ Yes ☐ No
19						☐ Yes ☐ No
20						☐ Yes ☐ No
21						☐ Yes ☐ No
22						☐ Yes ☐ No
23						☐ Yes ☐ No
24						☐ Yes ☐ No
25						☐ Yes ☐ No
26						☐ Yes ☐ No
27						☐ Yes ☐ No

Interpoll Inc.
(612)786-6020

EPA Method 7 Sample Collection
Field Data Sheet

Job Hibbing Taconite Co. Date 5-7-87 Bar. Pressure 28.45 IN.HG.

Test Location Indurating Fuel Type Gas Sample Train No. NO_x

Line #1, Scrubber Stack #1 Technician C. Mosser Pump No. NO_x

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.
1	4-1-A	1	1300	27.85	73	☑ Yes ☐ No
2	4-1-B	2	1315	27.90	73	☑ Yes ☐ No
3	4-1-C	3	1330	27.85	73	☑ Yes ☐ No
4	4-1-D	4	1345	27.85	73	☑ Yes ☐ No
5	4-2-A	5	1450	27.90	77	☑ Yes ☐ No
6	4-2-B	6	1505	27.90	77	☑ Yes ☐ No
7	4-2-C	7	1525	27.85	70	☑ Yes ☐ No
8	4-2-D	8	1540	27.85	70	☑ Yes ☐ No
9	4-3-A	9	1625	27.85	71	☑ Yes ☐ No
10	4-3-B	10	1640	27.85	70	☑ Yes ☐ No
11	4-3-C	11	1655	27.85	70	☑ Yes ☐ No
12	4-3-D	12	1710	29.85	70	☑ Yes ☐ No
13						☐ Yes ☐ No
14						☐ Yes ☐ No
15						☐ Yes ☐ No
16						☐ Yes ☐ No
17						☐ Yes ☐ No
18						☐ Yes ☐ No
19						☐ Yes ☐ No
20						☐ Yes ☐ No
21						☐ Yes ☐ No
22						☐ Yes ☐ No
23						☐ Yes ☐ No
24						☐ Yes ☐ No
25						☐ Yes ☐ No
26						☐ Yes ☐ No
27						☐ Yes ☐ No

S-263R

Interpoll Inc.
(612)786-6020

EPA Method 7 Sample Collection
Field Data Sheet

Job HERRING TACONITE Co. Date 5-5-87 5-6-87 Bar. Pressure 28.60 IN.HG.
Test Location INDURATING Fuel Type PET COKE Sample Train No. 1
LINE #2 / STACK #4 Technician R. ROSENTHAL Pump No. 7 & 8

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.
1	1/1/A	13	1055	28.20	65	☐ Yes ☒ No
2	1/1/B	14	1110	28.15	65	☐ Yes ☒ No
3	1/1/C	15	1125	27.98	65	☐ Yes ☒ No
4	1/1/D	16	1140	28.00	65	☐ Yes ☒ No
5	1/2/A	17	1215	27.95	68	☐ Yes ☒ No
6	1-2-B	18	1230	27.88	68	☐ Yes ☒ No
7	1-2-C	19	1245	27.85	68	☐ Yes ☒ No
8	1-2-D	20	1300	27.90	68	☐ Yes ☒ No
9	1-3-A	21	1355	27.80	70	☐ Yes ☒ No
10	1-3-B	22	1410	27.85	70	☐ Yes ☒ No
11	1-3-C	23	1425	27.85	70	☐ Yes ☒ No
12	1-3-D	24	1440	27.80	70	☐ Yes ☒ No
13						☐ Yes ☐ No
14						☐ Yes ☐ No
15						☐ Yes ☐ No
16						☐ Yes ☐ No
17						☐ Yes ☐ No
18						☐ Yes ☐ No
19						☐ Yes ☐ No
20						☐ Yes ☐ No
21						☐ Yes ☐ No
22						☐ Yes ☐ No
23						☐ Yes ☐ No
24						☐ Yes ☐ No
25						☐ Yes ☐ No
26						☐ Yes ☐ No
27						☐ Yes ☐ No

Interpoll Inc.
(612)786-6020

EPA Method 7 Sample Collection
Field Data Sheet

Job HIBBING TACONITE Date 5-6-87 Bar. Pressure 28.50 IN.HG.
Test Location INDURATING Fuel Type Pet COKE Sample Train No. 1
LINE #2 - STACK #3 Technician R. Rosenthal Pump No. 7 & 8

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.
1	2-1-A	25	1305	27.75	72	☐ Yes ☒ No
2	2-1-B	26	1320	27.65	72	☐ Yes ☒ No
3	2-1-C	27	1336	27.80	72	☐ Yes ☒ No
4	2-1-D	28	1350	27.80	72	☐ Yes ☒ No
5	2-2-A	29	1635	27.80	72	☐ Yes ☒ No
6	2-2-B	30	1650	27.75	72	☐ Yes ☒ No
7	2-2-C	31	1705	27.80	72	☐ Yes ☒ No
8	2-2-D	32	1720	27.85	70	☐ Yes ☒ No
9	2-3-A	33	1900	27.90	70	☐ Yes ☒ No
10	2-3-B	34	1915	27.90	70	☐ Yes ☒ No
11	2-3-C	35	1930	27.95	68	☐ Yes ☒ No
12	2-3-D	36	1945	27.85	68	☐ Yes ☒ No
13						☐ Yes ☐ No
14						☐ Yes ☐ No
15						☐ Yes ☐ No
16						☐ Yes ☐ No
17						☐ Yes ☐ No
18						☐ Yes ☐ No
19						☐ Yes ☐ No
20						☐ Yes ☐ No
21						☐ Yes ☐ No
22						☐ Yes ☐ No
23						☐ Yes ☐ No
24						☐ Yes ☐ No
25						☐ Yes ☐ No
26						☐ Yes ☐ No
27						☐ Yes ☐ No

Interpoll Inc.
(612)786-6020

EPA Method 7 Sample Collection
Field Data Sheet

Job Hibbing Taconite Co. Date 5-7-87 Bar. Pressure 28.45 IN.HG.
Test Location Incinerating Fuel Type Pet Coke Sample Train No. 1
Line #2 Stack #2 Technician R. Downs Pump No. 788

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.
1	3-1-A	49	820	27.65	65	☐ Yes ☒ No
2	3-1-B	50	835	27.50	65	☐ Yes ☒ No
3	3-1-C	51	850	27.55	65	☐ Yes ☒ No
4	3-1-D	52	905	27.60	65	☐ Yes ☒ No
5	3-2-A	53	955	27.50	65	☐ Yes ☒ No
6	3-2-B	54	1010	27.38	66	☐ Yes ☒ No
7	3-2-C	55	1025	27.59	66	☐ Yes ☒ No
8	3-2-D	56	1040	27.42	66	☐ Yes ☒ No
9	3-3-A	57	1125	27.20	66	☐ Yes ☒ No
10	3-3-B	58	1140	27.20	66	☐ Yes ☒ No
11	3-3-C	59	1155	27.70	66	☐ Yes ☒ No
12	3-3-D	60	1210	27.55	66	☐ Yes ☒ No
13						☐ Yes ☐ No
14						☐ Yes ☐ No
15						☐ Yes ☐ No
16						☐ Yes ☐ No
17						☐ Yes ☐ No
18						☐ Yes ☐ No
19						☐ Yes ☐ No
20						☐ Yes ☐ No
21						☐ Yes ☐ No
22						☐ Yes ☐ No
23						☐ Yes ☐ No
24						☐ Yes ☐ No
25						☐ Yes ☐ No
26						☐ Yes ☐ No
27						☐ Yes ☐ No

Interpoll Inc.
(612)786-6020

EPA Method 7 Sample Collection
Field Data Sheet

Job HIBBING TACONITE Date 5-7-87 Bar. Pressure 28.45 IN.HG.
Test Location INDURATING LINE #2 STACK #1 Fuel Type PET COKE Technician R. DOWNS Sample Train No. 1 Pump No. 748

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.
1	4-1-A	73	1310	27.25	70	☐ Yes ☒ No
2	4-1-B	74	1325	27.59	70	☐ Yes ☒ No
3	4-1-C	75	1340	27.55	70	☐ Yes ☒ No
4	4-1-D	76	1355	27.50	70	☐ Yes ☒ No
5	4-2-A	77	1455	27.52	72	☐ Yes ☒ No
6	4-2-B	78	1510	27.49	72	☐ Yes ☒ No
7	4-2-C	79	1525	27.42	72	☐ Yes ☒ No
8	4-2-D	80	1540	27.53	72	☐ Yes ☒ No
9	4-3-A	81	1635	27.45	72	☐ Yes ☒ No
10	4-3-B	82	1650	27.50	72	☐ Yes ☒ No
11	4-3-C	83	1705	27.45	72	☐ Yes ☒ No
12	4-3-D	84	1720	27.60	72	☐ Yes ☒ No
13						☐ Yes ☐ No
14						☐ Yes ☐ No
15						☐ Yes ☐ No
16						☐ Yes ☐ No
17						☐ Yes ☐ No
18						☐ Yes ☐ No
19						☐ Yes ☐ No
20						☐ Yes ☐ No
21						☐ Yes ☐ No
22						☐ Yes ☐ No
23						☐ Yes ☐ No
24						☐ Yes ☐ No
25						☐ Yes ☐ No
26						☐ Yes ☐ No
27.						☐ Yes ☐ No

APPENDIX F

LABORATORY DATA SHEETS FOR INDURATING LINE NO. 1

4851

Interpoll Inc.
(612)786-6020

Pg ___ of ___

Chain of Custody
Sample Deposition Sheet

Job HIBBING TACONITE
Site INDURATING LINE #1 STACK #4
Team Leader E THOMBLADE
Priority
Date Submitted 5-7-87
Received by B.D.
Test No(s). 1
Number of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Date Analyzed	Other Information or Special Instructions
4	Probe Wash Solvent(s):	☒ As per EPA 5 ☐ PB+BL		R1 acid may have affected PW
4	Filter: ☒ 4" glass fiber ☐ Stainless steel ☐ ERC	☒ As per EPA 5 ☐ PB+BL		
4	Wet Catch	☐ Organic ☐ Inorganic ☐ Other PB		
3	Orsat			
4	SO_2	PB+BL		
	SO_2 Audit Sample			EPA Control No(s).
12	NO_x (Open box tops after unloading)	☐ Colorimetric ☐ Ion Chromatographic		Date 1 1 & Time of arrival at Interpoll
3	NO_x ~~Audit~~ BLANK Sample			EPA Control No(s).
	Fuel Sample			

Source Information

1) Type of source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☐ Other ___
2) Fuel: ☐ Coal ☐ Wood ☒ Gas ☐ Oil ☐ Other ___
3) Is sample combustible? ☐ No ☐ Yes
4) Does sample need special desiccating? ☐ No ☐ Yes If yes, explain ___
5) Is particle size analysis required ☐ No ☐ Yes If yes, how many run(s)? ___
run preference ___

S-278RRRR

EPA METHOD 3

LABORATORY REPORT

SUMMARY OF ORSAT DATA

Job: Hibbing Taconite
Sampling Location: Line #1 Stack #4
Sampling Date: 5-11-87
Analysis Date:
Technician: BMM

TEST NO. AND DATE	RUN NO.	RESULTS						
		INTEGRATED (BAG)			GRAB (BULB)			O_2 ANALYZER
		% CO_2	% O_2	% CO	% CO_2	% O_2	% CO	% O_2
4851-09 5-11-87 1	1	0.60	19.20					
4851-14 5-11-87 1	2	0.90	19.10					
4851-19 5-11-87 1	3	0.80	19.30					

Interpoll Inc.
(612)786-6020

EPA Method 3 Data Sheet (Orsat Analysis)

Technician SMM — Date of Analysis 5-11-87

Orsat Analyzer No. 3 — Leak Check Performed ☒ YES ☐ NO

Job Nibbing Taconite — Source 2 inc H1

City/State _____ Fuel Type _____ — Test Site Stack H4

Sample Identification	Test/Run	Analysis No.	Buret Readings (cc)			Concentration (% v/v,dry)		F_o
			Zero Point	After CO_2	After O_2	CO_2	O_2	
Ambient Air						0.00	20.90	
4851-A F/~~B~~	1/1	1	0.00	0.60	19.80	0.60	19.20	
		2	0.00	0.60	19.80	0.60	19.20	
		3						
		AVG				0.60	19.20	
-14 F/~~B~~	1/2	1	0.00	0.90	20.00	0.90	19.10	
		2	0.00	0.90	20.00	0.90	19.10	
		3						
		AVG				0.90	19.10	
-19 F/~~B~~	1/3	1	0.00	0.80	20.10	0.80	19.30	
		2	0.00	0.80	20.10	0.80	19.30	
		3						
		AVG				0.80	19.30	

F = Flask (250 cc all-glass); B = Tedlar bag (5-layer)

Note 1 Analyses performed as per CFR title 40, Part 60, Appendix A, Method 3; KOH for CO_2 and reduced methylene blue for O_2 absorption using a Burrell Orsat Analyzer with a 100 cc buret.

Note 2 Use PC-3 Program "ORSAT" Version 6-85.

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Acetone Blank

Date of Analysis 5-11-87
Technician B.D.

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 1 µg/cc

---

(1)

interpoll

Job HIBBING TACONITE CO
Date 5-5-87
City/State
Log # 4451-01
Source INDURATING LINE #1
Test Site SCRUBBER STACK #4
Sample type PW
Tech ET
Remarks: FIELD BLANK
Test/Run 1/0
1 of 1

Special Handling Required

Evaporating Dish No. .14
Volume of acetone 100 cc
E. Dish Tare Wt. 97.6649 g
E. Dish + Sample Wt. 97.6650 g
Comments

---

(2)

interpoll

Job
Date
City/State
Log#
Source
Test Site
Sample type
Tech
Remarks:
Test/Run
of

Special Handling Required

Evaporating Dish No.
Volume of acetone cc
E. Dish Tare Wt. g
E. Dish + Sample Wt. g
Comments

---

(3)

interpoll

Job
Date
City/State
Log#
Source
Test Site
Sample type
Tech
Remarks:
Test/Run
of

Special Handling Required

Evaporating Dish No.
Volume of acetone cc
E. Dish Tare Wt. g
E. Dish + Sample Wt. g
Comments

RESULTS:

1 F-4 2 3

LSC-01Y

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Filter Blank

Date of Analysis_____

Technician_____

---

(1)

interpoll

Job Hibbing Taconite Date 5-5-87
City/State Hibbing/MN. Log# 4951-02
Source Induring Line #1
Test Site Stacks 1, 2, 3 & 4
Sample type Filter Tech ET
Remarks: BLANK Test/Run 1/0
1 of 1

Special Handling Required_____

Filter No. 8115
Filter Type_____
Filter Tare Wt. .8959 g
Filter + Sample Wt. .8961 g
Comments_____

---

(2)

interpoll

Job _____ Date _____
City/State _____ Log#_____
Source _____
Test Site _____
Sample type _____ Tech _____
Remarks: Test/Run _____
_____ of _____

Special Handling Required_____

Filter No. _____
Filter Type_____
Filter Tare Wt._____ g
Filter + Sample Wt._____ g
Comments_____

---

(3)

interpoll

Job _____ Date _____
City/State _____ Log#_____
Source _____
Test Site _____
Sample type _____ Tech _____
Remarks: Test/Run _____
_____ of _____

Special Handling Required_____

Filter No._____
Filter Type_____
Filter Tare Wt._____ g
Filter + Sample Wt._____ g
Comments_____

RESULTS:

1	2	3
0.0002		

LSC-02P

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Date of Analysis 5-11-87
Technician B.D.

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 1 µg/cc

(1)

interpoll

Job Hibbing Taconite Co Date 5-5-87
City/State _____ Log # 4957-05
Source Indurating Line #1
Test Site Scrubber Stack #4
Sample type PW Tech ET
Remarks: Test/Run 1/1
1 of 1

Special Handling Required _____
Evaporating Dish No. 8
Volume of acetone 125 cc
E. Dish Tare Wt. 101.7319 g
E. Dish + Sample Wt. 101.7534 g
Comments _____

(2)

interpoll

Job Hibbing Taconite Co Date 5-5-87
City/State _____ Log # 4957-10
Source Indurating Line #1
Test Site Scrubber Stack #4
Sample type PW Tech CAM
Remarks: Test/Run 1/2
1 of 1

Special Handling Required _____
Evaporating Dish No. 45
Volume of acetone 125 cc
E. Dish Tare Wt. 92.7862 g
E. Dish + Sample Wt. 92.8240 g
Comments _____

(3)

interpoll

Job Hibbing Taconite Date 5/5/87
City/State _____ Log # 4957-15
Source Indurating Line #1
Test Site Scrubber Stack #4
Sample type PW Tech ET
Remarks: Test/Run 1/3
1 of 1

Special Handling Required _____
Evaporating Dish No. 52
Volume of acetone 80 cc
E. Dish Tare Wt. 92.8478 g
E. Dish + Sample Wt. 92.8735 g
Comments _____

RESULTS:

1 / 0.0214 F-6 2 / 0.0357 3 / 0.0256

LSC-01Y

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Date of Analysis _____

Technician _____

---

(1)

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log# 4851-06
Source Indurating Line #1
Test Site Scrubber stack #4
Sample type Filter Tech ET
Remarks: Test/Run 1/1
1 of 1

Special Handling Required _____

Filter No. 8113
Filter Type _____
Filter Tare Wt. .8996 g
Filter + Sample Wt. .9047 g (1, 2)
Comments _____

---

(2)

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log# 4851-11
Source Indurating line #1
Test Site Scrubber Stack #4
Sample type Filter Tech ET
Remarks: Test/Run 1/2
1 of 1

Special Handling Required _____

Filter No. 8118
Filter Type _____
Filter Tare Wt. .8991 g
Filter + Sample Wt. .9117 g (1, 2)
Comments _____

---

(3)

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log# _____
Source Indurating line #1
Test Site Scrubber stack #4
Sample type Filter Tech ET
Remarks: Test/Run 1/3
1 of 1

Special Handling Required _____

Filter No. 8119
Filter Type _____
Filter Tare Wt. .9000 g
Filter + Sample Wt. .9073 g (1, 2)
Comments _____

RESULTS:

1	2	3
0.0051	0.0126	0.0073

0.0265	0.0483	0.0329

LSC-02P

INTERPOLL INC.

EPA Methods 6 & 8 Barium Perchlorate Titrant Standardization Sheet

Date of Standardization 5/11/87
Technician BMM
Buret No. SO_2

The normality of the nominal .01 N barium titrant solution is verified by comparing it against a primary standard of 0.0100 N H_2SO_4 solution using Thorin I as the endpoint indicator.

1. Preparation of Primary Standard (.0100 N H_2SO_4)

   a. Quantitatively transfer the contents of one "Dilut-It" ampule (available from J. T. Baker Coom. No. 4699) to a clean 1 L volumetric flask and bring to volume with distilled water, and mix well by shaking and inverting. Solution is 0.100 N H_2SO_4 and is stable for one year or more if protected from evaporation.

   b. Using a 100 ml volumetric pipet, add 100.00 cc of 0.100 N H_2SO_4 solution to clean 1 L volumetric flask and bring to volume with distilled water and mix well be shaking and inverting. Transfer the contents to a standard reagent bottle and label as follows:

   .0100 N H_2SO_4 Primary Standard
   Prepared on 5/11/87 by BMM
   Prepared by dilution from "Dilut-It" ampule

2. Standardization of the Barium Perchlorate Titrant

   a. Pipet 25.00 cc of the 0.0100 N H_2SO_4 primary standard into each of the three clean 250 cc Erleymeyer flasks. Add 100 cc of checked absolute isopropanol to each flask 4,drops of Thorin I indicating solution and mix by swirling. Titrate these standards with the barium perchlorate titrant recording the starting and ending buret readings below.

   b. Prepare and titrate at least one blank in an identical manner (Pipet 25 ml of distilled water in place of the 0.0100 N H_2SO_4 standard). Record the results of this titration below also.

3. Standardization Data

   All buret readings should be read to the nearest 1/100 and an adequately long time period waited before reading to allow the liquid on the walls to flow down.

	Blank	1st Titr.	2nd Titr.	3rd Titr.
Initial reading (ml)	0.00	0.00	0.00	0.00
Final reading (ml)	0.02	25.20	25.20	25.20
Volume of titrant (ml)	V_b 0.02	V_1 25.20	V_2 25.20	V_3 25.20

4. Calculations

$$V_t = \frac{V_1 + V_2 + V_3}{3} = \frac{(25.20) + (25.20) + (25.20)}{3} = 25.20 \text{ ml}$$

$$N = \frac{0.25}{V_t - V_b} = \frac{0.25}{(25.20) - (0.02)} = 0.00993 \text{ Normality}$$

L-214RRR

Job Name: Hibbing Taconite
Test/Run: 1/0
Log No.: 4851-03

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (264.2 Samp.+ Bottle) - (64.3 Bottle) = 199.9 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State Log # 4851-03
Source Induration Line # 1
Test Site Stack # 4
Sample type Tech
Remarks: Test/Run 1/0
of

Step 2 Orig. sample brought to volume (V_{soln}):

- ☐ 100 cc
- ☐ 250 cc
- ☐ 500 cc
- ☒ 199.9 cc

Step 3 Dilution procedure:

- ☒ No dilution (DF = 1)
- ☐ 10 → 100 (DF = 10)
- ☐ 10 → 250 (DF = 25)
- ☐ 5 → 250 (DF = 50)
- ☐ 1 → 250 (DF = 250)
- ☐ __ → __ (DF = __)

Step 4 Volume taken for titration (V_a):

- ☐ 1 cc
- ☒ 5 cc
- ☐ 10 cc
- ☐ 25 cc
- ☐ __ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	10.00 cc	10.00 cc	____ cc	
Final volume of buret	10.02 cc	10.02 cc	____ cc	
Volume of titrant for aliquot (V_s)	0.02 cc	0.02 cc	____ cc	0.02 cc

F-9

ISC-06

Job Name: Hibbing Taconite
Test/Run: 1/1
Log No.: 4851-07

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (344.9 Samp.+ Bottle) - (64.4 Bottle) = 280.5 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4851-07
Source Induration Line # 1
Test Site Stack # 4
Sample type _____ Tech _____
Remarks: Test/Run 1/1
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):

☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 280.5 cc

Step 3 Dilution procedure:

☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	10.00 cc	10.00 cc	____ cc	
Final volume of buret	12.00 cc	12.00 cc	____ cc	
Volume of titrant for aliquot (V_s)	2.00 cc	2.00 cc	____ cc	2.00 cc

F-10

LSC.06

Job Name: Hibbing Taconite
Test/Run: 1/2
Log No.: 4851-12

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (339.7 Samp.+ Bottle) - (65.3 Bottle) = 274.4 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State Log # 4851-12
Source Indurating Line # 1
Test Site Stack # 4
Sample type Tech
Remarks: Test/Run 1/2
of

Step 2 Orig. sample brought to volume (V_{soln}):

- ☐ 100 cc
- ☐ 250 cc
- ☐ 500 cc
- ☒ 274.4 cc

Step 3 Dilution procedure:

- ☒ No dilution (DF = 1)
- ☐ 10 → 100 (DF = 10)
- ☐ 10 → 250 (DF = 25)
- ☐ 5 → 250 (DF = 50)
- ☐ 1 → 250 (DF = 250)
- ☐ __ → __ (DF = __)

Step 4 Volume taken for titration (V_a):

- ☐ 1 cc
- ☒ 5 cc
- ☐ 10 cc
- ☐ 25 cc
- ☐ __ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	15.00 cc	10.00 cc	____ cc	
Final volume of buret	16.80 cc	11.80 cc	____ cc	
Volume of titrant for aliquot (V_s)	1.80 cc	1.80 cc	____ cc	1.80 cc

F-11

Job Name: Hibbing Taconite
Test/Run: 1/3
Log No.: 4851-17

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (340.2 Samp.+ Bottle) - (64.4 Bottle) = 275.8 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4851-17
Source Induration Line # 1
Test Site Stack # 4
Sample type _____ Tech _____
Remarks: Test/Run 1/3
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):

- ☐ 100 cc
- ☐ 250 cc
- ☐ 500 cc
- ☒ 275.8 cc

Step 3 Dilution procedure:

- ☒ No dilution (DF = 1)
- ☐ 10 → 100 (DF = 10)
- ☐ 10 → 250 (DF = 25)
- ☐ 5 → 250 (DF = 50)
- ☐ 1 → 250 (DF = 250)
- ☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

- ☐ 1 cc
- ☒ 5 cc
- ☐ 10 cc
- ☐ 25 cc
- ☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	17.00 cc	18.75 cc	____ cc	
Final volume of buret	18.75 cc	20.50 cc	____ cc	
Volume of titrant for aliquot (V_s)	1.75 cc	1.75 cc	____ cc	1.75 cc

F-12

ISC 06

INTERPOLL INC.
(612)786-6020

EPA METHOD 10 ANALYSIS DATA SHEET

Job Name HIBBING TACONITE
Source INDURATING LINE #1 STACK #4
Date of NDIR Analysis 5-11-87

NDIR Model ACS model 3300 0-500/1000 PPM
NDIR Flow Rate 1000 cc/min
Technician E. TRAWBRIDGE

SAMPLE NAME	SAMPLE LOG NO.	CARBON DIOXIDE % v/v (B'CO_2)	MOISTURE CONTENT % v/v (B'H_2O)	CARBON MONODIXE CONCENTRATION (PPM)							
				BASIS						DRY BASIS	WET BASIS
				Trial 1		Trial 2		AVG			
				DF	PPM	DF	PPM	DF	PPM		
T1 R1				1	12	1	12	1	12		
R2				1	11	1	11	1	11		
R3				1	11	1	11	1	11		

DF = dilution factor

ZERO GAS: 99.998 % N_2

CAL GAS(ES): 892.9 PPM CO IN NITROGEN SOURCE: SCOTT SPECIALTY GASES

Note 1: The carbon monoxide concentrations in the dry gas sample are determined after CO_2 removal (Ascarite column) using a nondispersive infrared analyzer. Orsat analysis is performed to determine CO_2 concentration. Field moisture content data is used to convert to a wet basis.

Note 2: The analyzer must be zeroed and spanned immediately before and after analysis. Additional Zero and span values may be made between analyses if required. Record all zero and span values after initial calibration is complete.

Note 3: Calculation Equations: $CO\text{-}DRY = CO_{CO_2\text{-free AVG}} (1\text{-}B'_{CO_2}/(100 * DF))$; $CO\text{-}WET = CO\text{-}DRY (1\text{-}B'_{H_2O}/100)$

S-305RR

4852

Interpoll Inc.
(612)786-6020

Pg ___ of ___

Chain of Custody
Sample Deposition Sheet

Job HIBBING TACONITE CO
Site INDURATING LINE 1, SCRUBBER STACK #3
Team Leader E TROWBRIDGE
Priority
Date Submitted
Received by B.D.
Test No(s). 2
Number of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Date Analyzed	Other Information or Special Instructions
3	Probe Wash Solvent(s):	☒ As per EPA 5 ☐ LEAD + BE _____		
3	Filter: ☒ 4" glass fiber ☐ Stainless steel ☐ ERC	☒ As per EPA 5 ☐ LEAD + BE _____		
3	Wet Catch	☐ Organic ☐ Inorganic ☒ Other LEAD		
3	Orsat			
3	SO_2	LEAD + BE		
	SO_2 Audit Sample			EPA Control No(s).
12	NO_x (Open box tops after unloading)	☐ Colorimetric ☐ Ion Chromatographic		Date / / & Time of arrival at Interpoll
	NO_x Audit Sample			EPA Control No(s).
	Fuel Sample			

Source Information

1) Type of source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☒ Other _____
2) Fuel: ☐ Coal ☐ Wood ☒ Gas ☐ Oil ☐ Other _____
3) Is sample combustible? ☐ No ☐ Yes
4) Does sample need special desiccating? ☐ No ☐ Yes If yes, explain _____
5) Is particle size analysis required ☐ No ☐ Yes If yes, how many run(s)? _____
run preference _____

S-278RRRR

EPA METHOD 3

LABORATORY REPORT

SUMMARY OF ORSAT DATA

Job: Hibbing Taconite
Sampling Location: Indurating Line # 1 Stack # 3
Sampling Date:
Analysis Date: 5-7-87
Technician: RCV

TEST NO. AND DATE	RUN NO.	RESULTS						
		INTEGRATED (BAG)			GRAB (BULB)			O_2 ANALYZER
		% CO_2	% O_2	% CO	% CO_2	% O_2	% CO	% O_2
5-7-87 2	1	0.60	19.60					
5-7-87 2	2	0.60	19.60					
5-7-87 2	3	0.60	19.60					

Interpoll Inc.
(612)786-6020

EPA Method 3 Data Sheet (Orsat Analysis)

Technician RCV
Date of Analysis 5-7-87
Orsat Analyzer No. 3
Leak Check Performed ☑ YES ☐ NO
Job Hibbing Taconite
Source Induration Line #1
City/State _____ Fuel Type _____
Test Site Scrubber Stack #3
Bag Box 11

Sample Identification		Test/Run	Analysis No.	Buret Readings (cc)			Concentration (% v/v,dry)		F_o
				Zero Point	After CO_2	After O_2	CO_2	O_2	
Ambient Air				0.00	0.00	20.90	0.00	20.90	
4852-05	F	2/1	1	0.00	0.60	20.20	0.60	19.60	
	B ✓		2	0.00	0.60	20.20	0.60	19.60	
			3						
			AVG				0.60	19.60	
4852-10	F	2/2	1	0.00	0.60	20.20	0.60	19.60	
	B ✓		2	0.00	0.60	20.20	0.60	19.60	
			3						
			AVG				0.60	19.60	
4852-15	F	2/3	1	0.00	0.60	20.20	0.60	19.60	
	B ✓		2	0.00	0.60	20.20	0.60	19.60	
			3						
			AVG				0.60	19.60	

F = Flask (250 cc all-glass); B = Tedlar bag (5-layer)

Note 1 Analyses performed as per CFR title 40, Part 60, Appendix A, Method 3; KOH for CO_2 and reduced methylene blue for O_2 absorption using a Burrell Orsat Analyzer with a 100 cc buret.

Note 2 Use PC-3 Program "ORSAT" Version 6-85.

LSC-04B

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Date of Analysis 5-11-87
Technician B.D.

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 1 µg/cc

(1)

interpoll

Job Hibbing Taconite Date 5-6-87
City/State Log # 4852-01
Source Preheating Cyc #1
Test Site Scrubber Stack #3
Sample type PW Tech ET
Remarks: Test/Run 1/1
1 of 1

Special Handling Required
Evaporating Dish No. 17
Volume of acetone 125 cc
E. Dish Tare Wt. 97.4014 g
E. Dish + Sample Wt. 98.0054 g
Comments

(2)

interpoll

Job Hibbing Taconite Co Date 5-6-87
City/State Log # 4852-06
Source Induration Line #1
Test Site Scrubber Stack #3
Sample type PW Tech ET
Remarks: Test/Run 2/2
1 of 1

Special Handling Required
Evaporating Dish No. 21
Volume of acetone 65 cc
E. Dish Tare Wt. 104.6154 g
E. Dish + Sample Wt. 104.6246 g
Comments

(3)

interpoll

Job Hibbing Taconite Date 5-6-87
City/State Log # 4852-11
Source Induration Line #1
Test Site Scrubber Stack #3
Sample type PW Tech ET
Remarks: Test/Run 2/3
1 of 1

Special Handling Required
Evaporating Dish No. 28
Volume of acetone 100 cc
E. Dish Tare Wt. 95.3388 g
E. Dish + Sample Wt. 95.3547 g
Comments

RESULTS:

1/ 0.0239 | 2/ 0.0091 | 3/ 0.0158

LSC-01Y

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Date of Analysis _____

Technician _____

---

(1)

interpoll

Job Hibbing Taconite Date 5-6-87
City/State _____ Log# 4852-02
Source Indurating line #1
Test Site Scrubber stack #3
Sample type Filter Tech ET
Remarks: Test/Run 2/1
1 of 1

Special Handling Required _____

Filter No. 8123
Filter Type _____
Filter Tare Wt. .9281 g
Filter + Sample Wt. .9319 g
Comments _____

---

(2)

interpoll

Job Hibbing Taconite Date 5-6-87
City/State _____ Log# 4852-03
Source Indurating line #1
Test Site Scrubber stack #3
Sample type Filter Tech ET
Remarks: Test/Run 2/2
1 of 1

Special Handling Required _____

Filter No. 8124
Filter Type _____
Filter Tare Wt. .9229 g
Filter + Sample Wt. .9249 g
Comments _____

---

(3)

interpoll

Job Hibbing Taconite Date 5-6-87
City/State _____ Log# 4852-12
Source Indurating line #1
Test Site Stack Scrubber Stack #3
Sample type Filter Tech ET
Remarks: Test/Run 2/3
1 of 1

Special Handling Required _____

Filter No. 8125
Filter Type _____
Filter Tare Wt. .9238 g
Filter + Sample Wt. .9260 g
Comments _____

RESULTS:

1	2	3
0.0038	0.0020	0.0022

0.0277	0.0111	0.0180

LSC-02P

Job Name: Hibbing Taconite
Test/Run: 2/1
Log No.: 4852-03

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (326.9 Samp.+ Bottle) - (64.5 Bottle) = 262.4 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4852-03
Source Indurating Line # 1
Test Site Stack # 3
Sample type _____ Tech _____
Remarks: Test/Run 2/1
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):

☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 262.4 cc

Step 3 Dilution procedure:

☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	10.00 cc	10.00 cc	____ cc	
Final volume of buret	11.90 cc	11.90 cc	____ cc	
Volume of titrant for aliquot (V_s)	1.90 cc	1.90 cc	____ cc	1.90 cc

F-19

Job Name: Hibbing Taconite
Test/Run: 2/2
Log No.: 4852-08

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (334.5 Samp.+ Bottle) - (66.0 Bottle) = 268.5 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State Log # 4852-08
Source Induration Line # 1
Test Site Stack #2
Sample type Tech
Remarks: Test/Run 2/2
of

Step 2 Orig. sample brought to volume (V_{soln}):
☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 268.5 cc

Step 3 Dilution procedure:
☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ __ → __ (DF = __)

Step 4 Volume taken for titration (V_a):
☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ __ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	20.00 cc	21.80 cc	____ cc	
Final volume of buret	21.80 cc	23.60 cc	____ cc	
Volume of titrant for aliquot (V_s)	1.80 cc	1.80 cc	____ cc	1.80 cc

F-20

Job Name: Hibbing Taconite
Test/Run: 2/3
Log No.: 4852-13

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician Amr

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (329.5 Samp.+ Bottle) - (65.5 Bottle) = 264.0 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4852-13
Source Induration Line # 1
Test Site Stack # 3
Sample type _____ Tech _____
Remarks: Test/Run 2/3
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):

☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 264.0 cc

Step 3 Dilution procedure:

☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ ___ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	10.00 cc	10.00 cc	____ cc	
Final volume of buret	11.20 cc	11.20 cc	____ cc	
Volume of titrant for aliquot (V_s)	1.20 cc	1.20 cc	____ cc	1.20 cc

F-21

INTERPOLL INC.
(612)786-6020

EPA METHOD 10 ANALYSIS DATA SHEET

Job Name Hibbing Taconite
Source Indurating Line #1 stack #3
Date of NDIR Analysis 5-11-87

NDIR Model ACS Model 3300 0-500/1000 PPM
NDIR Flow Rate 1000 cc/min
Technician J Buresh

SAMPLE NAME	SAMPLE LOG NO.	CARBON DIOXIDE % v/v ($B'CO_2$)	MOISTURE CONTENT % v/v ($B'H_2O$)	CARBON MONODIXE CONCENTRATION (PPM)							
				BASIS						DRY BASIS	WET BASIS
				Trial 1		Trial 2		AVG			
				DF	PPM	DF	PPM	DF	PPM		
2/1				1	6	1	6	1	6		
2/2				1	5	1	5	1	5		
2/3				1	5	1	5	1	5		

DF = dilution factor

ZERO GAS: 99.998 % N_2

CAL GAS(ES): 892.9 PPM CO IN NITROGEN SOURCE: Scott specialty gases

Note 1: The carbon monoxide concentrations in the dry gas sample are determined after CO_2 removal (Ascarite column) using a nondispersive infrared analyzer. Orsat analysis is performed to determine CO_2 concentration. Field moisture content data is used to convert to a wet basis.

Note 2: The analyzer must be zeroed and spanned immediately before and after analysis. Additional Zero and span values may be made between analyses if required. Record all zero and span values after initial calibration is complete.

Note 3: Calculation Equations: $CO\text{-}DRY = CO_{CO_2\text{-free AVG}} (1-B'_{CO_2}/(100 * DF))$; $CO\text{-}WET = CO\text{-}DRY (1-B'_{H_2O}/100)$

S-305RR

4853

Interpoll Inc.
(612)786-6020

Pg ___ of ___

Chain of Custody
Sample Deposition Sheet

Job HIBBING TACONITE CO
Site INDURATING LINE #1 SCRUBBER STACK # 2
Team Leader E TROWBRIDGE
Priority
Date Submitted 5-7-87
Received by B.D.
Test No(s). 3
Number of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Date Analyzed	Other Information or Special Instructions
3	Probe Wash Solvent(s):	☒ As per EPA 5 ☐ PB + BE		
3	Filter: ☒ 4" glass fiber ☐ Stainless steel ☐ ERC	☒ As per EPA 5 ☐ PB + BE		
3	Wet Catch	☐ Organic ☐ Inorganic ☒ Other PB		
3	Orsat	O2, CO2, CO		
3	SO_2	LEAD + BE		
	SO_2 Audit Sample			EPA Control No(s).
12	NO_x (Open box tops after unloading)	☐ Colorimetric ☐ Ion Chromatographic		Date 5/7/87 & Time 2300 of arrival at Interpoll
	NO_x Audit Sample			EPA Control No(s).
	Fuel Sample			

Source Information

1) Type of source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☐ Other ___
2) Fuel: ☐ Coal ☐ Wood ☒ Gas ☐ Oil ☐ Other ___
3) Is sample combustible? ☐ No ☐ Yes
4) Does sample need special desiccating? ☐ No ☐ Yes If yes, explain ___
5) Is particle size analysis required ☐ No ☐ Yes If yes, how many run(s)? ___
run preference ___

S-278RRRR

EPA METHOD 3

LABORATORY REPORT

SUMMARY OF ORSAT DATA

Job: Hibbing Taconite
Sampling Location: Indurating Line # 1 Stack #2
Sampling Date:
Analysis Date: 5-7-87
Technician: RCV

TEST NO. AND DATE	RUN NO.	RESULTS						
		INTEGRATED (BAG)			GRAB (BULB)			O_2 ANALYZER
		% CO_2	% O_2	% CO	% CO_2	% O_2	% CO	% O_2
5-7-87 3	1	0.40	20.20					
5-7-87 3	2	0.40	20.20					
5-7-87 3	3	0.40	20.20					

Interpoll Inc.
(612)786-6020

EPA Method 3 Data Sheet (Orsat Analysis)

Technician RCV
Orsat Analyzer No. 3
Job Hibbing Taconite
City/State _____ Fuel Type _____
Bag Box #12

Date of Analysis 5-7-87
Leak Check Performed ☑ YES ☐ NO
Source Indurating Line #1
Test Site Scrubber Stack #2

Sample Identification		Test/Run	Analysis No.	Buret Readings (cc)			Concentration (% v/v,dry)		F_o
				Zero Point	After CO_2	After O_2	CO_2	O_2	
Ambient Air				0.00	0.00	20.70	0.00	20.70	
4853-05	F/B	3/1	1	0.00	0.40	20.60	0.40	20.20	
			2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.20	
4853-10	F/B	3/2	1	0.00	0.40	20.60	0.40	20.20	
			2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.30	
4853-15	F/B	3/3	1	0.00	0.40	20.60	0.40	20.20	
			2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.20	

F = Flask (250 cc all-glass); B = Tedlar bag (5-layer)

Note 1 Analyses performed as per CFR title 40, Part 60, Appendix A, Method 3; KOH for CO_2 and reduced methylene blue for O_2 absorption using a Burrell Orsat Analyzer with a 100 cc buret.

Note 2 Use PC-3 Program "ORSAT" Version 6-85.

LSC-04B

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Date of Analysis 5-11-87
Technician B.D.

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 1 µg/cc

(1)

interpoll

Job NIBBING TACONITE CO Date 5-7-87
City/State _____ Log # 4853-01
Source INDURATING LINE #1
Test Site SCRUBBER STACK #2
Sample type PW Tech ET
Remarks: Test/Run 3/1
1 of 1

Special Handling Required _____

Evaporating Dish No. 30
Volume of acetone 90 cc
E. Dish Tare Wt. 94.9970 g
E. Dish + Sample Wt. 95.0138 g
Comments _____

(2)

interpoll

Job NIBBING TACONITE Date 5-7-87
City/State _____ Log # 4853-06
Source INDURATING LINE #1
Test Site SCRUBBER STACK #2
Sample type PW Tech ET
Remarks: Test/Run 3/2
1 of 1

Special Handling Required _____

Evaporating Dish No. 37
Volume of acetone 100 cc
E. Dish Tare Wt. 95.1761 g
E. Dish + Sample Wt. 95.1908 g
Comments _____

(3)

interpoll

Job NIBBING TACONITE Date 5-7-87
City/State _____ Log # 4853-11
Source INDURATING LINE #1
Test Site SCRUBBER STACK #2
Sample type PW Tech ET
Remarks: Test/Run 3/3
1 of 1

Special Handling Required _____

Evaporating Dish No. 57
Volume of acetone 80 cc
E. Dish Tare Wt. 92.8540 g
E. Dish + Sample Wt. 92.8716 g
Comments _____

RESULTS:

1/ 0.0167 F-26 2/ 0.0146 3/ 0.0175

LSC-01Y

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Date of Analysis_____

Technician_____

---

(1)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log# 4853-02
Source Indurating line # 1
Test Site Scrubber Stack #2
Sample type Filter Tech ET
Remarks: Test/Run 3/1
1 of 1

Special Handling Required_____

Filter No. 8140
Filter Type_____
Filter Tare Wt. .9416 g
Filter + Sample Wt. .95 1/2 4 g
Comments_____

---

(2)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log# 4853-07
Source Indurating Line # 1
Test Site Scrubber stack #2
Sample type Filter Tech ET
Remarks: Test/Run 3/2
1 of 1

Special Handling Required_____

Filter No. 8134
Filter Type 4 inch G.F.
Filter Tare Wt. .9345 g
Filter + Sample Wt. .94 1/2 17 g
Comments_____

---

(3)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log# 4853-12
Source Indurating Line # 1
Test Site Scrubber stack #3
Sample type Filter Tech E1
Remarks: Test/Run 3/3
1 of 1

Special Handling Required_____

Filter No. 8135
Filter Type_____
Filter Tare Wt. .9443 g
Filter + Sample Wt. .95 1/2 19 g
Comments_____

RESULTS:

1	2	3
0.0108	0.0072	0.0096
0.0275	0.0218	0.0251

LSC-02P

Job Name: Hibbing Taconite
Test/Run: 3/1
Log No.: 4853-05

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (307.9 Samp.+ Bottle) - (65.6 Bottle) = 2423 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4853-05
Source Indurating Line #1
Test Site Stack #2
Sample type _____ Tech _____
Remarks: Test/Run 3/1
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):

- ☐ 100 cc
- ☐ 250 cc
- ☐ 500 cc
- ☒ 2423 cc

Step 3 Dilution procedure:

- ☒ No dilution (DF = 1)
- ☐ 10 → 100 (DF = 10)
- ☐ 10 → 250 (DF = 25)
- ☐ 5 → 250 (DF = 50)
- ☐ 1 → 250 (DF = 250)
- ☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

- ☐ 1 cc
- ☒ 5 cc
- ☐ 10 cc
- ☐ 25 cc
- ☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	10.00 cc	10.00 cc	____ cc	
Final volume of buret	11.55 cc	11.55 cc	____ cc	
Volume of titrant for aliquot (V_s)	1.55 cc	1.55 cc	____ cc	1.55 cc

F-28

Job Name: Hibbing Taconite
Test/Run: 3/2
Log No.: 4853-08

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician BMH

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (306.4 Samp.+ Bottle) - (64.6 Bottle) = 241.8 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State Log # 4853-08
Source Indurating Line # 1
Test Site Stack # 2
Sample type Tech
Remarks: Test/Run 3/2
of

Step 2 Orig. sample brought to volume (V_{soln}):

☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 241.8 cc

Step 3 Dilution procedure:

☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ __ → __ (DF = __)

Step 4 Volume taken for titration (V_a):

☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ __ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	10.00 cc	10.00 cc	____ cc	
Final volume of buret	11.55 cc	11.55 cc	____ cc	
Volume of titrant for aliquot (V_s)	1.55 cc	1.55 cc	____ cc	1.55 cc

F-29

Job Name: Hibbing Taconite
Test/Run: 3/3
Log No.: 4853-13

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (305.3 Samp.+ Bottle) - (65.5 Bottle) = 239.8 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4853-13
Source Induration Line # 1
Test Site Stack # 2
Sample type _____ Tech _____
Remarks: Test/Run 3/3
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):
☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 239.8 cc

Step 3 Dilution procedure:
☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ __ → __ (DF = __)

Step 4 Volume taken for titration (V_a):
☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ __ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	10.00 cc	10.00 cc	____ cc	
Final volume of buret	11.45 cc	11.45 cc	____ cc	
Volume of titrant for aliquot (V_s)	1.45 cc	1.45 cc	____ cc	1.45 cc

INTERPOLL INC.
(612)786-6020

EPA METHOD 10 ANALYSIS DATA SHEET

Job Name Hibbing Taconite
Source Indurating line #1 stack #2
Date of NDIR Analysis 5-11-87

NDIR Model ACS Model 3300 0-500/1000 PPM
NDIR Flow Rate 1000 cc/min
Technician J Breeth

SAMPLE NAME	SAMPLE LOG NO.	CARBON DIOXIDE % v/v ($B'CO_2$)	MOISTURE CONTENT % v/v ($B'H_2O$)	CARBON MONODIXE CONCENTRATION (PPM)							
				BASIS						DRY BASIS	WET BASIS
				Trial 1		Trial 2		AVG			
				DF	PPM	DF	PPM	DF	PPM		
3/1				1	4	1	4	1	4		
3/2				1	5	1	5	1	5		
3/3				1	5	1	5	1	5		

DF = dilution factor

ZERO GAS: 99.998 % N_2

CAL GAS(ES): 892.9 PPM CO IN NITROGEN SOURCE: Scott Specialty Gases

Note 1: The carbon monoxide concentrations in the dry gas sample are determined after CO_2 removal (Ascarite column) using a nondispersive infrared analyzer. Orsat analysis is performed to determine CO_2 concentration. Field moisture content data is used to convert to a wet basis.

Note 2: The analyzer must be zeroed and spanned immediately before and after analysis. Additional Zero and span values may be made between analyses if required. Record all zero and span values after initial calibration is complete.

Note 3: Calculation Equations: $CO\text{-}DRY = CO_{CO_2\text{-free AVG}} (1-B'_{CO_2}/(100 * DF))$; $CO\text{-}WET = CO\text{-}DRY (1-B'_{H_2O}/100)$

S-305RR

4854

Interpoll Inc.
(612)786-6020

Pg ___ of ___

Chain of Custody
Sample Deposition Sheet

Job HIBBING TACONITE
Site INDURATING LINE #1 SCRUBBER STACK #1
Team Leader E FLOWBRIDGE
Priority
Date Submitted 5-7-87
Received by B.D.
Test No(s). 4
Number of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Date Analyzed	Other Information or Special Instructions
3	Probe Wash Solvent(s):	☑ As per EPA 5 ☐ Pb + Be		ANALYZE FOR LEAD, BERYLLIUM ALSO
3	Filter: ☑ 4" glass fiber ☐ Stainless steel ☐ ERC	☑ As per EPA 5 ☐ PB + BE		ANALYZE for lead + beryllium also
3	Wet Catch	☐ Organic ☐ Inorganic ☑ Other LEAD		
3	Orsat	O2, CO2, O2		
3	SO_2	Pb + Be		
	SO_2 Audit Sample			EPA Control No(s).
12	NO_x (Open box tops after unloading)	☐ Colorimetric ☐ Ion Chromatographic		Date 5/7/87 & Time 2300 of arrival at Interpoll
	NO_x Audit Sample			EPA Control No(s).
	Fuel Sample			

Source Information

1) Type of source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☐ Other ___
2) Fuel: ☐ Coal ☐ Wood ☒ Gas ☐ Oil ☐ Other ___
3) Is sample combustible? ☐ No ☐ Yes
4) Does sample need special desiccating? ☐ No ☐ Yes If yes, explain ___
5) Is particle size analysis required ☐ No ☐ Yes If yes, how many run(s)? ___
run preference ___

S-278RRRR

EPA METHOD 3

LABORATORY REPORT

SUMMARY OF ORSAT DATA

Job: Hibbing Taconite
Sampling Location: Indurating Line #1 Stack 1
Sampling Date:
Analysis Date: 5-7-87
Technician: RCU

TEST NO. AND DATE	RUN NO.	RESULTS						
		INTEGRATED (BAG)			GRAB (BULB)			O_2 ANALYZER
		% CO_2	% O_2	% CO	% CO_2	% O_2	% CO	% O_2
5-7-87 4	1	0.40	20.20					
5-7-87 4	2	0.40	20.20					
5-7-87 4	3	0.40	20.20					

Interpoll Inc.
(612)786-6020

EPA Method 3 Data Sheet (Orsat Analysis)

Technician Bob
Orsat Analyzer No. 3
Job Hibbing Taconite
City/State Bay Box 6 Fuel Type

Date of Analysis 5-7-87
Leak Check Performed ☑ YES ☐ NO
Source Indurating Line #1
Test Site Scrubber Stack #1

Sample Identification		Test/Run	Analysis No.	Buret Readings (cc)			Concentration (% v/v,dry)		F_o
				Zero Point	After CO_2	After O_2	CO_2	O_2	
Ambient Air				0.00	0.00	20.70	0.00	20.70	
4854-05	F	4/1	1	0.00	0.40	20.60	0.40	20.20	
	B		2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.20	
4854-10	F	4/2	1	0.00	0.40	20.60	0.40	20.20	
	B		2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.20	
4854-15	F	4/3	1	0.00	0.40	20.60	0.40	20.20	
	B		2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.20	

F = Flask (250 cc all-glass); B = Tedlar bag (5-layer)

Note 1 Analyses performed as per CFR title 40, Part 60, Appendix A, Method 3; KOH for CO_2 and reduced methylene blue for O_2 absorption using a Burrell Orsat Analyzer with a 100 cc buret.

Note 2 Use PC-3 Program "ORSAT" Version 6-85.

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Date of Analysis 5-1-97
Technician B.D.

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 1 µg/cc

(1)

interpoll

Job HIBBING TACONITE Date 5-7-87
City/State Log # 4854-01
Source INDURATING LINE #1
Test Site SCRUBBER STACK #1
Sample type PW Tech ET
Remarks: Test/Run 4-1
1 of 1

Special Handling Required
Evaporating Dish No. 32
Volume of acetone 90 cc
E. Dish Tare Wt. 103.4814 g
E. Dish + Sample Wt. 103.4985 g
Comments

(2)

interpoll

Job HIBBING TACONITE Date 5-7-87
City/State Log # 4854-06
Source INDURATING LINE #1
Test Site SCRUBBER STACK #1
Sample type PW Tech ET
Remarks: Test/Run 4-2
1 of 1

Special Handling Required
Evaporating Dish No. 42
Volume of acetone 90 cc
E. Dish Tare Wt. 87.7899 g
E. Dish + Sample Wt. 87.8062 g
Comments

(3)

interpoll

Job HIBBING TACONITE Date 5-7-87
City/State Log # 4854-11
Source INDURATING LINE #1
Test Site SCRUBBER STACK #1
Sample type FW Tech ET
Remarks: Test/Run 4-3
1 of 1

Special Handling Required
Evaporating Dish No. 47
Volume of acetone 80 cc
E. Dish Tare Wt. 92.4699 g
E. Dish + Sample Wt. 92.4817 g
Comments

RESULTS:

1/ 0.0165 F-35 2/ 0.0162 3/ 0.0117

LSC-01Y

APPENDIX G

LABORATORY DATA SHEETS FOR INDURATING LINE NO. 2

4855

Interpoll Inc.
(612)786-6020

Pg ___ of ___

Chain of Custody
Sample Deposition Sheet

Job Hibbing Taconite Co. Site Indurating Line #2 Stack #4
Team Leader Ron Rosenthal Priority ___
Date Submitted 5-8-87 Received by ___
Test No(s). 1 Number of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Date Analyzed	Other Information or Special Instructions
4	Probe Wash Solvent(s): 1 BLANK	☒ As per EPA 5 ☒ LEAD & Be		
4	Filter: ☒ 4" glass fiber ☐ Stainless steel ☐ ERC 1 BLANK	☒ As per EPA 5 ☒ LEAD & Be		
3	~~Back Catch~~ LEAD NHO_3	☐ Organic ☐ Inorganic ☒ Other LEAD M-12		
3	Orsat	CO, CO_2, O_2		
3	SO_2	Analyze Pb & Be		
	SO_2 Audit Sample			EPA Control No(s).
12	NO_x (Open box tops after unloading)	☐ Colorimetric ☐ Ion Chromatographic		Date 5/8/87 & Time 1230 of arrival at Interpoll
	NO_x Audit Sample			EPA Control No(s).
	Fuel Sample			

Source Information

1) Type of source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☒ Other Indurating Line #2
2) Fuel: ☐ Coal ☐ Wood ☐ Gas ☐ Oil ☒ Other Pet Coke
3) Is sample combustible? ☒ No ☐ Yes
4) Does sample need special desiccating? ☒ No ☐ Yes If yes, explain ___
5) Is particle size analysis required ☒ No ☐ Yes If yes, how many run(s)? ___
run preference ___

S-278RRRR

EPA METHOD 3

LABORATORY REPORT

SUMMARY OF ORSAT DATA

Job: Hibbing Taconite
Sampling Location: Line #2 Stack #4
Sampling Date:
Analysis Date: 5-7-87
Technician: RCV

TEST NO. AND DATE	RUN NO.	RESULTS						
		INTEGRATED (BAG)			GRAB (BULB)			O_2 ANALYZER
		% CO_2	% O_2	% CO	% CO_2	% O_2	% CO	% O_2
5-7-87 1	1	1.00	19.40					
5-7-87 1	2	1.00	19.40					
5-7-87 1	3	1.00	19.40					

Interpoll Inc.
(612)786-6020

EPA Method 3 Data Sheet (Orsat Analysis)

Technician R.C.V
Orsat Analyzer No. 3
Job Hibbing Taconite
City/State _____ Fuel Type _____
Bag Box 2

Date of Analysis 5-7 87
Leak Check Performed ☑ YES ☐ NO
Source Indurating Line #2
Test Site Stack 4

Sample Identification		Test/Run	Analysis No.	Buret Readings (cc)			Concentration (% v/v,dry)		F_o
				Zero Point	After CO_2	After O_2	CO_2	O_2	
Ambient Air				0.00	0.00	20.90	0.00	20.90	
4855-01	F	1/1	1	0.00	1.00	20.40	1.00	19.40	
	B		2	0.00	1.00	20.40	1.00	19.40	
			3						
			AVG				1.00	19.40	
4855-12	F	1/2	1	0.00	1.00	20.40	1.00	19.40	
	B		2	0.00	1.00	20.40	1.00	19.40	
			3						
			AVG				1.00	19.40	
4855-17	F	1/3	1	0.00	1.00	20.40	1.00	19.40	
	B		2	0.00	1.00	20.40	1.00	19.40	
			3						
			AVG				1.00	19.40	

F = Flask (250 cc all-glass); B = Tedlar bag (5-layer)

Note 1 Analyses performed as per CFR title 40, Part 60, Appendix A, Method 3; KOH for CO_2 and reduced methylene blue for O_2 absorption using a Burrell Orsat Analyzer with a 100 cc buret.

Note 2 Use PC-3 Program "ORSAT" Version 6-85.

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Date of Analysis_____

Technician_____

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(1)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log# 4854-02
Source Indurating Line #1
Test Site Scrubber Stack #1
Sample type Filter Tech ET
Remarks: Test/Run 4/1
1 of 1

Special Handling Required_____

Filter No. 8129
Filter Type_____
Filter Tare Wt. .7350 g
Filter + Sample Wt. .9429 g
Comments_____

---

(2)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log#_____
Source Indurating Line #1
Test Site Scrubber Stack #1
Sample type Filter Tech ET
Remarks: Test/Run 4/2
1 of 1

Special Handling Required_____

Filter No. 8130
Filter Type_____
Filter Tare Wt. .9323 g
Filter + Sample Wt. .942 5/2 g
Comments_____

---

(3)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log# 4854-12
Source Indurating Line #1
Test Site Scrubber Stack #1
Sample type Filter Tech EI
Remarks: Test/Run 4/3
1 of 1

Special Handling Required_____

Filter No. 8139
Filter Type_____
Filter Tare Wt. .9491 g
Filter + Sample Wt. .96 1/2 8 g
Comments_____

RESULTS:

1	2	3
0.0079	0.0102	0.0137

0.0244	0.0264	0.0254

LSC-02P

Job Name: Hibbing Taconite
Test/Run: 4/1
Log No.: 4854-03

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (533.4 Samp.+ Bottle) - (294.7 Bottle) = 238.7 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4854-03
Source Induration Line # 1
Test Site Stack #[illegible] 1
Sample type _____ Tech _____
Remarks: Test/Run 4/1
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):
☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 238.7 cc

Step 3 Dilution procedure:
☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ __ → __ (DF = __)

Step 4 Volume taken for titration (V_a):
☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ __ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	30.00 cc	30.00 cc	____ cc	
Final volume of buret	32.65 cc	32.65 cc	____ cc	
Volume of titrant for aliquot (V_s)	2.65 cc	2.65 cc	____ cc	2.65 cc

F-37

USC 06

Job Name: Hibbing Taconite
Test/Run: 4/2
Log No.: 4654-08

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (529.9 Samp.+ Bottle) - (295.9 Bottle) = 239.0 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4652-08
Source Induration Line # 1
Test Site Stack # 1
Sample type _____ Tech _____
Remarks: Test/Run 4/2
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):
☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 239.0 cc

Step 3 Dilution procedure:
☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):
☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	10.01 cc	10.00 cc	____ cc	
Final volume of buret	11.65 cc	11.65 cc	____ cc	
Volume of titrant for aliquot (V_s)	1.65 cc	1.65 cc	____ cc	1.65 cc

F-38

Job Name: Hibbing Taconite
Test/Run: 4/3
Log No.: 4854-13

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (530.5 Samp.+ Bottle) - (295.0 Bottle) = 240.5 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4854-13
Source Induration Line # 1
Test Site Stack # 1
Sample type _____ Tech _____
Remarks: Test/Run 4/3
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):

- ☐ 100 cc
- ☐ 250 cc
- ☐ 500 cc
- ☒ 240.5 cc

Step 3 Dilution procedure:

- ☒ No dilution (DF = 1)
- ☐ 10 → 100 (DF = 10)
- ☐ 10 → 250 (DF = 25)
- ☐ 5 → 250 (DF = 50)
- ☐ 1 → 250 (DF = 250)
- ☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

- ☐ 1 cc
- ☒ 5 cc
- ☐ 10 cc
- ☐ 25 cc
- ☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	10.00 cc	10.00 cc	_____ cc	
Final volume of buret	11.55 cc	11.55 cc	_____ cc	
Volume of titrant for aliquot (V_s)	1.55 cc	1.55 cc	_____ cc	1.55 cc

LSC 06

INTERPOLL INC.
(612)786-6020

EPA METHOD 10 ANALYSIS DATA SHEET

Job Name HIBBING TACONITE CO
Source TRAVELING GRATE #1 STACK #1
Date of NDIR Analysis 5-11-87

NDIR Model ACS Model 3300 0-500/1000 PPM
NDIR Flow Rate 1000 cc/min
Technician E TROWBRIDGE

SAMPLE NAME	SAMPLE LOG NO.	CARBON DIOXIDE % v/v ($B'CO_2$)	MOISTURE CONTENT % v/v ($B'H_2O$)	CARBON MONODIXE CONCENTRATION (PPM)							
				BASIS						DRY BASIS	WET BASIS
				Trial 1		Trial 2		AVG			
				DF	PPM	DF	PPM	DF	PPM		
T4 R1				1	6						
R2				1	5						
R3				1	5						

DF = dilution factor

ZERO GAS: 99.998 % N_2
CAL GAS(ES): 892.9 PPM CO IN NITROGEN SOURCE: SCOTT SPECIALTY GASES

Note 1: The carbon monoxide concentrations in the dry gas sample are determined after CO_2 removal (Ascarite column) using a nondispersive infrared analyzer. Orsat analysis is performed to determine CO_2 concentration. Field moisture content data is used to convert to a wet basis.
Note 2: The analyzer must be zeroed and spanned immediately before and after analysis. Additional Zero and span values may be made between analyses if required. Record all zero and span values after initial calibration is complete.
Note 3: Calculation Equations: $CO\text{-}DRY = CO_{CO_2\text{-free AVG}} (1-B'_{CO_2}/(100 * DF))$; $CO\text{-}WET = CO\text{-}DRY (1-B'_{H_2O}/100)$

S-305RR

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Acetone Blank

Date of Analysis 5-11-97

Technician B.D.

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 4 µg/cc

1

interpoll

Job HIBBING TACONITE Date 5-7-82
City/State _____ Log # 4855-01
Source INDURATING LINE #2
Test Site STACK
Sample type PW Tech RR
Remarks: ANALYZE FOR PB & BE Test/Run 1/0
1 of 1

Special Handling Required _____

Evaporating Dish No. 60

Volume of acetone 100 (1) cc

E. Dish Tare Wt. 94.9006 (2) g

E. Dish + Sample Wt. 94.9010 (3) g

Comments _____

2

interpoll

Job _____ Date _____
City/State _____ Log# _____
Source _____
Test Site _____
Sample type _____ Tech _____
Remarks: Test/Run _____
_____ of _____

Special Handling Required _____

Evaporating Dish No. _____

Volume of acetone _____ (1) cc

E. Dish Tare Wt. _____ (2) g

E. Dish + Sample Wt. _____ (3) g

Comments _____

3

interpoll

Job _____ Date _____
City/State _____ Log# _____
Source _____
Test Site _____
Sample type _____ Tech _____
Remarks: Test/Run _____
_____ of _____

Special Handling Required _____

Evaporating Dish No. _____

Volume of acetone _____ (1) cc

E. Dish Tare Wt. _____ (2) g

E. Dish + Sample Wt. _____ (3) g

Comments _____

RESULTS:

1 _____ G-4 2 _____ 3 _____

LSC-01Y

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Filter Blank

Date of Analysis _____

Technician _____

---

(1)

interpoll

Job Hibbing Taconite — Date _____
City/State _____ — Log# _____
Source Induring Line #2
Test Site Stack #1, 2, 3, 4
Sample type Filter — Tech RR
Remarks: Blank — Test/Run 1/0
_____ of _____

Special Handling Required _____

Filter No. 8076
Filter Type _____
Filter Tare Wt. .8973 g
Filter + Sample Wt. .8995 g
(2)
Comments _____

---

(2)

interpoll

Job _____ — Date _____
City/State _____ — Log# _____
Source _____
Test Site _____
Sample type _____ — Tech _____
Remarks: — Test/Run _____
_____ of _____

Special Handling Required _____

Filter No. _____
Filter Type _____
Filter Tare Wt. _____ g
(1)
Filter + Sample Wt. _____ g
(2)
Comments _____

---

(3)

interpoll

Job _____ — Date _____
City/State _____ — Log# _____
Source _____
Test Site _____
Sample type _____ — Tech _____
Remarks: — Test/Run _____
_____ of _____

Special Handling Required _____

Filter No. _____
Filter Type _____
Filter Tare Wt. _____ g
(1)
Filter + Sample Wt. _____ g
(2)
Comments _____

RESULTS:

1	2	3
0.0002		

LSC-02P

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Date of Analysis 5-11-87
Technician B.D

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 4 µg/cc

(1)

interpoll

Job HIBBING TACONITE Date 5-5-87
City/State _____ Log # 4955-03
Source INDURATING LINE #2
Test Site STACK #4
Sample type PW Tech RR
Remarks: ANALYZE FOR Pb & Be Test/Run 1/1
1 of 1

Special Handling Required _____
Evaporating Dish No. 31
Volume of acetone 110 cc
E. Dish Tare Wt. 102.2403 g
E. Dish + Sample Wt. 102.2600 g (2, 3)
Comments _____

(2)

interpoll

Job HIBBING TACONITE CO Date 5-5-87
City/State HIBBING MN Log # 4955-08
Source INDURATING LINE 2
Test Site STACK 4
Sample type PW Tech _____
Remarks: ANALYZE FOR Pb & Be Test/Run 1/2
_____ of _____

Special Handling Required _____
Evaporating Dish No. 55
Volume of acetone 70 cc
E. Dish Tare Wt. 90.5405 g
E. Dish + Sample Wt. 90.5600 g (2, 3)
Comments _____

(3)

interpoll

Job HIBBING TACONITE Date 5-2-87
City/State _____ Log # 4955-13
Source INDURATING LINE #2
Test Site STACK #4
Sample type PW Tech RR
Remarks: ANALYZE FOR Pb & Be Test/Run 1/3
1 of 1

Special Handling Required _____
Evaporating Dish No. 48
Volume of acetone 110 cc
E. Dish Tare Wt. 91.8810 g
E. Dish + Sample Wt. 91.9041 g (2, 3)
Comments _____

RESULTS:

1/ 0.0193 G-6 2/ 0.0192 3/ 0.0227

LSC-01Y

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Date of Analysis_____

Technician_____

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(1)

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log# 4855-04
Source Indurating Line #2
Test Site Stack #4
Sample type Filter Tech RR
Remarks: Test/Run 1/1
1 of 1

Special Handling Required_____

Filter No. 8075
Filter Type_____
Filter Tare Wt. .9977 g
Filter + Sample Wt. .9078 g
Comments_____

---

(2)

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log# 4855-09
Source Indurating Line #2
Test Site Stack #4
Sample type Filter Tech RR
Remarks: Test/Run 1/2
1 of 1

Special Handling Required_____

Filter No. 8078
Filter Type_____
Filter Tare Wt. .9152 g
Filter + Sample Wt. .9253 g
Comments_____

---

(3)

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log# 4855-14
Source Indurating Line #2
Test Site _____
Sample type Filter Tech RR
Remarks: Test/Run 1/3
1 of 1

Special Handling Required_____

Filter No. 8077
Filter Type_____
Filter Tare Wt. .9064 g
Filter + Sample Wt. .9149 g
Comments_____

RESULTS:

1	2	3
0.0101	0.0101	0.0085
0.0294	0.0293	0.0312

LSC-02P

Job Name: Hibbing Taconite
Test/Run: 1/1
Log No.: 4855-05

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (563.1 Samp.+ Bottle) - (295.0 Bottle) = 268.1 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State Log # 4855-05
Source Induration Line #2
Test Site Stack #4
Sample type Tech
Remarks: Test/Run 1/1
of

Step 2 Orig. sample brought to volume (V_{soln}):

☐ 100 cc
☐ 250 cc
☐ 500 cc
268.1 ☐ [illegible] cc

Step 3 Dilution procedure:

☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ ___ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	0.00 cc	0.00 cc	___ cc	
Final volume of buret	16.80 cc	16.80 cc	___ cc	
Volume of titrant for aliquot (V_s)	16.80 cc	16.80 cc	___ cc	16.80 cc

Job Name: Hibbing Taconite
Test/Run: 1/2
Log No.: 4855-10

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (563.5 Samp.+ Bottle) - (295.5 Bottle) = 268.0 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4855-10
Source Induration Line #2
Test Site Stack #4
Sample type _____ Tech _____
Remarks: Test/Run 1/2
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):

- ☐ 100 cc
- ☐ 250 cc
- ☐ 500 cc
- ☒ 268.0 cc

Step 3 Dilution procedure:

- ☒ No dilution (DF = 1)
- ☐ 10 → 100 (DF = 10)
- ☐ 10 → 250 (DF = 25)
- ☐ 5 → 250 (DF = 50)
- ☐ 1 → 250 (DF = 250)
- ☐ __ → __ (DF = __)

Step 4 Volume taken for titration (V_a):

- ☐ 1 cc
- ☒ 5 cc
- ☐ 10 cc
- ☐ 25 cc
- ☐ __ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	0.00 cc	0.00 cc	____ cc	
• Final volume of buret	17.10 cc	17.10 cc	____ cc	
Volume of titrant for aliquot (V_s)	17.10 cc	17.10 cc	____ cc	17.10 cc

6-9

Job Name: Hibbing Taconite
Test/Run: 1/3
Log No.: 4855-15

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (562.4 Samp.+ Bottle) - (295.2 Bottle) = 267.2 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4855-15
Source Induration Line #2
Test Site Stack #4
Sample type _____ Tech _____
Remarks: Test/Run 1/3
_____ of _____

Step 2 Orig. sample brought to volume (V_{soln}):

☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 267.2 cc

Step 3 Dilution procedure:

☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	23.00 cc	23.00 cc	_____ cc	
Final volume of buret	40.50 cc	40.50 cc	_____ cc	
Volume of titrant for aliquot (V_s)	17.50 cc	17.50 cc	_____ cc	17.50 cc

G-10

INTERPOLL INC.
(612)786-6020

EPA METHOD 10 ANALYSIS DATA SHEET

Job Name Hibbing Taconite 2
Source Indurating Line 2 stack 4
Date of NDIR Analysis 5-11-87

NDIR Model ACS Model 3300 0-500/1000 PPM
NDIR Flow Rate 1000 cc/min
Technician J Burns

SAMPLE NAME	SAMPLE LOG NO.	CARBON DIOXIDE % v/v ($B'CO_2$)	MOISTURE CONTENT % v/v ($B'H_2O$)	CARBON MONODIXE CONCENTRATION (PPM)							
				BASIS						DRY BASIS	WET BASIS
				Trial 1		Trial 2		AVG			
				DF	PPM	DF	PPM	DF	PPM		
1/1				1	39	1	39	1	39		
1/2				1	31	1	31	1	31		
1/3				1	40	1	40	1	40		

DF = dilution factor

ZERO GAS: 99.998 % N_2

CAL GAS(ES): 892.9 PPM CO IN NITROGEN SOURCE: Scott Specialty Gases

Note 1: The carbon monoxide concentrations in the dry gas sample are determined after CO_2 removal (Ascarite column) using a nondispersive infrared analyzer. Orsat analysis is performed to determine CO_2 concentration. Field moisture content data is used to convert to a wet basis.

Note 2: The analyzer must be zeroed and spanned immediately before and after analysis. Additional Zero and span values may be made between analyses if required. Record all zero and span values after initial calibration is complete.

Note 3: Calculation Equations: $CO\text{-}DRY = CO_{CO_2\text{-free AVG}} (1-B'_{CO_2}/(100 * DF))$; $CO\text{-}WET = CO\text{-}DRY (1-B'_{H_2O}/100)$

4856

Interpoll Inc.
(612)786-6020

Pg ___ of ___

Chain of Custody
Sample Deposition Sheet

Job HIBBING TACONITE
Site INDURATING LINE #2 STACK #3
Team Leader RON ROSENTHAL
Priority
Date Submitted 5-8-87
Received by
Test No(s). 2
Number of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Date Analyzed	Other Information or Special Instructions
3	Probe Wash Solvent(s):	☒ As per EPA 5 ☒ LEAD & BERYLLIUM		
3	Filter: ☒ 4" glass fiber ☐ Stainless steel ☐ ERC	☒ As per EPA 5 ☒ LEAD & Be		
3	~~Wet Catch~~ LEAD NHO_3	☐ Organic ☐ Inorganic ☒ Other M-12 LEAD		
3	Orsat	CO, CO_2, O_2		
3	SO_2	LEAD & Be		
	SO_2 Audit Sample			EPA Control No(s).
12	NO_x (Open box tops after unloading)	☐ Colorimetric ☐ Ion Chromatographic		Date 5/8/87 & Time 1230 of arrival at Interpoll
	NO_x Audit Sample			EPA Control No(s).
	Fuel Sample			

Source Information

1) Type of source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☒ Other INDURATING LINE
2) Fuel: ☐ Coal ☐ Wood ☐ Gas ☐ Oil ☒ Other PET COKE
3) Is sample combustible? ☒ No ☐ Yes
4) Does sample need special desiccating? ☒ No ☐ Yes If yes, explain ___
5) Is particle size analysis required ☒ No ☐ Yes If yes, how many run(s)? ___
run preference ___

S-278RRRR

EPA METHOD 3

LABORATORY REPORT

SUMMARY OF ORSAT DATA

Job: Hibbing Taconite
Sampling Location: Line #2 Stack #3
Sampling Date:
Analysis Date: 5-11-87
Technician: Smith

TEST NO. AND DATE	RUN NO.	RESULTS						
		INTEGRATED (BAG)			GRAB (BULB)			O_2 ANALYZER
		% CO_2	% O_2	% CO	% CO_2	% O_2	% CO	% O_2
4856-05 5-11-87 2	1	0.90	19.30					
4856-10 5-11-87 2	2	0.90	19.30					
4856-15 5-11-87 2	3	0.90	19.30					

Interpoll Inc.
(612)786-6020

EPA Method 3 Data Sheet (Orsat Analysis)

Technician Grant
Orsat Analyzer No. #3
Job Nibbing Taconite
City/State _____ Fuel Type _____

Date of Analysis 5-11-87
Leak Check Performed ☒ YES ☐ NO
Source Line #2
Test Site Stack #3

Sample Identification	Test/Run	Analysis No.	Buret Readings (cc)			Concentration (% v/v,dry)		F_o
			Zero Point	After CO_2	After O_2	CO_2	O_2	
Ambient Air						0.00	20.90	
4856-05 F/~~B~~	2/1	1	0.00	0.90	20.20	0.90	19.30	
		2	0.00	0.90	20.20	0.90	19.30	
		3						
		AVG				0.90	19.30	
-10 F/~~B~~	2/2	1	0.00	0.90	20.20	0.90	19.30	
		2	0.00	0.90	20.20	0.90	19.30	
		3						
		AVG				0.90	19.30	
-15 F/~~B~~	2/3	1	0.00	0.90	20.20	0.90	19.30	
		2	0.00	0.90	20.20	0.90	19.30	
		3						
		AVG				0.90	19.30	

F = Flask (250 cc all-glass); B = Tedlar bag (5-layer)

Note 1 Analyses performed as per CFR title 40, Part 60, Appendix A, Method 3; KOH for CO_2 and reduced methylene blue for O_2 absorption using a Burrell Orsat Analyzer with a 100 cc buret.

Note 2 Use PC-3 Program "ORSAT" Version 6-85.

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Date of Analysis 5-11-87
Technician B.D.

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 4 µg/cc

(1)

interpoll

Job Hibbing Taconite Co Date 5687
City/State Hibbing MN Log # 4856-06
Source Induarting Line 2
Test Site Stack #3
Sample type PW Tech RR
Remarks: Analyze for Pb & Be Test/Run 2/1
1 of 1

Special Handling Required
Evaporating Dish No. 18
Volume of acetone 90 cc
E. Dish Tare Wt. 96.7885 g
E. Dish + Sample Wt. 96.8034 g
Comments

(2)

interpoll

Job Hibbing Taconite Date 5687
City/State Hibbing MN Log # 4856-11
Source Induarting Line 2
Test Site Stack #3
Sample type PW Tech RR
Remarks: Analyze for Pb & Be Test/Run 2-2
1 of 1

Special Handling Required
Evaporating Dish No. 35
Volume of acetone 70 cc
E. Dish Tare Wt. 95.9541 g
E. Dish + Sample Wt. 95.9692 g
Comments

(3)

interpoll

Job Hibbing Taconite Date 5-6-87
City/State Log # 4856-16
Source Induarting Line #2
Test Site Stack #3
Sample type PW Tech RR
Remarks: Analyze for Pb & Be Test/Run 2/3
1 of 1

Special Handling Required
Evaporating Dish No. 54
Volume of acetone 80 cc
E. Dish Tare Wt. 93.2613 g
E. Dish + Sample Wt. 93.2819 g
Comments

RESULTS:

1	2	3
0.0145	0.0148	0.0203

LSC-01Y

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Date of Analysis _____

Technician _____

---

(1)

interpoll

Job Hibbing Taconite — Date 5-6-87
City/State _____ — Log# 4856-07
Source Indurating Line #2
Test Site Stack #3
Sample type Filter — Tech RR
Remarks: — Test/Run 2/1
1 of 1

Special Handling Required _____

Filter No. 8086
Filter Type _____
Filter Tare Wt. .9077 g
Filter + Sample Wt. .9200[1][2] g
Comments _____

---

(2)

interpoll

Job Hibbing Taconite — Date 5-6-87
City/State _____ — Log# 4856-12
Source Indurating Line #2
Test Site Stack #3
Sample type Filter — Tech RR
Remarks: — Test/Run 2/2
1 of 1

Special Handling Required _____

Filter No. 8087
Filter Type _____
Filter Tare Wt. .9018 g
Filter + Sample Wt. .9136[1][2] g
Comments _____

---

(3)

interpoll

Job Hibbing Taconite — Date 5-6-87
City/State _____ — Log# 4856-12
Source Indurating Line #2
Test Site Stack #3
Sample type Filter — Tech RR
Remarks: — Test/Run 2/3
1 of 1

Special Handling Required _____

Filter No. 8088
Filter Type _____
Filter Tare Wt. .9015 g
Filter + Sample Wt. .9162[1][2] g
Comments _____

RESULTS:

1	2	3
0.0123	0.0118	0.0147
0.0268	0.0266	0.0350

LSC-02P

Job Name: Hibbing Taconite
Test/Run: 2/2
Log No.: 4856-08

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (552.6 Samp.+ Bottle) - (295.5 Bottle) = 257.1 cc

pH of original sample _____ Ion exchanged: ☐ Yes ☐ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4856-08
Source Induration Line #2
Test Site Stack # 3
Sample type _____ Tech _____
Remarks: Test/Run 2/1
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):
☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 257.1 cc

Step 3 Dilution procedure:
☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):
☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	20.00 cc	35.00 cc	_____ cc	
• Final volume of buret	34.85 cc	49.85 cc	_____ cc	
Volume of titrant for aliquot (V_s)	14.85 cc	14.85 cc	_____ cc	14.85 cc

ISC-06

Job Name: Hibbing Taconite
Test/Run: 2/3
Log No.: 4856-13

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (555.8 Samp.+ Bottle) - (295.2 Bottle) = 260.6 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4856-13
Source Induration Line #2
Test Site Stack #3
Sample type _____ Tech _____
Remarks: Test/Run 2/2
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):

☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 260.6 cc

Step 3 Dilution procedure:

☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	20.00 cc	26.70 cc	_____ cc	
• Final volume of buret	26.70 cc	33.40 cc	_____ cc	
Volume of titrant for aliquot (V_s)	6.70 cc	6.70 cc	_____ cc	6.70 cc

G-18

ISC 06

Job Name: Hibbing Taconite
Test/Run: 2/4
Log No.: 4856-18

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician AmM

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (554.1 Samp.+ Bottle) - (295.4 Bottle) = 258.7 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4856-18
Source Indurating Line #2
Test Site Stack #3
Sample type _____ Tech _____
Remarks: Test/Run 2/3
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):

- ☐ 100 cc
- ☐ 250 cc
- ☐ 500 cc
- ☒ ~~258.7~~ cc

Step 3 Dilution procedure:

- ☒ No dilution (DF = 1)
- ☐ 10 → 100 (DF = 10)
- ☐ 10 → 250 (DF = 25)
- ☐ 5 → 250 (DF = 50)
- ☐ 1 → 250 (DF = 250)
- ☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

- ☐ 1 cc
- ☒ 5 cc
- ☐ 10 cc
- ☐ 25 cc
- ☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00913 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	20.00 cc	35.00 cc	____ cc	
• Final volume of buret	34.90 cc	49.90 cc	____ cc	
Volume of titrant for aliquot (V_s)	14.90 cc	14.90 cc	____ cc	14.90 cc

G-19

INTERPOLL INC.
(612)786-6020

EPA METHOD 10 ANALYSIS DATA SHEET

Job Name HIBBING TACONITE CO
Source INCLINATING LINE #2 STACK #3
Date of NDIR Analysis 5-12-87

NDIR Model ACS Model 3300 0-500/1000 PPM
NDIR Flow Rate 1000 cc/min
Technician E. TROWBRIDGE

SAMPLE NAME	SAMPLE LOG NO.	CARBON DIOXIDE % v/v ($B'CO_2$)	MOISTURE CONTENT % v/v ($B'H_2O$)	CARBON MONODIXE CONCENTRATION (PPM) BASIS						DRY BASIS	WET BASIS
				Trial 1		Trial 2		AVG			
				DF	PPM	DF	PPM	DF	PPM		
T2 R1				1	40	1	40	1	40		
2				1	42	1	42	1	42		
3				1	40	1	40	1	40		

DF = dilution factor

ZERO GAS: 99.998 % N_2
CAL GAS(ES): 852.9 PPM CO IN NITROGEN SOURCE: Scott Specialty Gases

Note 1: The carbon monoxide concentrations in the dry gas sample are determined after CO_2 removal (Ascarite column) using a nondispersive infrared analyzer. Orsat analysis is performed to determine CO_2 concentration. Field moisture content data is used to convert to a wet basis.
Note 2: The analyzer must be zeroed and spanned immediately before and after analysis. Additional Zero and span values may be made between analyses if required. Record all zero and span values after initial calibration is complete.
Note 3: Calculation Equations: $CO\text{-}DRY = CO_{CO_2\text{-free AVG}} (1-B'_{CO_2}/(100 * DF))$; $CO\text{-}WET = CO\text{-}DRY (1-B'_{H_2O}/100)$

S-305RR

4857

Interpoll Inc.
(612)786-6020

Pg ___ of ___

Chain of Custody
Sample Deposition Sheet

Job Hibbing Taconite Co. Site Incinerating Line #2 / Stack #2
Team Leader Ron Rosenthal Priority ___
Date Submitted 5-8-87 Received by ___
Test No(s). 3 Number of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Date Analyzed	Other Information or Special Instructions
3	Probe Wash Solvent(s):	☒ As per EPA 5 ☒ Lead & Be		
3	Filter: ☒ 4" glass fiber ☐ Stainless steel ☐ ERC	☒ As per EPA 5 ☒ Lead & Be		
3	~~Wet Catch~~ Lead HNO_3	☐ Organic ☐ Inorganic ☒ Other M-12 Lead		
3	Orsat	CO, CO_2, O_2		
3	SO_2	Lead & Be		
	SO_2 Audit Sample			EPA Control No(s).
12	NO_x (Open box tops after unloading)	☐ Colorimetric ☐ Ion Chromatographic		Date 5/18/87 & Time 1230 of arrival at Interpoll
	NO_x Audit Sample			EPA Control No(s).
	Fuel Sample			

Source Information

1) Type of source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☒ Other Incinerating Line #2
2) Fuel: ☐ Coal ☐ Wood ☐ Gas ☐ Oil ☒ Other Pet Coke
3) Is sample combustible? ☒ No ☐ Yes
4) Does sample need special desiccating? ☒ No ☐ Yes If yes, explain ___
5) Is particle size analysis required ☒ No ☐ Yes If yes, how many run(s)? ___
run preference ___

S-278RRRR

EPA METHOD 3

LABORATORY REPORT

SUMMARY OF ORSAT DATA

Job: Hibbing Taconite
Sampling Location: Indurating Line # 2 Stack # 2
Sampling Date:
Analysis Date: 5-7-87
Technician: RCV

TEST NO. AND DATE	RUN NO.	RESULTS						
		INTEGRATED (BAG)			GRAB (BULB)			O_2 ANALYZER
		% CO_2	% O_2	% CO	% CO_2	% O_2	% CO	% O_2
5-7-87 3	1	0.40	20.20					
5-7-87 3	2	0.40	20.20					
5-7-87 3	3	0.40	20.20					

Interpoll Inc.
(612)786-6020

EPA Method 3 Data Sheet (Orsat Analysis)

Technician RCU
Orsat Analyzer No. 3
Job Hibbing Taconite
City/State _____ Fuel Type _____
Bag Box #5

Date of Analysis 5-7-87
Leak Check Performed ☑ YES ☐ NO
Source Indurating Line #2
Test Site Stack #2

Sample Identification		Test/Run	Analysis No.	Buret Readings (cc)			Concentration (% v/v,dry)		F_o
				Zero Point	After CO_2	After O_2	CO_2	O_2	
Ambient Air				0.00	0.00	20.90	0.00	20.90	
4857-05	F / B ✓	3/1	1	0.00	0.40	20.60	0.40	20.20	
			2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.20	
4857-10	F / B ✓	3/2	1	0.00	0.40	20.60	0.40	20.20	
			2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.20	
4857-15	F / B ✓	3/3	1	0.00	0.40	20.60	0.40	20.20	
			2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.20	

F = Flask (250 cc all-glass); B = Tedlar bag (5-layer)

Note 1 Analyses performed as per CFR title 40, Part 60, Appendix A, Method 3; KOH for CO_2 and reduced methylene blue for O_2 absorption using a Burrell Orsat Analyzer with a 100 cc buret.

Note 2 Use PC-3 Program "ORSAT" Version 6-85.

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Date of Analysis 5-11-87
Technician B.D.

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 4 µg/cc

(1) interpoll

Job HIBBING TACONITE Date 5-7-87
City/State _____ Log # 4857-01
Source INDURATING LINE #2
Test Site STACK #2
Sample type PW Tech RR
Remarks: ANALYZE FOR Test/Run 3/1
Pb & Be 1 of 1

Special Handling Required _____

Evaporating Dish No. 4
Volume of acetone 90 cc
E. Dish Tare Wt. 105.6899 g
E. Dish + Sample Wt. 105.7161 g
Comments _____

(2) interpoll

Job HIBBING TACONITE Date 5-7-87
City/State _____ Log # 4857-06
Source INDURATING LINE #2
Test Site STACK #2
Sample PW Tech RR
Remark ANALYZE FOR Test/Run 3/2
Pb & Be 1 of 1

Special Handling Required _____

Evaporating Dish No. 39
Volume of acetone 85 cc
E. Dish Tare Wt. 87.9173 g
E. Dish + Sample Wt. 87.9314 g
Comments _____

(3) interpoll

Job HIBBING TACONITE Date 5-7-87
City/State _____ Log # 4857-11
Source INDURATING LINE #2
Test Site STACK #2
Sample type PW Tech RR
Remarks: ANALYZE FOR Test/Run 3/3
Pb & Be 1 of 1

Special Handling Required _____

Evaporating Dish No. 58
Volume of acetone 100 cc
E. Dish Tare Wt. 92.2576 g
E. Dish + Sample Wt. 92.2746 g
Comments _____

RESULTS:

1 / 0.0198 G-24 2 / 0.0138 3 / 0.0166

LSC-01Y

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Date of Analysis_____

Technician_____

---

(1)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log# 4857-07
Source Indurating line #2
Test Site Stack #2
Sample type Filter Tech RR
Remarks: Test/Run 3/1
1 of 1

Special Handling Required_____

Filter No. 8089
Filter Type_____
Filter Tare Wt. .8967 g
Filter + Sample Wt. .9084 g
Comments_____

---

(2)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log# 4857-07
Source Indurating line #2
Test Site Stack #2
Sample type Filter Tech RR
Remarks: Test/Run 3/2
1 of 1

Special Handling Required_____

Filter No. 8092
Filter Type_____
Filter Tare Wt. .9106 g
Filter + Sample Wt. .9261 g
Comments_____

---

(3)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log#_____
Source Indurating line #2
Test Site Stack #2
Sample type Filter Tech RR
Remarks: Test/Run 3/3
1 of 1

Special Handling Required_____

Filter No. 8093
Filter Type_____
Filter Tare Wt. .9048 g
Filter + Sample Wt. .9186 g
Comments_____

RESULTS:

1	2	3
0.0117	0.0155	0.0138
0.0315	0.0293	0.0304

LSC-02P

Job Name: Hibbing Taconite
Test/Run: 3/1
Log No.: 4857-03

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician GMH

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (544.0 Samp.+ Bottle) - (295.3 Bottle) = 248.7 cc

pH of original sample 1.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State Log # 4857-03
Source Induration Line #2
Test Site Stack # 2
Sample type Tech
Remarks: Test/Run 3/1
of

Step 2 Orig. sample brought to volume (V_{soln}):

- ☐ 100 cc
- ☐ 250 cc
- ☐ 500 cc
- ☒ 248.7 cc

Step 3 Dilution procedure:

- ☒ No dilution (DF = 1)
- ☐ 10 → 100 (DF = 10)
- ☐ 10 → 250 (DF = 25)
- ☐ 5 → 250 (DF = 50)
- ☐ 1 → 250 (DF = 250)
- ☐ ___ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

- ☐ 1 cc
- ☒ 5 cc
- ☐ 10 cc
- ☐ 25 cc
- ☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	19.60 cc	30.00 cc	___ cc	
Final volume of buret	28.40 cc	39.40 cc	___ cc	
Volume of titrant for aliquot (V_s)	9.40 cc	9.40 cc	___ cc	9.40 cc

Job Name: Hibbing Taconite
Test/Run: 3/2
Log No.: 4857-08

Interpoll Inc.
(612)786-6020
EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician BmM

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (533.4 Samp.+ Bottle) - (294.7 Bottle) = 238.7 cc

pH of original sample | Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State Log # 4857-08
Source Induration Line #2
Test Site Stack #2
Sample type Tech
Remarks: Test/Run 3/2
of

Step 2 Orig. sample brought to volume (V_{soln}):

☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 238.7 cc

Step 3 Dilution procedure:

☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ __ → __ (DF = __)

Step 4 Volume taken for titration (V_a):

☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ __ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	20.00 cc	29.50 cc	____ cc	
• Final volume of buret	29.50 cc	39.00 cc	____ cc	
Volume of titrant for aliquot (V_s)	9.50 cc	9.50 cc	____ cc	9.50 cc

G-27

ISC-06

Job Name: Hibbing Taconite
Test/Run: 3/3
Log No.: 4857-13

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (538.0 Samp.+ Bottle) - (295.4 Bottle) = 242.6 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4857-13
Source Induration Line #2
Test Site Stack #2
Sample type _____ Tech _____
Remarks: Test/Run 3/3
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):
☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 242.6 cc

Step 3 Dilution procedure:
☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ ___ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):
☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) .02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	20.00 cc	20.00 cc	____ cc	
• Final volume of buret	28.85 cc	28.85 cc	____ cc	
Volume of titrant for aliquot (V_s)	8.85 cc	8.85 cc	____ cc	8.85 cc

G-28

ISC-06

INTERPOLL INC.
(612)786-6020

EPA METHOD 10 ANALYSIS DATA SHEET

Job Name Hibbing Taconite
Source Indurating line #2 stack #2
Date of NDIR Analysis 5-11-87

NDIR Model ACS model 3300 0-500/1000 PPM
NDIR Flow Rate 1000 cc/min
Technician J Burash

SAMPLE NAME	SAMPLE LOG NO.	CARBON DIOXIDE % v/v ($B'CO_2$)	MOISTURE CONTENT % v/v ($B'H_2O$)	CARBON MONODIXE CONCENTRATION (PPM)							
				BASIS						DRY BASIS	WET BASIS
				Trial 1		Trial 2		AVG			
				DF	PPM	DF	PPM	DF	PPM		
3/1				1	13	1	13	1	13		
3/2				1	14	1	14	1	14		
3/3				1	12	1	12	1	12		

DF = dilution factor

ZERO GAS: 99.998 % N_2

CAL GAS(ES): 992.9 PPM CO IN NITROGEN SOURCE: Scott specialty gases

Note 1: The carbon monoxide concentrations in the dry gas sample are determined after CO_2 removal (Ascarite column) using a nondispersive infrared analyzer. Orsat analysis is performed to determine CO_2 concentration. Field moisture content data is used to convert to a wet basis.

Note 2: The analyzer must be zeroed and spanned immediately before and after analysis. Additional Zero and span values may be made between analyses if required. Record all zero and span values after initial calibration is complete.

Note 3: Calculation Equations: $CO\text{-}DRY = CO_{CO_2\text{-free AVG}} (1-B'_{CO_2}/(100 * DF))$; $CO\text{-}WET = CO\text{-}DRY (1-B'_{H_2O}/100)$

S-305RR

4858

Interpoll Inc.
(612)786-6020

Pg ___ of ___

Chain of Custody
Sample Deposition Sheet

Job Hibbing Taconite Co. Site Induration Line #2 Stack #1
Team Leader Ron Rosenthal Priority ___
Date Submitted ___ Received by ___
Test No(s). 4 Number of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Date Analyzed	Other Information or Special Instructions
3	Probe Wash Solvent(s):	☒ As per EPA 5 ☒ Lead & Be		
3	Filter: ☒ 4" glass fiber ☐ Stainless steel ☐ ERC	☒ As per EPA 5 ☒ Lead & Be		
3	~~Wet Catch~~ Lead & HNO_3	☐ Organic ☐ Inorganic ☒ Other Pb Method-12		
3	Orsat	CO, CO_2, O_2		
3	SO_2	Analyze for Pb & Be		
	SO_2 Audit Sample			EPA Control No(s).
12	NO_x (Open box tops after unloading)	☐ Colorimetric ☐ Ion Chromatographic		Date 5/6/87 & Time 1230 of arrival at Interpoll
	NO_x Audit Sample			EPA Control No(s).
	Fuel Sample			

Source Information

1) Type of source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☒ Other Induration Line #2 Stack #1
2) Fuel: ☐ Coal ☐ Wood ☐ Gas ☐ Oil ☒ Other Pet Coke
3) Is sample combustible? ☒ No ☐ Yes
4) Does sample need special desiccating? ☒ No ☐ Yes If yes, explain ___
5) Is particle size analysis required ☒ No ☐ Yes If yes, how many run(s)? ___
run preference ___

S-278RRRR

EPA METHOD 3

LABORATORY REPORT

SUMMARY OF ORSAT DATA

Job: Hibbing Taconite
Sampling Location: Line #2 Stack #1
Sampling Date:
Analysis Date: 5/11/87
Technician: JMM

TEST NO. AND DATE	RUN NO.	RESULTS						
		INTEGRATED (BAG)			GRAB (BULB)			O_2 ANALYZER
		% CO_2	% O_2	% CO	% CO_2	% O_2	% CO	% O_2
4858-05 5-11-87 4	1	0.40	20.20					
4858-10 5-11-87 4	2	0.40	20.20					
4858-15 5-11-87 4	3	0.40	20.20					

Interpoll Inc.
(612)786-6020

EPA Method 3 Data Sheet (Orsat Analysis)

Technician [illegible]

Orsat Analyzer No. #3

Job Hibbing Taconite

City/State _____ Fuel Type _____

Date of Analysis 5-11-87

Leak Check Performed ☒ YES ☐ NO

Source Line #2

Test Site Stack #1

Sample Identification		Test/Run	Analysis No.	Buret Readings (cc) Zero Point	After CO_2	After O_2	Concentration (% v/v,dry) CO_2	O_2	F_o
Ambient Air							0.00	20.90	
4858-05	F ~~B~~	4/1	1	0.00	0.40	20.60	0.40	20.20	
			2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.20	
-10	F ~~B~~	4/2	1	0.00	0.40	20.60	0.40	20.20	
			2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.20	
-15	F ~~B~~	4/3	1	0.00	0.40	20.60	0.40	20.20	
			2	0.00	0.40	20.60	0.40	20.20	
			3						
			AVG				0.40	20.20	

F = Flask (250 cc all-glass); B = Tedlar bag (5-layer)

Note 1 Analyses performed as per CFR title 40, Part 60, Appendix A, Method 3; KOH for CO_2 and reduced methylene blue for O_2 absorption using a Burrell Orsat Analyzer with a 100 cc buret.

Note 2 Use PC-3 Program "ORSAT" Version 6-85.

LSC-04B

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Date of Analysis_____

Technician_____

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 4 µg/cc

(1)

interpoll

Job HIBBING TACONITE Date 5-7-87
City/State _____ Log # 4858-01
Source INDURATING LINE #2
Test Site STACK #1
Sample type PW Tech RR
Remarks: ANALYZE FOR Test/Run 4/1
Pb & Be 1 of 1

Special Handling Required_____

Evaporating Dish No. 15
Volume of acetone 60 cc
E. Dish Tare Wt. 97.5777 g
E. Dish + Sample Wt. 97.5932 g
Comments_____

(2)

interpoll

Job HIBBING TACONITE Date 5-7-87
City/State _____ Log # 4858-06
Source INDURATING LINE #2
Test Site STACK #1
Sample type PW Tech RR
Remarks: ANALYZE FOR Test/Run 4/2
Pb & Be 1 of 1

Special Handling Required_____

Evaporating Dish No. 20
Volume of acetone 90 cc
E. Dish Tare Wt. 100.9717 g
E. Dish + Sample Wt. 100.9846 g
Comments_____

(3)

interpoll

Job HIBBING TACONITE Date 5-7-87
City/State _____ Log # 4858-11
Source INDURATING LINE #2
Test Site STACK #1
Sample type PW Tech RR
Remarks: ANALYZE FOR Test/Run 4/3
Pb & Be 1 of 1

Special Handling Required_____

Evaporating Dish No. 33
Volume of acetone 80 cc
E. Dish Tare Wt. 102.8500 g
E. Dish + Sample Wt. 102.8590 g
Comments_____

RESULTS:

1 / 0.0153 G-33 2 / 0.0125 3 / 0.0087

LSC-01Y

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Date of Analysis_____

Technician_____

---

(1)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log# 4858-02
Source Indurating Line # 2
Test Site Stack #1
Sample type Filter Tech RR
Remarks: Test/Run 4/1
1 of 1

Special Handling Required_____

Filter No. 8094
Filter Type_____
Filter Tare Wt. .9100 g
Filter + Sample Wt. .9234 g
Comments_____

---

(2)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log# 4858-07
Source Indurating Line # 2
Test Site Stack #1
Sample type Filter Tech RR
Remarks: Test/Run 4/2
1 of 1

Special Handling Required_____

Filter No. 8095
Filter Type_____
Filter Tare Wt. .9099 g
Filter + Sample Wt. .9239 g
Comments_____

---

(3)

interpoll

Job Hibbing Taconite Date 5-7-87
City/State _____ Log# 4858-12
Source Indurating Line # 2
Test Site _____
Sample type _____ Tech _____
Remarks: Test/Run 4/3
_____ of _____

Special Handling Required_____

Filter No. 8120
Filter Type_____
Filter Tare Wt. .9184 g
Filter + Sample Wt. .9353 g
Comments_____

RESULTS:

1	2	3
0.0134	0.0160	0.0169
0.0287	0.0285	0.0256

LSC-02P

Job Name: Hibbing Taconite
Test/Run: 4/1
Log No.: 4858-04

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (311.9 Samp.+ Bottle) - (65.2 Bottle) = 246.7 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4858-04
Source Indurating Line #2
Test Site Stack # 1
Sample type _____ Tech _____
Remarks: Test/Run 4/1
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):
☐ 100 cc
☐ 250 cc
☐ 500 cc
☒ 246.7 cc

Step 3 Dilution procedure:
☒ No dilution (DF = 1)
☐ 10 → 100 (DF = 10)
☐ 10 → 250 (DF = 25)
☐ 5 → 250 (DF = 50)
☐ 1 → 250 (DF = 250)
☐ ___ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):
☐ 1 cc
☒ 5 cc
☐ 10 cc
☐ 25 cc
☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	20.00 cc	28.00 cc	____ cc	
• Final volume of buret	27.10 cc	35.10 cc	____ cc	
Volume of titrant for aliquot (V_s)	7.10 cc	7.10 cc	____ cc	7.10 cc

ISC 06

Job Name: Hibbing Taconite
Test/Run: 4/2
Log No.: 4858-08

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician [illegible]

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (3063 Samp.+ Bottle) - (64.0 Bottle) = 242.3 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4858-08
Source Induration Line # 2
Test Site Stack # 1
Sample type _____ Tech _____
Remarks: Test/Run 4/2
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):

- ☐ 100 cc
- ☐ 250 cc
- ☐ 500 cc
- ☒ 242.3 cc

Step 3 Dilution procedure:

- ☒ No dilution (DF = 1)
- ☐ 10 → 100 (DF = 10)
- ☐ 10 → 250 (DF = 25)
- ☐ 5 → 250 (DF = 50)
- ☐ 1 → 250 (DF = 250)
- ☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

- ☐ 1 cc
- ☒ 5 cc
- ☐ 10 cc
- ☐ 25 cc
- ☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) 0.02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	10.00 cc	10.00 cc	____ cc	
• Final volume of buret	16.80 cc	16.80 cc	____ cc	
Volume of titrant for aliquot (V_s)	6.80 cc	6.80 cc	____ cc	6.80 cc

Job Name: Hibbing Taconite
Test/Run: 4/3
Log No.: 4858-13

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 5-11-87
Technician Amr

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (318.8 Samp.+ Bottle) - (64.5 Bottle) = 254.3 cc

pH of original sample 3.0 Ion exchanged: ☐ Yes ☒ No

Note 1: If pH >3.5 adjust with conc. perchloric acid to pH ~2.0

Note 2: If ion exchange is required, must use a 10 cc aliquot and wash this through with a 10 cc aliquot of distilled water. Add 80 cc of isopropyl alcohol and titrate.

SAMPLE IDENTIFICATION

interpoll

Job Hibbing Taconite Date 5-5-87
City/State _____ Log # 4858-13
Source Indurating Line #2
Test Site Stack #1
Sample type _____ Tech _____
Remarks: Test/Run 4/3
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):

- ☐ 100 cc
- ☐ 250 cc
- ☐ 500 cc
- ☒ 254.3 cc

Step 3 Dilution procedure:

- ☒ No dilution (DF = 1)
- ☐ 10 → 100 (DF = 10)
- ☐ 10 → 250 (DF = 25)
- ☐ 5 → 250 (DF = 50)
- ☐ 1 → 250 (DF = 250)
- ☐ __ → ___ (DF = ___)

Step 4 Volume taken for titration (V_a):

- ☐ 1 cc
- ☒ 5 cc
- ☐ 10 cc
- ☐ 25 cc
- ☐ ___ cc

Step 5 TITRATION: Normality of titrant (N) 0.00993 Volume of titrant for blank (V_b) .002

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	20.00 cc	20.00 cc	____ cc	
• Final volume of buret	26.45 cc	26.45 cc	____ cc	
Volume of titrant for aliquot (V_s)	6.45 cc	6.45 cc	____ cc	6.45 cc

INTERPOLL INC.
(612)786-6020

EPA METHOD 10 ANALYSIS DATA SHEET

Job Name HIBBING TACONITE CO
Source INDURATING LINE #2 STACK #1
Date of NDIR Analysis 5-12-87

NDIR Model ACS Model 3300 0-500/1000 PPM
NDIR Flow Rate 1000 cc/min
Technician E TROWBRIDGE

SAMPLE NAME	SAMPLE LOG NO.	CARBON DIOXIDE % v/v ($B'CO_2$)	MOISTURE CONTENT % v/v ($B'H_2O$)	CARBON MONODIXE CONCENTRATION (PPM)							
				[illegible] BASIS						DRY BASIS	WET BASIS
				Trial 1		Trial 2		AVG			
				DF	PPM	DF	PPM	DF	PPM		
T4 R1				1	19	1	19	1	19		
R2				1	13	1	13	1	13		
R3				1	15	1	15	1	15		

DF = dilution factor

ZERO GAS: 99.998 % N_2

CAL GAS(ES): 892.9 PPM CO IN NITROGEN SOURCE: SCOTT SPECIALTY GASES

Note 1: The carbon monoxide concentrations in the dry gas sample are determined after CO_2 removal (Ascarite column) using a nondispersive infrared analyzer. Orsat analysis is performed to determine CO_2 concentration. Field moisture content data is used to convert to a wet basis.

Note 2: The analyzer must be zeroed and spanned immediately before and after analysis. Additional Zero and span values may be made between analyses if required. Record all zero and span values after initial calibration is complete.

Note 3: Calculation Equations: $CO\text{-}DRY = CO_{CO_2\text{-free AVG}} (1-B'_{CO_2}/(100 * DF))$; $CO\text{-}WET = CO\text{-}DRY (1-B'_{H_2O}/100)$

S-305RR

APPENDIX H

METHOD 7 LABORATORY DATA SHEETS

Stack #4

Interpoll Inc.
(612)786-6020

EPA Method 7 Recovery and Analysis Data Sheet (1)

**********SOURCE**********	**********RECOVERY**********	**********ANALYTICAL**********
Job HIBBING TACONITE Co.	Date of Recovery 5- -87	Date of Analysis 5-11,12-87
Source INDURATING LINE #1 & #2	Recovered by R. ROSENTHAL C. MOSSER	Analyst GM
STACK #4 Date of Sampling 5- -87	Recovery volume 100 ml	Eluent 0.0021 M $NaHCO_3$ 0.0017 M Na_2CO_3
Test No(s) 1	Barometric at time 28.50 IN.HG.	Chromatograph: Dionex System 10

Samples collected in accordance with EPA Method 7, CFR Title 40, Part 60, Appendix A. Samples analyzed in accordance with EPA Method 7A by ion chromatography. Mercury manometers used to measure flask pressures/vacuums in sampling and in recovery. Thommen Model TX 19 jewel barometer calibrated against laboratory mercury in glass barometer used to measure field barometric pressure. Three field blanks are prepared and the average used to correct measured nitrate concentrations. All samples are analyzed as a batch using an IBM Instruments Inc. Model LC/9540 Chromatograph Data Integrator. The integrator is programmed to give the actual concentration of the 500 ml recovered sample even if a subsequent dilution was made. The dilution is indicated here as well as on the chromatogram.

H-1

$$C_{RS} = DF(C_{DS}) \qquad M_{NO_3^-} = (C_{RS} - \bar{C}_B)V_R \qquad \bar{C}_B = (C_{B1} + C_{B2} + C_{B3})/3$$

where:

C_{RS} = concentration of nitrate in 500 ml recovered sample in ug/ml

DF = dilution factor

C_{DS} = concentration of nitrate of a 500 ml recovered sample which has been diluted by a factor of DF to bring it into the proper range for the ion chromatograph. This value is an intermediate number and is not outputted by the electronic integrator which is programmed to output the concentration of the original undiluted 500 ml recovered sample.

$M_{NO_3^-}$ = total mass of nitrate in micrograms in the 500 ml recovered sample and/or in the 2L flask.

$\bar{C}_B$ = average conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

C_{B1}, C_{B2}, C_{B3} = conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

V_R = recovery volume for samples and field blanks in ml

Stack #4

Interpoll Inc.
(612)786-6020

EPA Method 7 Recovery and Analysis Data Sheet (2)

	Sample Log ID No.	Flask No.	Test/ Run	Final Flask Conditions t_f (°F)	+	-	ΔP_g (IN.HG.)	Chrom Run No.	DF	Nitrate Concentration (ug/ml) Uncorr. for blank C_{RS}	Corr. for blank ($C_{RS} - \bar{C}_B$)	Total nitrate in Sample (ug) ($M_{NO_3^-}$)
1	4851-23	1	1-1-A	72	✓		.75	124	1	0.937	0.937	468.5
2	-24	2	1-1-B		✓		1.00	125	1	0.879	0.879	439.5
3	-25	3	1-1-C		✓		1.45	126	1	0.937	0.937	468.5
4	-26	4	1-1-D		✓		1.05	127	1	0.940	0.940	470.0
5	-27	5	1-2-A		✓		.95	128	1	0.837	0.837	418.5
6	-28	6	1-2-B		✓		1.00	129	1	0.818	0.818	409.0
7	-29	7	1-2-C		✓		.80	130	1	0.798	0.798	399.0
8	-30	8	1-2-D		✓		.40	131	1	0.860	0.860	430.0
9	-31	9	1-3-A		✓		1.10	132	1	0.794	0.794	397.0
10	-32	10	1-3-B			✓	.15	133	1	0.743	0.743	371.5
11	-33	11	1-3-C		✓		.15	136	1	0.691	0.691	345.5
12	-34	12	1-3-D		✓		.85	137	1	0.631	0.631	315.5
13	4855-18	13	1-1-A		✓		1.65	138	1	0.331	0.331	165.5
14	-19	14	1-1-B		✓		1.50	139	1	0.339	0.339	169.5
15	-20	15	1-1-C		✓		.80	140	1	0.379	0.379	189.5
16	-21	16	1-1-D		✓		.30	141	1	0.343	0.343	171.5
17	-22	17	1-2-A		✓		.50	142	1	0.320	0.320	160.0
18	-23	18	1-2-B		✓		.45	143	1	0.288	0.288	144.0
19	-24	19	1-2-C		✓		.60	145	1	0.312	0.312	156.0
20	-25	20	1-2-D		✓		.10	148	1	0.338	0.338	169.0
21	-26	21	1-3-A		✓		.20	149	1	0.346	0.346	173.0
22	-27	22	1-3-B		✓		.05	150	1	0.334	0.334	167.0
23	-28	23	1-3-C		✓		.50	151	1	0.322	0.322	161.0
24	-29	24	1-3-D	↓	✓		.10	152	1	0.369	0.369	184.5
25												
26												
27												
Blank 1									1	CB1		
Blank 2									1	CB2		
Blank 3									1	CB3		

LINE #1

H-2

LINE #2

$\bar{C}_B$ = _____

S-340(2) R-9/85

Interpoll Inc.
(612)786-6020

EPA Method 7 Recovery and Analysis Data Sheet (1)

**********SOURCE**********	**********RECOVERY**********	**********ANALYTICAL**********
Job HIBBING TACONITE CO.	Date of Recovery 5-8-87	Date of Analysis 5-11,12-87
STACK #3 Source INDURATING LINE #1 + #2	Recovered by GWH	Analyst GWH
Date of Sampling	Recovery volume 500 ml	Eluent 0.0021 M $NaHCO_3$ 0.0017 M Na_2CO_3
Test No(s) 2	Barometric at time 29.095 IN.HG.	Chromatograph: Dionex System 10

Samples collected in accordance with EPA Method 7, CFR Title 40, Part 60, Appendix A. Samples analyzed in accordance with EPA Method 7A by ion chromatography. Mercury manometers used to measure flask pressures/vacuums in sampling and in recovery. Thommen Model TX 19 jewel barometer calibrated against laboratory mercury in glass barometer used to measure field barometric pressure. Three field blanks are prepared and the average used to correct measured nitrate concentrations. All samples are analyzed as a batch using an IBM Instruments Inc. Model LC/9540 Chromatograph Data Integrator. The integrator is programmed to give the actual concentration of the 500 ml recovered sample even if a subsequent dilution was made. The dilution is indicated here as well as on the chromatogram.

H-3

$$C_{RS} = DF(C_{DS}) \qquad M_{NO_3^-} = (C_{RS} - \bar{C}_B)V_R \qquad \bar{C}_B = (C_{B1} + C_{B2} + C_{B3})/3$$

where:

C_{RS} = concentration of nitrate in 500 ml recovered sample in ug/ml

DF = dilution factor

C_{DS} = concentration of nitrate of a 500 ml recovered sample which has been diluted by a factor of DF to bring it into the proper range for the ion chromatograph. This value is an intermediate number and is not outputted by the electronic integrator which is programmed to output the concentration of the original undiluted 500 ml recovered sample.

$M_{NO_3^-}$ = total mass of nitrate in micrograms in the 500 ml recovered sample and/or in the 2L flask.

$\bar{C}_B$ = average conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

C_{B1}, C_{B2}, C_{B3} = conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

V_R = recovery volume for samples and field blanks in ml

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(612)786-6020

EPA Method 7 Recovery and Analysis Data Sheet (2)

	Sample Log ID No.	Flask No.	Test/ Run	Final Flask Conditions t_f (°F)	+	-	Δ Pg (IN.HG.)	Chrom Run No.	DF	Nitrate Concentration (ug/ml) Uncorr. for blank C_{RS}	Corr. for blank ($C_{RS} - \bar{C}_B$)	Total nitrate in Sample (ug) ($M_{NO_3^-}$)
1	4852-16	37	2-1-A	71°		✓	0.20	183	1	0.727	0.727	363.5
2	-17	38	2-1-B			✓	0.40	184	1	0.697	0.697	348.5
3	-18	39	2-1-C			✓	0.45	186	1	0.701	0.701	350.5
4	-19	40	2-1-D			✓	0.60	187	1	0.743	0.743	371.5
5	-20	41	2-2-A			✓	0.40	188	1	0.711	0.711	355.5
6	-21	42	2-2-B			✓	0.60	190	1	0.763	0.763	381.5
7	-22	43	2-2-C			✓	1.1	191	1	0.728	0.728	364.0
8	-23	44	2-2-D			✓	1.0	192	1	0.723	0.723	361.5
9	-24	45	2-3-A			✓	0.40	193	1	0.775	0.775	387.5
10	-25	46	2-3-B			✓	0.40	194	1	0.674	0.674	337.0
11	-26	47	2-3-C			✓	0.30	195	1	0.337	0.337	168.5
12	-27	48	2-3-D	✓		✓	0.30	196	1	0.353	0.353	176.5
13	4852-21	25	2-1-A	71°		✓	1.10	168	1	0.251	0.251	125.5
14	-22	26	2-1-B			✓	0.60	190	1	0.249	0.249	124.5
15	-23	27	2-1-C			✓	0.40	171	1	0.264	0.264	132.0
16	-24	28	2-1-D			✓	0.40	172	1	0.292	0.292	146.0
17	-25	29	2-2-A			✓	2.20	173	1	0.315	0.315	157.5
18	-26	30	2-2-B			✓	2.30	174	1	0.313	0.313	156.5
19	-27	31	2-2-C			✓	2.1	175	1	0.299	0.299	149.5
20	-28	32	2-2-D			✓	2.1	177	1	0.184	0.184	92.0
21	-29	33	2-3-A			✓	1.6	178	1	0.338	0.338	169.0
22	-30	34	2-3-B			✓	1.6	180	1	0.349	0.349	174.5
23	-31	35	2-3-C			✓	1.5	181	1	0.347	0.347	173.5
24	-32	36	2-3-D	↓		✓	1.5	182	1	0.311	0.311	155.5
25												
26												
27												
Blank 1									1	CB1		
Blank 2									1	CB2		$\bar{C}_B$ = ____
Blank 3									1	CB3		

LINE #1

H-4

LINE #2

S-340(2) R-9/85

Interpoll Inc.
(612)786-6020

EPA Method 7 Recovery and Analysis Data Sheet (1)

**********SOURCE**********	**********RECOVERY**********	**********ANALYTICAL**********
Job HIBBING TACONITE CO.	Date of Recovery 5-8-87	Date of Analysis 5-11,12-87
STACK #2 Source INDURATING LINE #1 + #2	Recovered by GWH	Analyst JAM, GWH
Date of Sampling	Recovery volume 500 ml	Eluent 0.0021 M $NaHCO_3$ 0.0017 M Na_2CO_3
Test No(s) 3	Barometric at time 29.095 IN.HG.	Chromatograph: Dionex System 10

Samples collected in accordance with EPA Method 7, CFR Title 40, Part 60, Appendix A. Samples analyzed in accordance with EPA Method 7A by ion chromatography. Mercury manometers used to measure flask pressures/vacuums in sampling and in recovery. Thommen Model TX 19 jewel barometer calibrated against laboratory mercury in glass barometer used to measure field barometric pressure. Three field blanks are prepared and the average used to correct measured nitrate concentrations. All samples are analyzed as a batch using an IBM Instruments Inc. Model LC/9540 Chromatograph Data Integrator. The integrator is programmed to give the actual concentration of the 500 ml recovered sample even if a subsequent dilution was made. The dilution is indicated here as well as on the chromatogram.

H-5

$$C_{RS} = DF(C_{DS}) \qquad M_{NO_3^-} = (C_{RS} - \overline{C}_B)V_R \qquad \overline{C}_B = (C_{B1} + C_{B2} + C_{B3})/3$$

where:

C_{RS} = concentration of nitrate in 500 ml recovered sample in ug/ml

DF = dilution factor

C_{DS} = concentration of nitrate of a 500 ml recovered sample which has been diluted by a factor of DF to bring it into the proper range for the ion chromatograph. This value is an intermediate number and is not outputted by the electronic integrator which is programmed to output the concentration of the original undiluted 500 ml recovered sample.

$M_{NO_3^-}$ = total mass of nitrate in micrograms in the 500 ml recovered sample and/or in the 2L flask.

$\overline{C}_B$ = average conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

C_{B1}, C_{B2}, C_{B3} = conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

V_R = recovery volume for samples and field blanks in ml

Interpoll Inc.
(612)786-6020

EPA Method 7 Recovery and Analysis Data Sheet (2)

	Sample Log ID No.	Flask No.	Test/ Run	Final Flask Conditions t_f (°F)	+	-	▲ Pg (IN.HG.)	Chrom Run No.	DF	Nitrate Concentration (ug/ml) Uncorr. for blank C_{RS}	Corr. for blank ($C_{RS} - C_B$)	Total nitrate in Sample (ug) ($M_{NO_3^-}$)
1	4853-16	61	3-1-A	71°		✓	0.55	226	1	0.523	0.523	261.5
2	-17	62	3-1-B			✓	0.45	227	1	0.447	0.447	223.5
3	-18	63	3-1-C			✓	0.40	229	1	0.499	0.499	249.5
4	-19	64	3-1-D			✓	0.40	230	1	0.499	0.499	249.5
5	-20	65	3-2-A			✓	0.20	231	1	0.473	0.473	236.5
6	-21	66	3-2-B			✓	0.25	232	1	0.487	0.487	243.5
7	-22	67	3-2-C			✓	1.00	233	1	0.541	0.541	270.5
8	-23	68	3-2-D			✓	0.95	234	1	0.512	0.512	256.0
9	-24	69	3-3-A			✓	0.65	235	1	0.489	0.489	244.5
10	-25	70	3-3-B			✓	0.60	237	1	0.515	0.515	257.5
11	-26	71	3-3-C			✓	0.60	238	1	0.498	0.498	249.0
12	-27	72	3-3-D			✓	0.50	240	1	0.530	0.530	265.0
13	4857-16	49	3-1-A			✓	0.30	197	1	0.253	0.253	126.5
14	-17	50	3-1-B			✓	0.30	198	1	0.224	0.224	112.0
15	-18	51	3-1-C			✓	0.10	199	1	0.262	0.262	131.0
16	-19	52	3-1-D			✓	0.20	202	1	0.229	0.229	114.5
17	-20	53	3-2-A			✓	0.40	203	1	0.338	0.338	169.0
18	-21	54	3-2-B			✓	0.40	204	1	0.355	0.355	177.5
19	-22	55	3-2-C			✓	0.70	219	1	0.216	0.216	108.0
20	-23	56	3-2-D			✓	0.85	220	1	0.241	0.241	120.5
21	-24	57	3-3-A			✓	0.10	221	1	0.331	0.331	165.5
22	-25	58	3-3-B			✓	2.20	222	1	0.288	0.288	144.0
23	-26	59	3-3-C			✓	2.30	223	1	0.219	0.219	109.5
24	-27	60	3-3-D	✓		✓	2.70	224	1	0.226	0.226	113.0
25												
26												
27												
Blank 1									1	CB1		
Blank 2									1	CB2		
Blank 3									1	CB3		

$\bar{C}_B$ = _____

S-340(2) R-9/85

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EPA Method 7 Recovery and Analysis Data Sheet (1)

**********SOURCE**********	**********RECOVERY**********	**********ANALYTICAL**********
Job HIBBING TACONITE Co	Date of Recovery 5-8-87	Date of Analysis 5-11,12-87
STACK #1 Source INDURATING LINE #1 + #2	Recovered by GWH	Analyst JMM GWH
Date of Sampling	Recovery volume 500 ml	Eluent 0.0021 M $NaHCO_3$ 0.0017 M Na_2CO_3
Test No(s) 4	Barometric at time 29.095 IN.HG.	Chromatograph: Dionex System 10

Samples collected in accordance with EPA Method 7, CFR Title 40, Part 60, Appendix A. Samples analyzed in accordance with EPA Method 7A by ion chromatography. Mercury manometers used to measure flask pressures/vacuums in sampling and in recovery. Thommen Model TX 19 jewel barometer calibrated against laboratory mercury in glass barometer used to measure field barometric pressure. Three field blanks are prepared and the average used to correct measured nitrate concentrations. All samples are analyzed as a batch using an IBM Instruments Inc. Model LC/9540 Chromatograph Data Integrator. The integrator is programmed to give the actual concentration of the 500 ml recovered sample even if a subsequent dilution was made. The dilution is indicated here as well as on the chromatogram.

H-7

$$C_{RS} = DF(C_{DS}) \qquad M_{NO_3^-} = (C_{RS} - \bar{C}_B)V_R \qquad \bar{C}_B = (C_{B1} + C_{B2} + C_{B3})/3$$

where:

C_{RS} = concentration of nitrate in 500 ml recovered sample in ug/ml

DF = dilution factor

C_{DS} = concentration of nitrate of a 500 ml recovered sample which has been diluted by a factor of DF to bring it into the proper range for the ion chromatograph. This value is an intermediate number and is not outputted by the electronic integrator which is programmed to output the concentration of the original undiluted 500 ml recovered sample.

$M_{NO_3^-}$ = total mass of nitrate in micrograms in the 500 ml recovered sample and/or in the 2L flask.

$\bar{C}_B$ = average conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

C_{B1}, C_{B2}, C_{B3} = conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

V_R = recovery volume for samples and field blanks in ml

Interpoll Inc.
(612)786-6020

EPA Method 7 Recovery and Analysis Data Sheet (2)

	Sample Log ID No.	Flask No.	Test/ Run	Final Flask Conditions t_f (°F)	+	-	ΔPg (IN.HG.)	Chrom Run No.	DF	Nitrate Concentration (ug/ml) Uncorr. for blank C_{RS}	Corr. for blank ($C_{RS} - C_B$)	Total nitrate in Sample (ug) ($M_{NO_3^-}$)
1	4854-16	1	4-1-A	71°		✓	0.75	153	1	0.434	0.434	217.0
2	-17	2	4-1-B			✓	0.70	154	1	0.467	0.467	233.5
3	-18	3	4-1-C			✓	0.80	155	1	0.431	0.431	215.5
4	-19	4	4-1-D			✓	0.80	156	1	0.452	0.452	226.0
5	-20	5	4-2-A			✓	0.70	159	1	0.480	0.480	240.0
6	-21	6	4-2-B			✓	0.50	160	1	0.453	0.453	226.5
7	-22	7	4-2-C			✓	0.90	162	1	0.464	0.464	232.0
8	-23	8	4-2-D			✓	0.65	163	1	0.483	0.483	241.5
9	-24	9	4-3-A			✓	0.60	164	1	0.526	0.526	263.0
10	-25	10	4-3-B			✓	0.70	165	1	0.454	0.454	227.0
11	-26	11	4-3-C			✓	0.70	166	1	0.442	0.442	221.0
12	-27	12	4-3-D			✓	0.60	167	1	0.428	0.428	214.0
13	4858-16	73	4-1-A			✓	2.15	213	1	0.134	0.134	67.0
14	-17	74	4-1-B			✓	2.30	214	1	0.3316	0.3316	1168.0
15	-18	75	4-1-C			✓	2.00	215	1	0.193	0.193	96.5
16	-19	76	4-1-D			✓	0.40	216	1	0.214	0.214	107.0
17	-20	77	4-2-A			✓	0.60	217	1	0.176	0.176	88.0
18	-21	78	4-2-B			✓	3.10	218	1	0.185	0.185	92.5
19	-22	79	4-2-C			✓	1.95	206	1	0.168	0.168	84.0
20	-23	80	4-2-D			✓	2.25	207	1	0.274	0.274	137.0
21	-24	81	4-3-A			✓	3.10	208	1	0.170	0.170	85.0
22	-25	82	4-3-B			✓	3.65	209	1	0.205	0.205	102.5
23	-26	83	4-3-C			✓	1.05	210	1	0.153	0.153	76.5
24	-27	84	4-3-D	↓		✓	2.70	211	1	0.153	0.153	76.5
25												
26												
27												
Blank 1									1	CB1		
Blank 2									1	CB2		
Blank 3									1	CB3		

C_B = _____

S-340(2) R-9/85

APPENDIX I

PROCESS RATE DATA

During the second compliance test there was an upset in the petroleum coke feed system which is indicated by the 49.2 percent replacement rate during the second of the three runs. The upset was noted near the end of the second run but apparently was effecting the petroleum coke feed prior to its being noted. Testing was delayed for over an hour while the problem was being diagnosed and remedied. The replacement rate of 76.5 percent for the third run was below that experienced during the other tests but is not something which would be considered an abnormal operating condition. These points should be considered when reporting on the results of the testwork.

During the test period May 5th through the 8th, the pressure drop across the venturi rod deck of the four wind box and hood exhaust scrubbers averaged 6 inches of water. They varied from a high of 6.1 to a low of 5.9 inches of water. These were intermittent visual onsite readings taken throughout the test period. There is no provision for continuous monitoring. The water addition to each of the scrubbers is orifice controlled to 1000 GPM.

Production Statistics Summary - Compliance Test No. 1, Stack No. 4

Date: May 5, 1987

	(0915-1020)	(1205-1312)	(1345-1450)
Line No. 1			
Green Ball Production (LTPH) -	453	447	432
Pellet Production (LTPH) -	374	371	359
Gas Heat Input (BTU/HR) -	95960769	92782209	90295615
Gas Heat Input (BTU/LT) -	255395	250306	251761
Line No. 2			
Green Ball Production (LTPH) -	459	463	462
Pellet Production (LTPH) -	381	384	384
Gas Heat Input (BTU/HR) -	7630615	8016000	9018000
Pet Coke Heat Input (BTU/HR) -	72714462	71453612	71749846
Total Heat Input (BTU/HR) -	80345077	79469612	80767846
Total Heat Input (BTU/LT) -	210790	206956	210419
Pet Coke Replacement (Percent) -	90.5	89.9	88.8

Production Statistics Summary - Compliance Test No. 2, Stack No. 3

Date: May 6, 1987

	(1446-1552)	(1625-1729)	(1847-1951)
Line No. 1			
Green Ball Production (LTPH) -	485	419	474
Pellet Production (LTPH) -	402	347	394
Gas Heat Input (BTU/HR) -	94221212	87245328	93482734
Gas Heat Input (BTU/LT) -	234280	251152	237428
Line No. 2			
Green Ball Production (LTPH) -	495	429	488
Pellet Production (LTPH) -	411	356	405
Gas Heat Input (BTU/HR) -	9178970	35042313	21031656
Pet Coke Heat Input (BTU/HR) -	76621818	33986250	68338250
Total Heat Input (BTU/HR) -	85800788	69028563	89369906
Total Heat Input (BTU/LT) -	208799	193990	220567
Pet Coke Replacement (Percent) -	89.3	49.2	76.5

Production Statistics Summary - Compliance Test No. 3, Stack No. 2

Date: May 7, 1987

	(0810-0913)	(0945-1048)	(1115-1218)
Line No. 1			
Green Ball Production (LTPH) -	427	474	445
Pellet Production (LTPH) -	354	394	369
Gas Heat Input (BTU/HR) -	87138000	99567692	91771718
Gas Heat Input (BTU/LT) -	245950	252836	248525
Line No. 2			
Green Ball Production (LTPH) -	430	483	447
Pellet Production (LTPH) -	357	401	371
Gas Heat Input (BTU/HR) -	8460000	8460000	7607974
Pet Coke Heat Input (BTU/HR) -	66706286	76347429	69018208
Total Heat Input (BTU/HR) -	75166286	84807429	76626182
Total Heat Input (BTU/LT) -	210469	211591	206697
Pet Coke Replacement (Percent) -	88.7	90.0	90.1

Production Statistics Summary - Compliance Test No. 4, Stack No. 1

Date: May 7, 1987

	(1257-1401)	(1445-1549)	(1621-1725)
Line No. 1			
Green Ball Production (LTPH) -	466	481	411
Pellet Production (LTPH) -	387	399	341
Gas Heat Input (BTU/HR) -	99408615	131195077	92242980
Gas Heat Input (BTU/LT) -	256846	328673	270720
Line No. 2			
Green Ball Production (LTPH) -	474	487	417
Pellet Production (LTPH) -	394	405	346
Gas Heat Input (BTU/HR) -	9110769	9110769	7218624
Pet Coke Heat Input (BTU/HR) -	74051282	72539077	62450808
Total Heat Input (BTU/HR) -	83162051	81649846	69669431
Total Heat Input (BTU/LT) -	211200	201839	201493
Pet Coke Replacement (Percent) -	89.0	88.8	89.6

APPENDIX J

LABORATORY RESULTS FOR LEAD AND BERYLLIUM ANALYSES

interpoll

INTERPOLL INC.
4500 BALL ROAD N.E.
CIRCLE PINES, MINNESOTA 55014
612/786-6020

Hibbing Taconite
P. O. Box 589
Hibbing, MN 55754

Attention: Bob Ives

LABORATORY REPORT: #4851 May 14, 1987

SAMPLES RECEIVED: May 8, 1987

Sample Identification:		T1R0 Line #1 Stack #4	T1R1 Line #1 Stack #4	T1R2 Line #1 Stack #4	T1R3 Line #1 Stack #4
Laboratory Log Number:		4851-01	4851-05	4851-10	4851-15
Parameter	Units				
Lead	Total ug	< 5	24	32	22
Beryllium	Total ug	< 0.005	0.077	0.070	0.170

Respectfully submitted,

Richard R. Dahl,
Director of Analytical Services

RRD/cg
< = less than

The mass of lead and beryllium reported are for the entire M-12 sampling train (particulate catch + 0.1 N HNO_3 catch).

interpoll

INTERPOLL INC.
4500 BALL ROAD N.E.
CIRCLE PINES, MINNESOTA 55014
612/786-6020

Hibbing Taconite
P. O. Box 589
Hibbing, MN 55754

Attention: Bob Ives

LABORATORY REPORT: #4852 May 14, 1987

SAMPLES RECEIVED: May 8, 1987

		T2R1 Line #1 Stack #3	T2R2 Line #1 Stack #3	T2R3 Line #1 Stack #3
Sample Identification:				
Laboratory Log Number:		4852-01	4852-06	4852-11
Parameter	Units			
Lead	Total ug	26	14	18
Beryllium	Total ug	0.064	0.040	0.078

Respectfully submitted,

Richard R. Dahl,
Director of Analytical Services

RRD/cg

The mass of lead and beryllium reported are for the entire M-12 sampling train (particulate catch + 0.1 N HNO_3 catch).

interpoll

INTERPOLL INC.
4500 BALL ROAD N.E.
CIRCLE PINES, MINNESOTA 55014
612/786-6020

Hibbing Taconite
P. O. Box 589
Hibbing, MN 55754

Attention: Bob Ives

LABORATORY REPORT: #4853 May 14, 1987

SAMPLES RECEIVED: May 8, 1987

Sample Identification:		T3R1 Line #1 Stack #2	T3R2 Line #1 Stack #2	T3R3 Line #1 Stack #2
Laboratory Log Number:		4853-01	4853-06	4853-11
Parameter	Units			
Lead	Total ug	14	15	14
Beryllium	Total ug	0.052	0.050	0.024

Respectfully submitted,

Richard R. Dahl,
Director of Analytical Services

RRD/cg

The mass of lead and beryllium reported are for the entire M-12 sampling train (particulate catch + 0.1 N HNO_3 catch).

interpoll

INTERPOLL INC.
4500 BALL ROAD N.E.
CIRCLE PINES, MINNESOTA 55014
612/786-6020

Hibbing Taconite
P. O. Box 589
Hibbing, MN 55754

Attention: Bob Ives

LABORATORY REPORT: #4854 May 14, 1987

SAMPLES RECEIVED: May 8, 1987

Sample Identification:		T4R1 Line #1 Stack #1	T4R2 Line #1 Stack #1	T4R3 Line #1 Stack #1
Laboratory Log Number:		4854-01	4854-06	4854-11
Parameter	Units			
Lead	Total ug	10	14	14
Beryllium	Total ug	0.034	< 0.005	0.027

Respectfully submitted,

Richard R. Dahl,
Director of Analytical Services

RRD/cg
< = less than

The mass of lead and beryllium reported are for the entire M-12 sampling train (particulate catch + 0.1 N HNO_3 catch).

interpoll

INTERPOLL INC.
4500 BALL ROAD N.E.
CIRCLE PINES, MINNESOTA 55014
612/786-6020

Hibbing Taconite
P. O. Box 589
Hibbing, MN 55754

Attention: Bob Ives

LABORATORY REPORT: #4855 May 14, 1987

SAMPLES RECEIVED: May 8, 1987

		T1R0	T1R1	T1R2	T1R3
		Line #2	Line #2	Line #2	Line #2
Sample Identification:		Stack #4	Stack #4	Stack #4	Stack #4
Laboratory Log Number:		4855-01	4855-03	4855-08	4855-13
Parameter	Units				
Lead	Total ug	< 5	78	24	17
Beryllium	Total ug	< 0.005	0.100	0.076	0.098

Respectfully submitted,

Richard R. Dahl,
Director of Analytical Services

RRD/cg
< = less than

The mass of lead and beryllium reported are for the entire M-12 sampling train (particulate catch + 0.1 N HNO_3 catch).

interpoll

INTERPOLL INC.
4500 BALL ROAD N.E.
CIRCLE PINES, MINNESOTA 55014
612/786-6020

Hibbing Taconite
P. O. Box 589
Hibbing, MN 55754

Attention: Bob Ives

LABORATORY REPORT: #4856 May 14, 1987

SAMPLES RECEIVED: May 8, 1987

		T2R1 Line #2 Stack #3	T2R2 Line #2 Stack #3	T2R3 Line #2 Stack #3
Sample Identification:				
Laboratory Log Number:		4856-06	4856-11	4856-16
Parameter	Units			
Lead	Total ug	10	14	22
Beryllium	Total ug	0.230	0.044	0.088

Respectfully submitted,

Richard R. Dahl,
Director of Analytical Services

RRD/cg

The mass of lead and beryllium reported are for the entire M-12 sampling train (particulate catch + 0.1 N HNO_3 catch).

interpoll

INTERPOLL INC.
4500 BALL ROAD N.E.
CIRCLE PINES, MINNESOTA 55014
612/786-6020

Hibbing Taconite
P. O. Box 589
Hibbing, MN 55754

Attention: Bob Ives

LABORATORY REPORT: #4857 May 14, 1987

SAMPLES RECEIVED: May 8, 1987

Sample Identification:		T3R1 Line #2 Stack #2	T3R2 Line #2 Stack #2	T3R3 Line #2 Stack #2
Laboratory Log Number:		4857-01	4857-06	4857-11
Parameter	Units			
Lead	Total ug	18	14	14
Beryllium	Total ug	0.092	< 0.005	0.039

Respectfully submitted,

Richard R. Dahl,
Director of Analytical Services

RRD/cg
< = less than

The mass of lead and beryllium reported are for the entire M-12 sampling train (particulate catch + 0.1 N HNO_3 catch).

interpoll

INTERPOLL INC.
4500 BALL ROAD N.E.
CIRCLE PINES, MINNESOTA 55014
612/786-6020

Hibbing Taconite
P. O. Box 589
Hibbing, MN 55754

Attention: Bob Ives

LABORATORY REPORT: #4858 May 14, 1987

SAMPLES RECEIVED: May 8, 1987

Sample Identification:		T4R1 Line #2 Stack #1	T4R2 Line #2 Stack #1	T4R3 Line #2 Stack #1
Laboratory Log Number:		4858-01	4858-06	4858-11
Parameter	Units			
Lead	Total ug	15	15	10
Beryllium	Total ug	0.080	0.053	0.033

Respectfully submitted,

Richard R. Dahl,
Director of Analytical Services

RRD/cg

The mass of lead and beryllium reported are for the entire M-12 sampling train (particulate catch + 0.1 N HNO_3 catch).

APPENDIX K

PROCEDURES

Particulate Loadings and Emission Rates

The particulate emission rates were determined per EPA Methods 1-5, CFR title 40, Part 60, Appendix A (revised July 1, 1986). In this procedure, a preliminary velocity profile of the gases in the flue is obtained by means of a temperature and velocity traverse. On the basis of these values, sampling nozzles of appropriate diameter are selected to allow isokinetic sampling, a necessary prerequisite for obtaining a representative sample.

The sampling train consists of a heated stainless steel-lined sampling probe equipped with a Type S pitot and a thermocouple. The probe is attached to a sampling module which houses the all-glass in line filter holder in a temperature controlled oven. In addition, the sampling module also houses the impinger case and a Drierite drying column. The sampling module is connected by means of an umbilical cord to the control module which houses the dry test gasmeter, the calibrated orifice, a leakless pump, two inclined manometers, and all controls required for operating the sampling train.

Particulate samples were collected as follows: The sample gas was drawn in through the sampling probe isokinetically and passed through a 4-inch diameter Gelman Type A/E glass fiber filter. The particulates were removed at this point and collected on the filter. The gases then passed through an ice-cooled impinger train and a desiccant-packed drying column which quantitatively absorb all moisture from the sample gas stream after which the sample gas passes through the pump and the dry test gasmeter which integrates the sample gas flow throughout the course of the test. A calibrated orifice attached to the outlet of the gasmeter provides instantaneous flow rate data.

A representative particulate sample was acquired by sampling for equal periods of time at the centroid of a number of equal area regions in the duct. The sampling rate is adjusted at each site such that an isokinetic sampling condition prevails. Nomographs are used to aid in the rapid determination of the sampling rate.

FILTERABLE PM

After sampling is complete, the filter is removed and placed in a clean container. The nozzle and inlet side of the filter holder are quantitatively washed with acetone and the washings are stored in a second container. A brush is often used in the cleaning step to help dislodge deposits. The samples are returned to the laboratory where they are logged in and analyzed. The volume of the acetone rinse ("probe wash") is noted and then the rinse is quantitatively transferred to a tared 120 cc porcelain evaporating dish and the acetone evaporated off at 97-105 °F. This temperature is used to prevent condensation of atmospheric moisture due to the cooling effect induced by the evaporation of acetone. The acetone-free sample is then transferred to an oven and dried at 105 °C for 30 minutes, cooled in a desiccator over Drierite, and then weighed to the nearest .01 mg. The filter sample is quantitatively transferred to a 6-inch watch glass and dried in an oven at 105 °C for two hours. The filter and watch glass are then cooled in a desiccator and the filter weighed to the nearest .01 mg. All weighings are performed in a balance room where the relative humidity is hydrostatted to less than 50% relative humidity. Microscopic examination of the samples is performed if any unusual characteristics are observed. The weight of the acetone rinse is corrected for the acetone blank. The Drierite column is weighed on-site and the water collected by Drierite is added to the condensate so that the total amount of absorbed water may be ascertained.

Integrated gas samples for Orsat analysis were collected at a constant flow rate throughout each particulate run. The gas samples were analyzed using al all-glass Orsat analyzer. Standard commercially prepared solutions were used in the Orsat analyzer (sat. KOH for carbon dioxide and reduced methylene blue for oxygen). In addition to the above, the oxygen content of the flue gas was measured at each traverse during the particulate determinations using a Teledyne Model 320P-4 Portable Oxygen Analyzer to sample the effluent from the Method 5 train.

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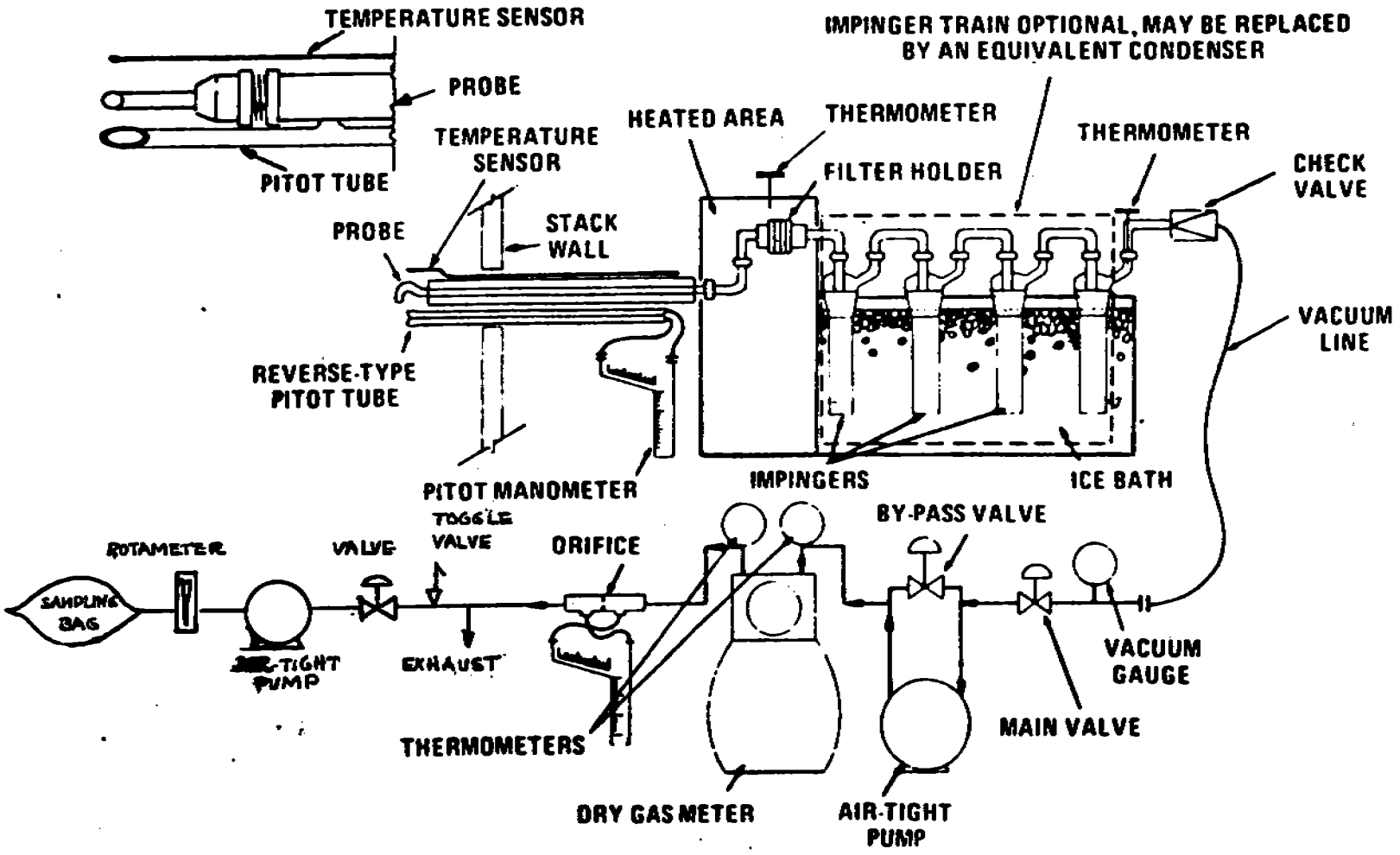

Particulate-sampling train.

Sulfur Dioxide Emissions

The sulfur dioxide concentrations were determined per Method 6, CFR Title 40, Part 60, Appendix A (Revised July 1, 1986). In the procedure employed, the back half of the Method 5 sampling train was used to collect SO_2 samples during the particulate determinations. Each of the first two impingers was filled with 100 cc of freshly prepared 3% hydrogen peroxide. The samples were quantitatively recovered in the field and returned to the laboratory for sulfate analysis by a barium-thorin titration method.

METHOD 10—DETERMINATION OF CARBON MONOXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and Applicability.*

1.1 *Principle.* An integrated or continuous gas sample is extracted from a sampling point and analyzed for carbon monoxide (CO) content using a Luft-type nondispersive infrared analyzer (NDIR) or equivalent.

1.2 *Applicability.* This method is applicable for the determination of carbon monoxide emissions from stationary sources only when specified by the test procedures for determining compliance with new source performance standards. The test procedure will indicate whether a continuous or an integrated sample is to be used.

2. *Range and sensitivity.*

2.1 Range. 0 to 1,000 ppm.

2.2 Sensitivity. Minimum detectable concentration is 20 ppm for a 0 to 1,000 ppm span.

3. *Interferences.*

Any substance having a strong absorption of infrared energy will interfere to some extent. For example, discrimination ratios for water (H_2O) and carbon dioxide (CO_2) are 3.5 percent H_2O per 7 ppm CO and 10 percent CO_2 per 10 ppm CO, respectively, for devices measuring in the 1,500 to 3,000 ppm range. For devices measuring in the 0 to 100 ppm range, interference ratios can be as high as 3.5 percent H_2O per 25 ppm CO and 10 percent CO_2 per 50 ppm CO. The use of silica gel and ascarite traps will alleviate the major interference problems. The measured gas volume must be corrected if these traps are used.

4. *Precision and accuracy.*

4.1 Precision. The precision of most NDIR analyzers is approximately ±2 percent of span.

4.2 Accuracy. The accuracy of most NDIR analyzers is approximately ±5 percent of span after calibration.

5. *Apparatus.*

5.1 Continuous sample (Figure 10-1).

5.1.1 Probe. Stainless steel or sheathed Pyrex[1] glass, equipped with a filter to remove particulate matter.

5.1.2 Air-cooled condenser or equivalent. To remove any excess moisture.

5.2 Integrated sample (Figure 10-2).

5.2.1 Probe. Stainless steel or sheathed Pyrex glass, equipped with a filter to remove particulate matter.

5.2.2 Air-cooled condenser or equivalent. To remove any excess moisture.

5.2.3 Valve. Needle valve, or equivalent, to to adjust flow rate.

5.2.4 Pump. Leak-free diaphragm type, or equivalent, to transport gas.

5.2.5 Rate meter. Rotameter, or equivalent, to measure a flow range from 0 to 1.0 liter per min. (0.035 cfm).

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

5.2.6 Flexible bag. Tedlar, or equivalent, with a capacity of 60 to 90 liters (2 to 3 ft^3). Leak-test the bag in the laboratory before using by evacuating bag with a pump followed by a dry gas meter. When evacuation is complete, there should be no flow through the meter.

5.2.7 Pitot tube. Type S, or equivalent, attached to the probe so that the sampling rate can be regulated proportional to the stack gas velocity when velocity is varying with the time or a sample traverse is conducted.

5.3 Analysis (Figure 10-3).

5.3.1 Carbon monoxide analyzer. Nondispersive infrared spectrometer, or equivalent. This instrument should be demonstrated, preferably by the manufacturer, to meet or exceed manufacturer's specifications and those described in this method.

5.3.2 Drying tube. To contain approximately 200 g of silica gel.

5.3.3 Calibration gas. Refer to paragraph 6.1.

5.3.4 Filter. As recommended by NDIR manufacturer.

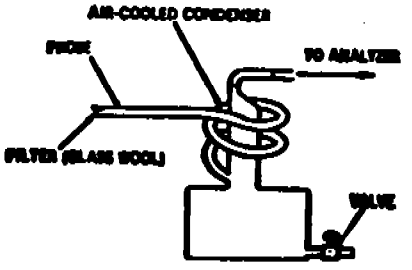

Figure 10-1. Continuous sampling train.

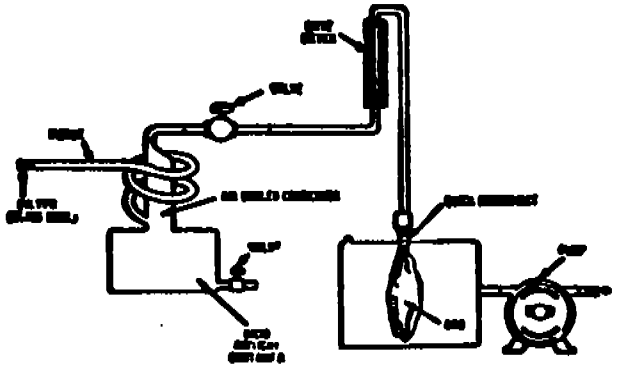

Figure 10-2. Integrated gas-sampling train.

5.3.5 CO_2 removal tube. To contain approximately 500 g of ascarite.

5.3.6 Ice water bath. For ascarite and silica gel tubes.

5.3.7 Valve. Needle valve, or equivalent, to adjust flow rate

5.3.8 Rate meter. Rotameter or equivalent to measure gas flow rate of 0 to 1.0 liter per min. (0.035 cfm) through NDIR.

5.3.9 Recorder (*optional*). *To provide permanent record of NDIR readings.*

6. *Reagents.*

6.1 Calibration gases. Known concentration of CO in nitrogen (N_2) for instrument span, prepurified grade of N_2 for zero, and two additional concentrations corresponding approximately to 60 percent and 30 percent span. The span concentration shall not exceed 1.5 times the applicable source performance standard. The calibration gases shall be certified by the manufacturer to be within ±2 percent of the specified concentration.

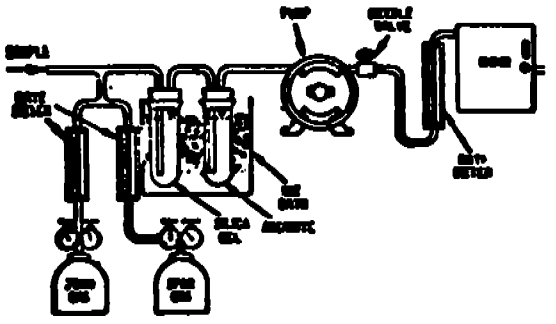

Figure 10-3. Analytical equipment.

6.2 Silica gel. Indicating type, 6 to 16 mesh, dried at 175° C (347° F) for 2 hours.

6.3 Ascarite. Commercially available.

7. *Procedure.*

7.1 Sampling.

7.1.1 Continuous sampling. Set up the equipment as shown in Figure 10-1 making sure all connections are leak free. Place the probe in the stack at a sampling point and purge the sampling line. Connect the analyzer and begin drawing sample into the analyzer. Allow 5 minutes for the system to stabilize, then record the analyzer reading as required by the test procedure. (See ¶ 7.2 and 8). CO_2 content of the gas may be determined by using the Method 3 integrated sample procedure (36 FR 24886), or by weighing the ascarite CO_2 removal tube and computing CO_2 concentration from the gas volume sampled and the weight gain of the tube.

7.1.2 Integrated sampling. Evacuate the flexible bag. Set up the equipment as shown in Figure 10-2 with the bag disconnected. Place the probe in the stack and purge the

sampling line. Connect the bag, making sure that all connections are leak free. Sample at a rate proportional to the stack velocity. CO_2 content of the gas may be determined by using the Method 3 integrated sample procedures (36 FR 24886), or by weighing the ascarite CO_2 removal tube and computing CO_2 concentration from the gas volume sampled and the weight gain of the tube.

7.2 CO Analysis. Assemble the apparatus as shown in Figure 10-3, calibrate the instrument, and perform other required operations as described in paragraph 8. Purge analyzer with N_2 prior to introduction of each sample. Direct the sample stream through the instrument for the test period, recording the readings. Check the zero and span again after the test to assure that any drift or malfunction is detected. Record the sample data on Table 10-1.

8. *Calibration.*

Assemble the apparatus according to Figure 10-3. Generally an instrument requires a warm-up period before stability is obtained. Follow the manufacturer's instructions for specific procedure. Allow a minimum time of 1 hour for warm-up. During this time check the sample conditioning apparatus, i.e., filter, condenser, drying tube, and CO_2 removal tube, to ensure that each component is in good operating condition. Zero and calibrate the instrument according to the manufacturer's procedures using, respectively, nitrogen and the calibration gases.

TABLE 10-1—FIELD DATA

	Comments
Location	
Test	
Date	
Operator	

Clock time	Rotameter setting, liters per minute (cubic feet per minute)

9. *Calculation.*

Concentration of carbon monoxide. Calculate the concentration of carbon monoxide in the stack using equation 10-1.

$$C_{CO\ stack} = C_{CO\ NDIR}(1 - F_{CO_2})$$

where:

$C_{CO\ stack}$ = concentration of CO in stack, ppm by volume (dry basis).

$C_{CO\ NDIR}$ = concentration of CO measured by NDIR analyzer, ppm by volume (dry basis).

F_{CO_2} = volume fraction of CO_2 in sample, i.e., percent CO_2 from Orsat analysis divided by 100.

10. *Bibliography.*

10.1 McElroy, Frank, The Intertech NDIR-CO Analyzer, Presented at 11th Methods Conference on Air Pollution, University of California, Berkeley, Calif., April 1, 1970.

10.2 Jacobs, M. B., et al., Continuous Determination of Carbon Monoxide and Hydrocarbons in Air by a Modified Infrared Analyzer, J. Air Pollution Control Association, 9(2): 110-114, August 1959.

10.3 MSA LIRA Infrared Gas and Liquid Analyzer Instruction Book, Mine Safety Appliances Co., Technical Products Division, Pittsburgh, Pa.

10.4 Models 215A, 315A, and 415A Infrared Analyzers, Beckman Instruments, Inc., Beckman Instructions 1635-B, Fullerton, Calif., October 1967.

10.5 Continuous CO Monitoring System, Model A5611, Intertech Corp., Princeton, N.J.

10.6 UNOR Infrared Gas Analyzers, Bendix Corp., Ronceverte, West Virginia.

ADDENDA—A. PERFORMANCE SPECIFICATIONS FOR NDIR CARBON MONOXIDE ANALYZERS.

Range (minimum)	0-1000 ppm.
Output (minimum)	0-10mV.
Minimum detectable sensitivity.	20 ppm.
Rise time, 90 percent (maximum).	30 seconds.
Fall time, 90 percent (maximum).	30 seconds.
Zero drift (maximum)	10% in 8 hours.
Span drift (maximum)	10% in 8 hours.
Precision (minimum)	±2% of full scale.
Noise (maximum)	±1% of full scale.
Linearity (maximum deviation)	2% of full scale.
Interference rejection ratio	CO_2—1000 to 1, H_2O—500 to 1.

B. *Definitions of Performance Specifications.*

Range—The minimum and maximum measurement limits.

Output—Electrical signal which is proportional to the measurement; intended for connection to readout or data processing devices. Usually expressed as millivolts or milliamps full scale at a given impedance.

Full scale—The maximum measuring limit for a given range.

Minimum detectable sensitivity—The smallest amount of input concentration that can be detected as the concentration approaches zero.

Accuracy—The degree of agreement between a measured value and the true value; usually expressed as ± percent of full scale.

Time to 90 percent response—The time interval from a step change in the input concentration at the instrument inlet to a reading of 90 percent of the ultimate recorded concentration.

Rise Time (90 percent)—The interval between initial response time and time to 90 percent response after a step increase in the inlet concentration.

Fall Time (90 percent)—The interval between initial response time and time to 90 percent response after a step decrease in the inlet concentration.

Zero Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is zero; usually expressed as percent full scale.

Span Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is a stated upscale value; usually expressed as percent full scale.

Precision—The degree of agreement between repeated measurements of the same concentration, expressed as the average deviation of the single results from the mean.

Noise—Spontaneous deviations from a mean output not caused by input concentration changes.

Linearity—The maximum deviation between an actual instrument reading and the reading predicted by a straight line drawn between upper and lower calibration points.

METHOD 12—DETERMINATION OF INORGANIC LEAD EMISSIONS FROM STATIONARY SOURCES

1. *Principle and Applicability*

1.1 Applicability. This method applies to the determination of inorganic lead (Pb) emissions from specified stationary sources only.

1.2 Principle. Particulate and gaseous Pb emissions are withdrawn isokinetically from the source and collected on a filter and in dilute nitric acid. The collected samples are digested in acid solution and analyzed by atomic absorption spectrometry using an air acetylene flame.

2. *Range, Sensitivity, Precision, and Interferences.*

2.1 Range. For a minimum analytical accuracy of ±10 percent, the lower limit of the range is 100 μg. The upper limit can be considerably extended by dilution.

2.2 Analytical Sensitivity. Typical sensitivities for a 1-percent change in absorption (0.0044 absorbance units) are 0.2 and 0.5 μg Pb/ml for the 217.0 and 283.3 nm lines, respectively.

2.3 Precision. The within-laboratory precision, as measured by the coefficient of variation ranges from 0.2 to 9.5 percent relative to a run-mean concentration. These values were based on tests conducted at a gray iron foundry, a lead storage battery manufacturing plant, a secondary lead smelter, and a lead recovery furnace of an alkyl lead manufacturing plant. The concentrations encountered during these tests ranged from 0.61 to 123.3 mg Pb/m³.

2.4 Interferences. Sample matrix effects may interfere with the analysis for Pb by flame atomic absorption. If this interference is suspected, the analyst may confirm the presence of these matrix effects and frequently eliminate the interference by using the Method of Standard Additions.

High concentrations of copper may interfere with the analysis of Pb at 217.0 nm. This interference can be avoided by analyzing the samples at 283.3 nm.

3. *Apparatus.*

3.1 Sampling Train. A schematic of the sampling train is shown in Figure 12-1; it is similar to the Method 5 train. The sampling train consists of the following components:

3.1.1 Probe Nozzle, Probe Liner, Pitot Tube, Differential Pressure Gauge, Filter Holder, Filter Heating System, Metering System, Barometer, and Gas Density Determination Equipment. Same as Method 5, Sections 2.1.1 to 2.1.6 and 2.1.8 to 2.1.10, respectively.

3.1.2 Impingers. Four impingers connected in series with leak-free ground glass fittings or any similar leak-free noncontaminating fittings. For the first, third, and fourth impingers, use the Greenburg-Smith design, modified by replacing the tip with a 1.3 cm (½ in.) ID glass tube extending to about 1.3 cm (½ in.) from the bottom of the flask. For the second impinger, use the Greenburg-Smith design with the standard tip. Place a thermometer, capable of measuring temperature to within 1°C (2°F) at the outlet of the fourth impinger for monitoring purposes.

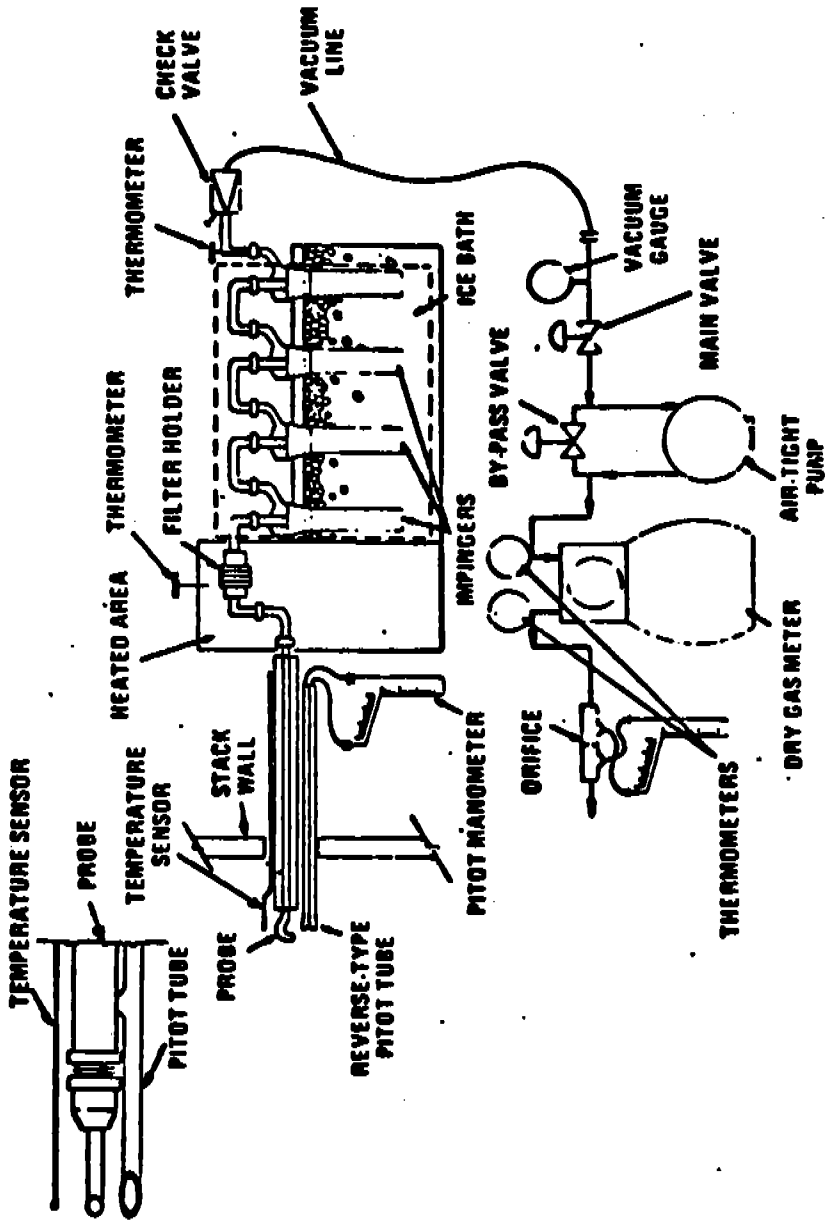

Figure 12-1. Inorganic lead sampling train.

3.2 Sample Recovery. The following items are needed:

3.2.1 Probe-Liner and Probe-Nozzle Brushes, Petri Dishes, Plastic Storage Containers, and Funnel and Rubber Policeman. Same as Method 5, Sections 2.2.1, 2.2.4, 2.2.6, and 2.2.7, respectively.

3.2.2 Wash Bottles. Glass (2).

3.2.3 Sample Storage Containers. Chemically resistant, borosilicate glass bottles, for 0.1 nitric acid (HNO_3) impinger and probe solutions and washes, 1000-ml. Use screw-cap liners that are either rubber-backed Teflon* or leak-free and resistant to chemical attack by 0.1 N HNO_3. (Narrow mouth glass bottles have been found to be less prone to leakage.)

3.2.4 Graduated Cylinder and/or Balance. To measure condensed water to within 2 ml or 1 g. Use a graduated cylinder that has a minimum capacity of 500 ml, and subdivisions no greater than 5 ml. (Most laboratory balances are capable of weighing to the nearest 0.5 g or less.)

3.2.5 Funnel. Glass, to aid in sample recovery.

3.3 Analysis. The following equipment is needed:

3.3.1 Atomic Absorption Spectrophotometer. With lead hollow cathode lamp and burner for air/acetylene flame.

3.3.2 Hot Plate.

3.3.3 Erlenmeyer Flasks. 125-ml, 24/40 $.

3.3.4 Membrane Filters. Millipore SCWPO 4700 or equivalent.

3.3.5 Filtration Apparatus. Millipore vacuum filtration unit, or equivalent, for use with the above membrane filter.

3.3.6 Volumetric Flasks. 100-ml, 250-ml, and 1000-ml.

4. *Reagents.*

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

4.1.1 Filter. Gelman Spectro Grade, Reeve Angel 934 AH, MSA 1106 BH, all with lot assay for Pb, or other high-purity glass fiber filters, without organic binder, exhibiting at least 99.95 percent efficiency (<0.05 percent penetration) on 0.3 micron dioctyl phthalate smoke particles. Conduct the filter efficiency test using ASTM Standard Method D2986-71 (incorporated by reference—see § 60.17) or use test data from the supplier's quality control program.

4.1.2 Silica Gel, Crushed Ice, and Stopcock Grease. Same as Method 5, Section 3.1.2, 3.1.4, and 3.1.5, respectively.

4.1.3 Water. Deionized distilled, to conform to ASTM Specification D1193-77 (incorporated by reference—see § 60.17), Type 3. If high concentrations of organic matter are not expected to be present, the analyst may delete the potassium permanganate test for oxidizable organic matter.

4.1.4 Nitric Acid, 0.1 N. Dilute 6.5 ml of concentrated HNO_3 to 1 liter with deionized distilled water. (It may be desirable to run blanks before field use to eliminate a high blank on test samples.)

4.2 Pretest Preparation. 6 N HNO_3 is needed. Dilute 390 ml of concentrated HNO_3 to 1 liter with deionized distilled water.

4.3 Sample Recovery. 0.1 N HNO_3 (same as 4.1.4 above) is needed for sample recovery.

4.4 Analysis. The following reagents are needed for analysis (use ACS reagent grade chemicals or equivalent, unless otherwise specified):

4.4.1 Water. Same as 4.1.3 above.

4.4.2 Nitric Acid. Concentrated.

4.4.3 Nitric Acid, 50 percent (V/V). Dilute 500 ml of concentrated HNO_3 to 1 liter with deionized distilled water.

4.4.4 Stock Lead Standard Solution, 1000 μg Pb/ml. Dissolve 0.1598 g of lead nitrate [$Pb(NO_3)_2$] in about 60 ml of deionized distilled water, add 2 ml concentrated HNO_3, and dilute to 100 ml with deionized distilled water.

4.4.5 Working Lead Standards. Pipet 0.0, 1.0, 2.0, 3.0, 4.0, and 5.0 ml of the stock lead standard solution (4.4.4) into 250-ml volumetric flasks. Add 5 ml of concentrated HNO_3 to each flask and dilute to volume with deionized distilled water. These working standards contain 0.0, 4.0, 8.0, 12.0, 16.0, and 20.0 μg Pb/ml, respectively. Prepare, as needed, additional standards at other concentrations in a similar manner.

4.4.6 Air. Suitable quality for atomic absorption analysis.

4.4.7 Acetylene. Suitable quality for atomic absorption analysis.

4.4.8 Hydrogen Peroxide, 3 percent (V/V). Dilute 10 ml of 30 percent H_2O_2 to 100 ml with deionized distilled water.

5. *Procedure.*

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

5.1.1 Pretest Preparation. Follow the same general procedure given in Method 5, Section 4.1.1, except the filter need not be weighed.

5.1.2 Preliminary Determinations. Follow the same general procedure given in Method 5, Section 4.1.2.

5.1.3 Preparation of Collection Train. Follow the same general procedure given in Method 5, Section 4.1.3, except place 100 ml of 0.1 HNO_3 in each of the first two impingers, leave the third impinger empty, and transfer approximately 200 to 300 g of preweighed silica gel from its container to

*Mention of trade names or specific products does not constitute endorsement by the U.S. Environmental Protection Agency.

the fourth impinger. Set up the train as shown in Figure 12-1.

5.1.4 Leak-Check Procedures. Follow the general leak-check procedures given in Method 5, Sections 4.1.4.1. (Pretest Leak-Check), 4.1.4.2 (Leak-Checks During the Sample Run), and 4.1.4.3 (Post-Test Leak-Check).

5.1.5 Sampling Train Operation. Follow the same general procedure given in Method 5, Section 4.1.5. For each run, record the data required on a data sheet such as the one shown in EPA Method 5, Figure 5-2.

5.1.6 Calculation of Percent Isokinetic. Same as Method 5, Section 4.1.6.

5.2 *Sample Recovery.* Begin proper cleanup procedure as soon as the probe is removed from the stack at the end of the sampling period.

Allow the probe to cool. When it can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over it. Do not cap off the probe tip tightly while the sampling train is cooling down as this would create a vacuum in the filter holder, thus drawing liquid from the impingers into the filter.

Before moving the sampling train to the cleanup site, remove the probe from the sapling train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the glassware inlet where the probe was fastened and cap the inlet. Remove the umbilical cord from the last impinger and cap the impinger. The tester may use ground-glass stoppers, plastic caps, or serum caps to close these openings.

Transfer the probe and filter-impinger assembly to a cleanup area, which is clean and protected from the wind so that the chances of contaminating or losing the sample are minimized.

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

5.2.1 *Container No. 1* (Filter). Carefully remove the filter from the filter holder and place it in its identified petri dish container. If it is necessary to fold the filter, do so such that the sample-exposed side is inside the fold. Carefully transfer to the petri dish any visible sample matter and/or filter fibers that adhere to the filter holder gasket by using a dry Nylon bristle brush and/or a sharp-edged blade. Seal the container.

5.2.2 *Container No. 2* (Probe). Taking care that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover sample matter or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components with 0.1 N HNO_3 and placing the wash into a glass sample storage container. Measure and record (to the nearest 2-ml) the total amount of 0.1 N HNO_3 used for each rinse. Perform the 0.1 N HNO_3 rinses as follows:

Carefully remove the probe nozzle and rinse the inside surfaces with 0.1 N HNO_3 from a wash bottle while brushing with a stainless steel, Nylon-bristle brush. Brush until the 0.1 N HNO_3 rinse shows no visible particles, then make a final rinse of the inside surface.

Brush and rinse with 0.1 N HNO_3 the inside parts of the Swagelok fitting in a similar way until no visible particles remain.

Rinse the probe liner with 0.1 N HNO_3. While rotating the probe so that all inside surfaces will be rinsed with 0.1 N HNO_3, tilt the probe and squirt 0.1 N HNO_3 into its upper end. Let the 0.1 N HNO_3 drain from the lower end into the sample container. The tester may use a glass funnel to aid in transferring liquid washes to the container. Follow the rinse with a probe brush. Hold the probe in an inclined position, squirt 0.1 N HNO_3 into the upper end of the probe as the probe brush is being pushed with a twisting action through the probe; hold the sample container underneath the lower end of the probe and catch any 0.1 N HNO_3 and sample matter that is brushed from the probe. Run the brush through the probe three times or more until no visible sample matter is carried out with the 0.1 N HNO_3 and none remains on the probe liner on visual inspection. With stainless steel or other metal probes, run the brush through in the above prescribed manner at least six times, since metal probes have small crevices in which sample matter can be entrapped. Rinse the brush with 0.1 N HNO_3 and quantitatively collect these washings in the sample container. After the brushing make a final rinse of the probe as described above.

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

After insuring that all joints are wiped clean of silicone grease, brush and rinse with 0.1 N HNO_3 the inside of the front half of the filter holder. Brush and rinse each suface three times or more, if needed, to remove visible sample matter. Make a final rinse of the brush and filter holder. After all 0.1 N HNO_3 washings and sample matter are collected in the sample container, tighten the lid on the sample container so that the fluid will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to determine whether leakage occurs during transport. Label the container to clearly identify its contents.

5.2.3 *Container No. 3* (Silica Gel). Check the color of the indicating silica gel to deter-

mine if it has been completely spent and make a notation of its condition. Transfer the silica gel from the fourth impinger to the original container and seal. The tester may use a funnel to pour the silica gel and a rubber policeman to remove the silica gel from the impinger. It is not necessary to remove the small amount of particles that may adhere to the walls and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, the tester may follow procedure for Container No. 3 under Section 5.4 (Analysis).

5.2.4 *Container No. 4* (Impingers). Due to the large quantity of liquid involved, the tester may place the impinger solutions in several containers. Clean each of the first three impingers and connecting glassware in the following manner:

1. Wipe the impinger ball joints free of silicone grease and cap the joints.

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

3. Transfer the contents of the impingers to a 500-ml graduated cylinder. Remove the outlet ball joint cap and drain the contents through this opening. Do not separate the impinger parts (inner and outer tubes) while transferring their contents to the cylinder. Measure the liquid volume to within ±2 ml. Alternatively, determine the weight of the liquid to within ±0.5 g. Record in the log the volume or weight of the liquid present, along with a notation of any color or film observed in the impinger catch. The liquid volume or weight is needed, along with the silica gel data, to calculate the stack gas moisture content (see Method 5, Figure 5-3).

4. Transfer the contents to Container No. 4.

5. Note: In steps 5 and 6 below, measure and record the total amount of 0.1 N HNO_3 used for rinsing. Pour approximately 30 ml of 0.1 N HNO_3 into each of the first three impingers and agitate the impingers. Drain the 0.1 N HNO_3 through the outlet arm of each impinger into Container No. 4. Repeat this operation a second time; inspect the impingers for any abnormal conditions.

6. Wipe the ball joints of the glassware connecting the impingers free of silicone grease and rinse each piece of glassware twice with 0.1 N HNO_3; transfer this rinse into Container No. 4. (*Do not rinse or brush the glass-fritted filter support.*) Mark the height of the fluid level to determine whether leakage occurs during transport. Label the container to clearly identify its contents.

5.2.5 Blanks. Save 200 ml of the 0.1 N HNO_3 used for sampling and cleanup as a blank. Take the solution directly from the bottle being used and place into a glass sample container labeled "0.1 N HNO_3 blank."

5.3 Sample Preparation.

5.3.1 *Container No. 1* (Filter). Cut the filter into strips and transfer the strips and all loose particulate matter into a 125-ml Erlenmeyer flask. Rinse the petri dish with 10 ml of 50 percent HNO_3 to insure a quantitative transfer and add to the flask. (Note: If the total volume required in Section 5.3.3 is expected to exceed 80 ml, use a 250-ml Erlenmeyer flask in place of the 125-ml flask.)

5.3.2 *Containers No. 2 and No. 4* (Probe and Impingers). (Check the liquid level in Containers No. 2 and/or No. 4 and confirm as to whether or not leakage occurred during transport; note observation on the analysis sheet. If a noticeable amount of leakage had occurred, either void the sample or take steps, subject to the approval of the Administrator, to adjust the final results.) Combine the contents of Containers No. 2 and No. 4 and take to dryness on a hot plate.

5.3.3 Sample Extraction for lead. Based on the approximate stack gas particulate concentration and the total volume of stack gas sampled, estimate the total weight of particulate sample collected. Then transfer the residue from Containers No. 2 and No. 4 to the 125-ml Erlenmeyer flask that contains the filter using rubber policeman and 10 ml of 50 percent HNO_3 for every 100 mg of sample collected in the train or a minimum of 30 ml of 50 percent HNO_3, whichever is larger.

Place the Erlenmeyer flask on a hot plate and heat with periodic stirring for 30 min at a temperature just below boiling. If the sample volume falls below 15 ml, add more 50 percent HNO_3. Add 10 ml of 3 percent H_2O_2 and continue heating for 10 min. Add 50 ml of hot (80°C) deionized distilled water and heat for 20 min. Remove the flask from the hot plate and allow to cool. Filter the sample through a Millipore membrane filter or equivalent and transfer the filtrate to a 250-ml volumetric flask. Dilute to volume with deionized distilled water.

5.3.4 Filter Blank. Determine a filter blank using two filters from each lot of filters used in the sampling train. Cut each filter into strips and place each filter in a separate 125-ml Erlenmeyer flask. Add 15 ml of 50 percent HNO_3 and treat as described in Section 5.3.3 using 10 ml of 3 percent H_2O_2 and 50 ml of hot, deionized distilled water. Filter and dilute to a toal volume of 100 ml using deionized distilled water.

5.3.5 0.1 N HNO_3 Blank. Take the entire 200 ml of 0.1 N HNO_3 to dryness on a steam bath, add 15 ml of 50 percent HNO_3, and treat as described in Section 5.3.3 using 10 ml of 3 percent H_2O_2 and 50 ml of hot,

the Pb concentration of the sample into the linear range of the spectrophotometer.

7.4 Lead Concentration. Calculate the stack gas Pb concentration C_{Pb} in mg/dscm as follows:

$$C_{Pb} = K \frac{C'_{Pb}}{V_{m(std)}} \qquad \text{Eq. 12-2}$$

Where:

K = 0.001 mg/μg for metric units.
= 2.205 lb/μg × 10^{-9} for English units.

7.5 Isokinetic Variation and Acceptable Results. Same as Method 5; Sections 6.11 and 6.12, respectively. To calculate v_s, the average stack gas velocity, use Equation 2-9 of Method 2 and the data from this field test.

8. *Alternative Test Methods for Inorganic Lead.*

8.1 Simultaneous Determination of Particulate and Lead Emissions. The tester may use Method 5 to simultaneously determine Pb provided that (1) he uses acetone to remove particulate from the probe and inside of the filter holder as specified by Method 5, (2) he uses 0.1 N HNO_3 in the impingers, (3) he uses a glass fiber filter with a low Pb background, and (4) he treats and analyzes the entire train contents, including the impingers, for Pb as described in Section 5 of this method.

8.2 Filter Location. The tester may use a filter between the third and fourth impinger provided that he includes the filter in the analysis for Pb.

8.3 In-stack Filter. The tester may use an in-stack filter provided that (1) he uses a glass-lined probe and at least two impingers, each containing 100 ml of 0.1 N HNO_3, after the in-stack filter and (2) he recovers and analyzes the probe and impinger contents for Pb. Recover sample from the nozzle with acetone if a particulate analysis is to be made.

9. *Bibliography*

9.1 Perkin Elmer Corporation. Analytical Methods for Atomic Absorption Spectrophotometry. Norwalk, Connecticut. September 1976.

9.2 American Society for Testing and Materials. Annual Book of ASTM Standards. Part 31; Water, Atmospheric Analysis. Philadelphia, Pa. 1974. p. 40-42.

9.3 Klein, R. and C. Hach. Standard Additions—Uses and Limitations in Spectrophotometric Analysis. *Amer. Lab.* 9:21-27. 1977.

9.4 Mitchell, W.J. and M.R. Midgett. Determining Inorganic and Alkyl Lead Emissions from Stationary Sources. U.S. Environmental Protection Agency, Emission Monitoring and Support Laboratory. Research Triangle Park, N.C. (Presented at National APCA Meeting. Houston. June 26, 1978).

9.5 Same as Method 5, Citations 2 to 5 and 7 of Section 7.

Method 104—Reference Method for Determination of Beryllium Emissions From Stationary Sources

1. *Applicability and Principle.*

1.1 Applicability. This method is applicable for the determination of beryllium (Be) emissions in ducts or stacks at stationary sources. Unless otherwise specified, this method is not intended to apply to gas streams other than those emitted directly to the atmosphere without further processing.

1.2 Principle. Be emissions are isokinetically sampled from the source, and the collected sample is digested in an acid solution and analyzed by atomic absorption spectrophotometry.

2. *Apparatus.*

2.1 Sampling Train. The sampling train is identical to the Method 5 train as shown in Figure 5-1 (mention of Method 5 refers to 40 CFR Part 60). The sampling train consists of the following components:

2.1.1 Probe Nozzle, Pitot Tube, Differential Pressure Gauge, Metering System, Barometer, and Gas Density Determination Equipment. Same as Method 5, Sections 2.1.1, 2.1.3, 2.1.4, 2.1.8, 2.1.9, and 2.1.10, respectively.

2.1.2 Probe Liner. Borosilicate or quartz glass tubing. The tester may use a heating system capable of maintaining a gas temperature of 120±14°C (248±25°F) at the probe exit during sampling to prevent water condensation. *Note:* Do not use metal probe liners.

2.1.3 Filter Holder. Borosilicate glass, with a glass frit filter support and a silicone rubber gasket. Other materials of construction (e.g., stainless steel, Teflon, Viton) may be used, subject to the approval of the Administrator. (*Note:* Mention of trade names of specific products does not constitute endorsement by the Environmental Protection Agency.) The holder design shall provide a positive seal against leakage from the outside or around the filter. The holder shall be attached immediately at the outlet of the probe. A heating system capable of maintaining the filter at a minimum temperature in the range of the stack temperature may be used to prevent condensation from occurring.

2.1.4 Impingers. Four Greenburg-Smith impingers connnected in series with leak-free ground glass fittings or any similar leak-free noncontaminating fittings. For the first, third, and fourth impingers, the tester may use impingers that are modified by replacing the tip with a 13-mm-ID (0.5-in.) glass tube extending to 13 mm (0.5 in.) from the bottom of the flask.

2.2 Sample Recovery. The following items are needed:

2.2.1 Probe Cleaning Rod. At least as long as probe.

2.2.2 Glass Sample Bottles. Leakless, with Teflon-lined caps, 500-ml.

2.2.3 Graduated Cylinder. 250-ml.

2.2.4 Funnel and Rubber Policeman. To aid in transfer of silica gel to container; not necessary if silica gel is weighed in the field.

2.2.5 Funnel. Glass, to aid in sample recovery.

2.2.6 Plastic Jar. Approximately 300-ml.

2.3 Analysis. The following equipment is needed:

2.3.1 Atomic Absorption Spectrophotometer. Perkin-Elmer 303, or equivalent, with nitrous oxide/acetylene burner.

2.3.2 Hot Plate.
2.3.3 Perchloric Acid Fume Hood.

3. *Reagents.*

Use ACS reagent-grade chemicals or equivalent, unless otherwise specified.

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

3.1.1 Filter. Millipore AA, or equivalent. It is suggested that a Whatman 41 filter or equivalent be placed immediately against the back side of the Millipore filter as a guard against breaking the Millipore filter. To be equivalent, other filters shall exhibit at least 99.95 percent efficiency (0.05 percent penetration) on 0.3 micron dioctyl phthalate smoke particles. The filter efficiency tests shall be conducted in accordance with ASTM Standard Method D 2986-71 (reapproved 1978) (incorporated by reference—see § 61.18). Test data from the supplier's quality control program are sufficient for this purpose.

3.1.2 Water. Deionized distilled, meeting ASTM Specifications for Type 3 Reagent Water—ASTM Test Method D 1193-77 (incorporated by reference—see § 61.18). If high concentrations of organic matter are not expected to be present, the analyst may eliminate the $KMnO_4$ test for oxidizable organic matter.

3.1.3 Silica Gel. Indicating type, 6- to 16-mesh. If previously used, dry at 175° C (350° F) for 2 hours. The tester may use new silica gel as received.

3.1.4 Acetone.

3.1.5 Wash Acid, 50 Percent (V/V) Hydrochloric Acid (HCl).

Mix equal volumes of concentrated HCl and water, being careful to add the acid slowly to the water.

3.2 Sample Preparation and Analysis. The reagents needed are listed below:

3.2.1 Water. Same as Section 3.1.2.

3.2.2. Perchloric Acid ($HClO_4$). Concentrated (70 percent).

3.2.3 Nitric Acid (HNO_3). Concentrated.

3.2.4 Beryllium Powder. Minimum purity 98 percent.

3.2.5 Sulfuric Acid (H_2SO_4) Solution, 12 N. Dilute 33 ml of concentrated H_2SO_4 to 1 liter with water.

3.2.6 Hydrochloric Acid Solution, 25 percent HCl (V/V).

3.2.7 Standard Beryllium Solution, 1 μg Be/ml. Dissolve 10 mg of Be in 80 ml of 12N H_2SO_4 solution, and dilute to 1000 ml with water. Dilute a 10-ml aliquot to 100 ml with 25 percent HCl solution to give a concentration of 1 μg/ml. Prepare this dilute stock solution fresh daily. Equivalent strength Be stock solutions may be prepared from Be salts such as $BeCl_2$ and $Be(NO_3)_2$ (98 percent minimum purity).

4. *Procedure.*

4.1 Sampling. Because of the complexity of this method testers should be trained and experienced with the test procedures to assure reliable results. As Be is hazardous, testers should take precautions to minimize exposure. The amount of Be that is collected is generally small, therefore, it is necessary to exercise particular care to prevent contamination or loss of sample.

4.1.1 Pretest Preparation. Follow the general procedure given in Method 5, Section 4.1.1. Omit the directions of filters, except check them visually against light for irregularities and flaws such as pinholes.

4.1.2 Preliminary Determinations. Follow the general procedure given in Method 5, Section 4.1.2, except as follows: Select a nozzle size based on the range of velocity heads to assure that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates below 28 liters/min (1.0 cfm).

Obtain samples over a period or periods of time that accurately determine the maximum emissions that occur in a 24-hour period. In the case of cyclic operations, perform sufficient sample runs for the accurate determination of the emissions that occur over the duration of the cycle. A minimum sample time of 2 hours per run is recommended.

4.1.3 Prior to assembly, clean all glassware (probe, impingers, and connectors) by first soaking in wash acid for 2 hours, followed by rinsing with water. Place 100 ml of water in each of the first two impingers, and leave the third impinger empty. Save a portion of the water for a blank analysis. Place approximately 200 g of preweighted silica gel in the fourth impinger. The tester may use more silica gel, but should be careful to ensure that it is not entrained and carried out from the impinger during sampling. Place the silica gel container in a clean place for later use in the sample recovery. As an alternative, determine and record the weight of the silica gel plus impinger to the nearest 0.5 g.

Install the selected nozzel using a Viton A O-ring when stack temperatures are less the 260°C (500°F). Use a fiberglass string gasket if temperatures are higher. See APTD-0576 (Citation 9 in Section 10 of Method 101) for details. Other connecting systems using either 316 stainless steel or Teflon ferrules may be used.

If condensation in the probe or filter is a problem, probe and filter heaters will be required. Adjust the heaters to provide a temperature at or above the stack temperature. However, membrane filters such as the Millipore AA are limited to about 225°F. If the stack gas is in excess of about 200°F, consideration should be given to an alternate procedure such as moving the filter holder downstream of the first impinger to insure

that the filter does not exceed its temperature limit. Mark the probe with heat-resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point. Assemble the train as shown in Figure 5-1 of Method 5, using (if necessary) a very light coat of silicone grease on all ground glass joints. Grease only the outer portion (see APTD-0576) to avoid possibility of contamination by the silicon grease. *Note:* An empty impinger may be inserted between the third impinger and the silica gel to remove excess moisture from the sample stream.

After the sampling train has been assembled, turn on and set the probe, if applicable, at the desired operating temperature. Allow time for the temperatures to stabilize. Place crushed ice around the impingers.

4.1.4. Leak-Check Procedures. Follow the leak-check procedures outlined in Method 5, Sections 4.1.4.1 (Pretest Leak Check), 4.1.4.2 (Leak Checks During Sample Run), and 4.1.4.3 (Post-Test Leak Check).

4.1.5 Beryllium Train Operation. Follow the general procedure given in Method 5, Section 4.1.5. For each run, record the data required on a data sheet such as the one shown in Figure 5-2 of Method 5.

4.1.6 Calculation of Percent Isokinetic. Same as Method 5, Section 4.1.6.

4.2 Sample Recovery. Begin proper cleanup procedure as soon as the probe is removed from the stack at the end of the sampling period.

Allow the probe to cool. When it can be safely handled, wipe off any external particulate matter near the tip of the probe nozzle, and place a cap over it. Do not cap off the probe tip tightly while the sampling train is cooling. Capping would create a vacuum and draw liquid out from the impingers.

Before moving the sampling train to the cleanup site, remove the probe from the train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the impinger. Use either ground-glass stoppers, plastic caps, or serum caps to close these openings.

Transfer the probe and impinger assembly to a cleanup area that is clean, protected from the wind, and free of Be contamination.

Inspect the train before and during this assembly, and note any abnormal conditions. Treat the sample as follows:

Disconnect the probe from the impinger train. Remove the filter and any loose particulate matter from the filter holder, and place in a sample bottle. Place the contents (measured to ±1 ml) of the first three impingers into another sample bottle. Rinse the probe and all glassware between it and the back half of the third impinger with water and acetone, and add this to the latter sample bottle. Clean the probe with a brush or a long slender rod and cotton balls. Use acetone while cleaning. Add these to the sample bottle. Retain a sample of the water and acetone as a blank. The total amount of water and acetone used should be measured for accurate blank correction. Place the silica gel in the plastic jar. Seal and secure all sample containers for shipment. If an additional test is desired, the glassware can be carefully double rinsed with water and reassembled. However, if the glassware is out of use more than 2 days, repeat the initial acid wash procedure.

4.3 Analysis.

4.3.1 Apparatus Preparation. Before use, clean all glassware according to the procedure of Section 4.1.3. Adjust the instrument settings according to the instrument manual, using an absorption wavelength of 234.8 nm.

4.3.2 Sample Preparation. The digestion of Be samples is accomplished in part in concentrated $HClO_4$. *Caution:* The analyst must insure that the sample is heated to light brown fumes after the initial HNO_3 addition; otherwise, dangerous perchlorates may result from the subsequent $HClO_4$ digestion. $HClO_4$ should be used only under a hood.

4.3.2.1 Filter Preparation. Transfer the filter and any loose particulate matter from the sample container to a 150-ml beaker. Add 35 ml concentrated HNO_3. Heat on a hotplate until light brown fumes are evident to destroy all organic matter. Cool to room temperature, and add 5 ml concentrated H_2SO_4 and 5 ml concentrated $HClO_4$. Then proceed with step 4.3.2.4.

4.3.2.2 Water Preparation. Place a portion of the water and acetone sample into a 150-ml beaker, and put on a hotplate. Add portions of the remainder as evaporation proceeds and evaporate to dryness. Cool the residue, and add 35 ml concentrated HNO_3. Heat on a hotplate until light brown fumes are evident to destroy any organic matter. Cool to room temperature, and add 5 ml concentrated H_2SO_4 and 5 ml concentrated $HClO_4$. Then proceed with step 4.3.2.4.

4.3.2.3 Silica Gel Preparation Analyses. Weigh the spent silica gel, and report to the nearest gram.

4.3.2.4 Final Sample Preparation. Samples from 4.3.2.1 and 4.3.2.2 may be combined here for ease of analysis. Replace on a hotplate, and evaporate to dryness in a $HClO_4$ hood. Cool and dissolve the residue in 10.0 ml of 25 percent V/V HCl. Samples are now ready for the atomic absorption unit. It is necessary for the Be concentration of the sample to be within the calibration range of the unit. If necessary, perform further dilution of sample with 25 percent

V/V HCl to bring the sample within the calibration range.

4.3.3 Beryllium Determination. Analyze the samples prepared in 4.3.2 at 234.8 nm using a nitrous oxide/acetylene flame. Aluminum, silicon and other elements can interfere with this method if present in large quantities. Standard methods are available, however, that may be used to effectively eliminate these interferences (see Citation 2 in Section 8).

5. *Calibration.*

5.1 Sampling Train. Calibrate the sampling train components according to the procedures outlined in the following sections of Method 5: Section 5.1 (Probe Nozzle), Section 5.2 (Pitot Tube), Section 5.3 (Metering System), Section 5.4 (Probe Heater), Section 5.5 (Temperature Gauges), Section 5.7 (Barometer). Note that the leak check described in Section 5.6 of Method 5 applies to this method.

6. *Calculations.*

6.1 Dry Gas Volume. Using the data from each sample run, calculate the dry gas sample volume at standard conditions $V_{m(std)}$ (corrected for leakage, if necessary) as outlined in Section 6.3 of Method 5.

6.2 Volume of Water Vapor in Sample and Moisture Content of Stack Gas. Using the data obtained from each sample run, calculate the volume of water vapor $V_{w(std)}$ in the sample, and the moisture content B_{ws} of the stack gas. Use Equations 5-2 and 5-3 of Method 5.

6.3 Stack Gas Velocity. Using the data from each sample run and Equation 2-9 of Method 2, calculate the average stack gas velocity $v_{s(avg)}$.

6.4 Beryllium Emission Rate. Calculate the Be emission rate R in g/day for each stack using Equation 104-1. For cyclic operations, use only the time per day each stack is in operation. The total Be emission rate from a source will be the summation of results from all stacks.

$$R = K \frac{W_t v_{s(avg)} A_s (86{,}400 \times 10^{-6})}{(V_{m(std)} + V_{w(std)}) T_s / P_s}$$

Eq. 104-1

Where:

W_t = Total weight of Be collected, μg.
A_s = Stack cross-sectional area, M^2 (ft^2).
86,400 = Conversion factor, sec/day.
10^{-6} = Conversion factor, g/μg.
T_s = Absolute average stack gas temperature, °K (°P).
P_s = Absolute stack gas pressure, mm Hg (in. Hg).
K = 0.3858 °K/mm Hg for metric units.
= 17.64 °P/in. Hg for English units.

6.5 Isokinetic Variation and Acceptable Results. Same as Method 5, Sections 6.11 and 6.12, respectively.

7. *Determination of Compliance.*

Each performance test consists of three sample runs of the applicable test method. For the purpose of determining compliance with an applicable national emission standard, use the average of the results of all sample runs.

8. *Bibliography.*

In addition to Citations 1-3 and 5-15 of Section 10 of Method 101, the following citations may be helpful:

1. Amos, M.D., and J. B. Willis. Use of High-Temperature Pre-Mixed Flames in Atomic Absorption Spectroscopy. Spectrochim. Acta. *22*:1325. 1966.

2. Fleet, B., K. V. Liberty, and T. S. West. A Study of Some Matrix Effects in the Determination of Beryllium by Atomic Absorption Spectroscopy in the Nitrous Oxide-Acetylene Flame. Talanta *17*:203. 1970.

Method 105—Determination of Mercury in Wastewater Treatment Plant Sewage Sludge

1. *Applicability and principle.*

1.1 Applicability. This method applies to the determination of total organic and inorganic mercury (Hg) content in sewage sludges. The range of this method is 0.2 to 5 $\mu g/g$; it may be extended by increasing or decreasing sample size.

1.2 Principle. Time-composite sludge samples are withdrawn from the conveyor belt after dewatering and before incineration or drying. A weighed portion of the sludge is disgested in aqua regia and oxidized by potassium permanganate ($KMnO_4$). Hg in the digested sample is then measured by the conventional spectrophotometric cold-vapor technique.

2. *Apparatus.*

2.1 Sampling.

2.1.1 Container. Plastic, 50-liter.

2.1.2 Scoop. To remove 950-ml (1-qt.) sludge sample.

2.2 Sludge Sample Preparation.

2.2.1 Mixer. Mortar mixer, wheelbarrow-type, 57-liter (or equivalent) with electricity driven motor.

2.2.2 Blender. Waring-type, 2-liter. (Note: Mention of specific trade names does not constitute endorsement by the Environmental Protection Agency.)

2.2.3 Scoop. To remove 100-ml and 20-ml samples of blended sludge.

2.3 Analysis. Same as Method 101, Sections 5.3 and 5.4, except for the following:

2.3.1 Balance. The balance of Method 101, Section 5.3.17, is not needed.

APPENDIX L

CALCULATION EQUATIONS

CALCULATION EQUATIONS

METHOD 2

$$\bar{V}_s = 85.48\ C_p\ (\sqrt{\Delta p})_{avg}\ \sqrt{\frac{T_{s(avg)}}{P_s\ M_s}}$$

$$Q_{s,d} = 60(1 - B_{ws})\ \bar{V}_s\ A\ \left(\frac{528}{T_{s(avg)}}\right)\ \left(\frac{P_s}{29.92}\right)$$

$$Q_a = 60\ \bar{V}_s\ A$$

$$\dot{m}_g = \frac{4.995\ Q_{s,d}\ G_d}{1 - B_{ws}}$$

$$RH^* = 100\ (vp_{twb}\ 0.0003641\ P_s\ (T_{db} - T_{wb}))/vp_{tdb}$$

$$B^*_{ws} = RH(vp_{tdb})/P_s$$

$$= \frac{4.585 \times 10^{-2}\ P_s M_s}{T_{s\ (avg)}}$$

*Alternate equations for calculating moisture content from wet bulb and dry buld data.

CALCULATION EQUATIONS

METHOD 3

$$\%EA = \frac{100(\%O_2 -).5\%\ CO)}{0.264\%\ N_2 - \%O_2 + 0.5\%\ CO}$$

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

$$M_s = M_d\ (I - B_{ws}) + 0.18\ B_{ws}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

CALCULATION EQUATIONS

METHOD 5

$$V_{m(std)} = 17.65\ V_m\ \gamma\ \left(\frac{P_{bar} + \overline{\Delta H}/13.6}{T_{m(avg)}}\right)$$

$$V_{w(std)} = 0.0472\ V_{Is}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

$$I = 0.0944\ \left(\frac{T_{s(avg)}\ V_{m(std)}}{P_s\ V_s\ A_n\ \theta\ (1 - B_{ws})}\right)$$

$$C_s = \frac{15.43\ M_p}{V_{m(std)}}$$

$$C_a = \frac{272.3\ M_p\ P_s}{T_{s(avg)}\ (V_{w(std)} + V_{m(std)})}$$

$$(\dot{m}_p)_1 = 8.5714 \times 10^{-3}\ C_s\ Q_{s,d}$$

$$(\dot{m}_p)_2 = \frac{1.3228 \times 10^{-1}\ M_p\ A}{\theta\ A_n}$$

$$\dot{m}_p = \frac{(\dot{m}_p)_1 + (\dot{m}_p)_2}{2}$$

CALCULATION EQUATIONS

METHOD 5

$$V_{m(std)} = 17.65\ V_m\ Y\ \left(\frac{P_{bar} + \overline{\Delta H}/13.6}{T_{m(avg)}}\right)$$

$$V_{w(std)} = 0.0472\ V_{Is}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

$$I = 0.0944\ \left(\frac{T_{s(avg)}\ V_{m(std)}}{P_s\ V_s\ A_n\ \theta\ (1 - B_{ws})}\right)$$

$$C_s = \frac{15.43\ M_p}{V_{m(std)}}$$

$$C_a = \frac{272.3\ M_p\ P_s}{T_{s(avg)}\ (V_{w(std)} + V_{m(std)})}$$

$$(\dot{m}_p)_1 = 8.5714 \times 10^{-3}\ C_s\ Q_{s,d}$$

$$(\dot{m}_p)_2 = \frac{1.3228 \times 10^{-1}\ M_p\ A}{\theta\ A_n}$$

$$\dot{m}_p = \frac{(\dot{m}_p)_1 + (\dot{m}_p)_2}{2}$$

SYMBOLS

A = Cross sectional area of stack, SQ. FT.

A_n = Cross sectional area of nozzle, SQ. FT.

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

C_p = Pitot tube coefficient, dimensionless

C_a = Concentration of particulate matter in stack gas, wet basis, GR/ACF

C_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, GR/DSCF

EA = Excess air, percent by volume

γ = Dry test meter correction factor, dimensionless

G_d = Specific gravity (relative to air), dimensionless

I = Isokinetic variation, percent by volume

M_d = Molecular weight of stack gas, dry basis, g/g - mole.

$\dot{m}_g$ = Mass flow of wet flue gas, LB/HR

$\dot{m}_p$ = Particulate mass flow, LB/HR

M_s = Molecular weight of stack gas, wet basis, g/g, mole.

M_p = Total amount of particulate matter collected, g

P_{bar} = Atmospheric pressure, IN. HG. (uncompensated)

P_g = Stack static gas pressure, IN. WC.

P_s = Absolute pressure of stack gas, IN.HG.

P_{std} = Standard absolute pressure, 29.92 IN. HG.

A_a = Actual volumetric stack gas flow rate, ACFM

$Q_{s,d}$ = Dry volumetric stack gas flow rate corrected to standard conditions, DSCFM

RH = Relative humidity, %

T_{db} = Dry bulb temperature of stack gas, ^oF

T_{wb} = Wet bulb temperature of stack gas, ^oF

$T_{m(avg)}$ = Absolute average dry gas meter temperature, ^oR

$T_s(avg)$ = Absolute average stack temperature, ^oF

T_{std} = Standard absolute temperature, 528 ^oF (68 ^oF)

θ = Total sampling time, min.

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml

V_m = Volume of gas sample as measured by dry gas meter, CF

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

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

$\bar{V}_s$ = Average actual stack gas velocity, FT/SEC

v_{Ptdb} = Vapor pressure at T_{db}, IN. HG.

vP_{twb} = Vapor pressure at T_{wb}, IN. HG

$\overline{\Delta H}$ = Average pressure differential across the orifice meter, IN. WC.

ΔP = Velocity pressure of stack gas, IN. WC.

γ = Dry test meter correction coefficient, dimensionless

ρ = Actual gas density, LB/ACF

CALCULATION EQUATIONS

METHOD 6

$$V_{std} = 17.64 \frac{V_m P_{b\gamma}}{T_m} \quad \text{(MIDGET IMPINGER VERSION)}$$

$$V_{std} = \frac{17.64\ V_m\ (P_b + \frac{\overline{\Delta H}}{13.6})\gamma}{T_m} \quad \text{(LARGE IMPINGER VERSION)}$$

$$MEQ = (V_t - V_{tb})\ N\ (\frac{V_{soln}}{V_a})\ DF$$

$$C_s = \frac{7.06 \times 10^{-5}\ MEQ}{V_{std}}$$

$$E = \frac{20.90\ C_s F_d}{20.90 - \overline{B}'_{O_2}} = \frac{F_c C_s}{\overline{B}'_{CO_2}}$$

$$C_s\ (MG/DSCM) = 1.60186 \times 10^7\ C_s$$

$$C_s\ (GR/DSCF) = 7000\ C_s$$

$$C_s\ (ppm, dry) = 6.02119 \times 10^6\ C_s$$

$$C_s\ (ppm, wet) = 6.02119 \times 10^6\ C_s\ (1 - \frac{MC}{100})$$

SYMBOLS

$\overline{B'}_{O_2}$	=	Average oxygen content in flue gas, % v/v, dry
$\overline{B'}_{CO_2}$	=	Average carbon dioxide content in flue gas, % v/v, dry
C_s	=	Concentration of sulfur dioxide in flue gas, dry basis, corrected to standard conditions, LB/DSCF
C_s (GR/DSCF)	=	Concentration of sulfur dioxide in flue gas, dry basis, corrected to standard conditions, GR/DSCF
C_s (MG/DSCM)	=	Concentration of sulfur dioxide in flue gas, dry basis, corrected to standard conditions, MG/DSCM
DF	=	Dilution Factor
E	=	Emission factor, LB of $SO_2/10^6$BTU
F_d	=	Dry oxygen F-Factor for given fuel type, DSCF/10^6BTU
F_c	=	Carbon dioxide F-Factor for given fuel type, DSCF/10^6BTU
ΔH	=	Average pressure drop across calibrated orifice, IN. W.C.
γ	=	Dry test meter correction factor, dimensionless
MC	=	Moisture content of flue gas, % v/v
MEQ	=	Total milliequivalents of SO_2 in gas sample
N	=	Normality of barium perchlorate titrant
P_b	=	Barometric pressure at the dry gas meter, IN. HG.

C_s (ppm-dry) = Concentration of sulfur dioxide in flue gas, dry basis, (v/v), ppm

C_s (ppm-wet) = Concentration of sulfur dioxide in flue gas, wet basis, (v/v), ppm

T_m = Absolute average dry gas meter temperature, ^oR

V_a = Volume of sample aliquot titrated, cc

V_m = Dry gas volume as measured by the dry gas meter, DCF

V_{std} = Dry gas volume as measured by the dry gas meter, corrected to standard conditions (at 68 ^oF and 1 atmosphere), DSCF

V_{soln} = Total volume of the solution in which the sulfur dioxide sample is contained, cc

V_t = Volume of barium perchlorate titrant used for the sample, cc (average of replicate titrations)

V_{tb} = Volume of barium perchlorate titrant used for the blank, cc

CALCULATION EQUATIONS

METHOD 7

$$V_{m(std)} = 17.64\ (V_f - 25)\ \left[\frac{P_f}{T_f} - \frac{P_l}{T_l}\right]$$

$$C_s = 6.243 \times 10^{-5}\ \frac{M}{V_{m(std)}}$$

$$E = \frac{2090\ C_s F}{20.9 - \bar{B}'_{O_2}}$$

$$C_s\ (GR/DSCF) = 7000\ C_s$$

$$C_s\ (MG/DSCM) = 1.60186 \times 10^{7}\ C_s$$

$$C_s\ (ppm\text{-}dry) = 8.37552 \times 10^{6}\ C_s$$

$$C_s\ (ppm\text{-}3\%\ O_2) = 8.37552 \times 10^{6}\ C_s \left\{1 + \left[\frac{\bar{B}'_{O_2} - 3}{20.9 - B'_{O_2}}\right]\right\}$$

$$C_s\ (ppm\text{-}wet) = 8.37552 \times 10^{6}\ C_s\ \left(1 - \frac{MC}{100}\right)$$

SYMBOLS

B'_{O_2} = Average oxygen content in flue gas, % v/v

C_s = Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, LB/DSCF

C_s (GR/DSCF) = Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, GR/DSCF

C_s (MG/DSCM) = Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, MG/DSCM

E = Emission factor, LB/10^6BTU

F = F-Factor for given fuel type, DSCF/10^4BTU

M = Mass of nitrogen oxides as nitrogen dioxide in gas sample, µg

MC = Moisture content of flue gas, %

P_f = Final absolute pressure in flask, IN. HG

P_I = Initial absolute pressure in flask, IN. HG

C_s (ppm-dry) = Concentration of nitrogen oxides in flue gas, dry basis, (v/v), ppm

C_s (ppm-3% O_2) = Concentration of nitrogen oxides in flue gas, dry basis, corrected to 3% O_2 , (v/v) ppm

C_s (ppm-wet) = Concentration of nitrogen oxides in flue gas, wet basis, (v/v), ppm

T_f = Final absolute temperature in flask, ^{o}R

T_i = Initial absolute temperature in flask, ^{o}R

V_f = Volume of flask and valve, cc

$V_{m(std)}$ = Sample volume at standard conditions, dry basis, cc

CALCULATION EQUATIONS

METHOD 10

$$CO\cdot PPM\cdot DRY = CO_{CO_2\text{-free,dry,avg}} \left(1 - CO_{2,d}/100\right)$$

$$CO\cdot PPM\cdot WET = CO\cdot PPM\cdot DRY \left(1 - MC/100\right)$$

$$GR/DSCF = 5.0885 \times 10^{-4} \left(CO\cdot PPM\cdot DRY\right)$$

$$mg/dscm = 1.165 \left(CO\cdot PPM\cdot DRY\right)$$

$$\dot{m} = 8.5714 \times 10^{-3} \left(GR/DSCF\right)\left(Q_{s,d}\right)$$

$$E = \frac{2.9857 \times 10^{-3} \, F_d \left(GR/DSCF\right)}{20.9 - O_{2,d}}$$

Where

$CO_{CO_2\text{-free,dry,avg}}$ = average of two determinations of carbon monoxide on a dry, CO_2-free integrated flue gas sample reported in ppm by volume

$CO_{2,d}$ = carbon dioxide concentration of flue gas on a dry percent by volume basis

$O_{2,d}$ = oxygen concentration of flue gas on a dry percent by volume basis

MC	= moisture content of flue gas on a percent by volume basis
CO·PPM·DRY	= carbon monoxide concentration in ppm by volume on a dry basis
CO·PPM·WET	= carbon monoxide concentration in ppm by volume on a wet or actual basis
GR/DSCF	= concentration of carbon monoxide in flue gas on a grains per dry standard cubic foot basis (68 ^{O}F, 29.92 IN.HG.)
mg/dscm	= concentration of carbon monoxide in flue gas on a milligrams per dry standard cubic meter basis (60 ^{O}F, 29.92 IN.HG.)
$\dot{m}$	= emission or mass rate of carbon monoxide on a LB/HR basis
$Q_{s,d}$	= volumetric flow rate of flue gas in dry standard cubic feet per minute
E	= emission factor of carbon monoxide in pounds of carbon monoxide emitted per million BTU heat input (LB/MMBTU)
F_d	= F-Factor of respective fuel in dry standard cubic feet of exhaust gas at 0% oxygen per million BTU of heat input (DSCF/MMBTU)