Background Report Reference

AP-42 Section Number: 11.23

Background Chapter: 4

Reference Number: 5

Title: Results of the August 5, 1986, Particulate and SO2 Compliance Test on the No. 2 Machine Wind Box an dHood Exhaust No. 4 Scrubber Stack at the Hibbing Taconite Company Plant

Interpoll, Inc.

Interpoll, Inc.

August 1986

(5)

Interpoll Inc.
4500 Ball Road N.E.
Circle Pines, Minnesota 55014

Telephone (612) 786-6020

RESULTS OF THE AUGUST 5, 1986, PARTICULATE AND SO2 COMPLIANCE TESTS ON THE NO. 2 MACHINE WIND BOX AND HOOD EXHAUST NO. 4 SCRUBBER STACK AT THE HIBBING TACONITE COMPANY PLANT

Submitted to:

HIBBING TACONITE COMPANY
P. O. Box 589
Hibbing, Minnesota 55754

Attention: Bob Ives

Approved by:

Perry Lonnes, Ph.D.
President

Report Number 6-2255
August 25, 1986

Interpoll Inc.
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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

On August 5, 1985, Interpoll Inc. personnel conducted a particulate and SO_2 emission compliance test on the No. 2 Machine Wind Box and Hood Exhaust No. 4 Scrubber at the Hibbing Taconite Company Plant located in Hibbing, Minnesota. On-site testing was performed by a two-man team under the direction of Dr. P. Lonnes. Coordination between plant operation and testing activities was provided by Bob Ives and other plant personnel of the Hibbing Taconite Company. The test was witnessed by Bob Beresford of the Minnesota Pollution Control Agency.

Evaluations were performed in accordance with EPA Methods 1-6, CFR Title 40, Part 60, Appendix A (revised July 1, 1985). Previously collected data was used to select the appropriate nozzle diameter required for isokinetic sample withdrawal. An Interpoll sampling train which meets or exceeds specifications in the above-cited reference was used to collect the samples by means of a heated stainless steel-lined probe. Sulfur dioxide determinations were performed in accordance with the large impinger version of EPA Method 6 using the back half of the Method 5 sampling train.

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. 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 the No. 2 Machine Wind Box and Hood Exhaust No. 4 Scrubber was conducted from two test ports oriented at 90 degrees approximately two stack diameters downstream of a transition breeching and more than eight 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. Results of preliminary measurements, field data and all other supporting information are presented in the appendices.

2 SUMMARY AND DISCUSSION

The important results of the particulate and sulfur dioxide emission compliance test are summarized in Tables 1 and 2. As will be noted, the particulate emission rate averaged 11.8 LB/HR. The sulfur dioxide emission factor averaged 1.77 LB/10^6BTU.

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 particulate and sulfur dioxide concentrations reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

TABLE 1. Summary of the Results of the August 5, 1986, Particulate Emission Compliance Test on the No. 2 Wind Box & Hood Exhaust No. 4 Scrubber at the Hibbing Taconite Plant in Hibbing, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		08-05-86	08-05-86	08-05-86
Time runs were done	(HRS)	800/ 905	927/1031	1050/1154
Process rate	(KLB/HR)	902.7 451 ton/hr	902.7 451	902.7 451 TON/HR
Volumetric flow				
actual	(ACFM)	177659	177764	178245
standard	(DSCFM)	131653	131183	132198
Gas temperature	(DEG-F)	132	133	135
Moisture content	(%V/V)	11.98	12.21	11.41
Gas composition	(%V/V,dry)			
carbon dioxide		1.20	1.20	1.20
oxygen		19.00	19.00	19.00
carbon monoxide		0.00	0.00	0.00
nitrogen		79.80	79.80	79.80
Isokinetic variation	(%)	96.8	101.8	98.6
Particulate concentration				
actual	(GR/ACF)	0.01016	0.00568	0.00734
standard	(GR/DSCF)	0.01371	0.00770	0.00990
Part. emission rate	(LB/HR)	15.47 20.00	8.65 21.25	11.22 20.80

* DRY CATCH ONLY

Table . Summary of the Results of the August 5, 1986, Sulfur Dioxide Emission Compliance Test on the No. 2 Machine Wind Box and Hood Exhaust No. 4 Scrubber Stack at the Hibbing Taconite Company Plant in Hibbing, Minnesota.

Test/Run	Time (HRS)	Sulfur Dioxide		
		Concentration (ppm,w)	Emission Factor ($LB/10^6BTU$)	Emission Rate (LB/HR)
1/1	0800-0905	84	1.75	125.76
1/2	0922-1031	85	1.78	127.06
1/3	1050-1154	86	1.78	128.33
	Average:	85	1.77	127.05

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 and visible emission 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. The dry particulate emission factor has been calculated by the Oxygen F-Factor Method using the latest EPA-published dry F-Factor for the stated fuel.

Test No. 1
No. 2 Machine WB & H No. 4 Scrubber Stack

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

Date of run	Run 1 08-05-86	Run 2 08-05-86	Run 3 08-05-86
Dry basis (orsat)			
carbon dioxide.....	1.20	1.20	1.20
oxygen.....	19.00	19.00	19.00
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.80	79.80	79.80
Wet basis (orsat)			
carbon dioxide.....	1.06	1.05	1.06
oxygen.....	16.72	16.68	16.83
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	70.24	70.06	70.69
water vapor.....	11.98	12.21	11.41
Dry molecular weight.....	28.95	28.95	28.95
Wet molecular weight.....	27.64	27.61	27.70
Specific gravity.....	0.955	0.954	0.957
Water mass flow.....(LB/HR)	50262	51176	47759

FO	1.583	1.583	1.583

Test No. 1
No. 2 Machine WB & H No. 4 Scrubber Stack

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

	Run 1	Run 2	Run 3
Date of run	08-05-86	08-05-86	08-05-86
Time run start/end.....(HRS)	800/ 905	927/1031	1050/1154
Static pressure.....(IN.WC)	-0.04	-0.04	-0.04
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)	107.0	114.0	111.0
desiccant.....(GRAMS)	20.0	22.0	12.0
total.....(GRAMS)	127.0	136.0	123.0
Total particulate material..			
.....collected(grams)	0.0391	0.0230	0.0289
Gas meter coefficient.....	1.0033	1.0033	1.0033
Barometric pressure..(IN.HG)	28.23	28.23	28.23
Avg. orif.pres.drop..(IN.WC)	1.88	2.09	2.02
Avg. gas meter temp..(DEF-F)	72.7	81.7	91.0
Volume through gas meter....			
at meter conditions...(CF)	46.68	49.72	49.40
standard conditions.(DSCF)	44.00	46.11	45.03
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.252	.252	.252
Avg.stack gas temp ..(DEG-F)	132	133	135
Volumetric flow rate.....			
actual.....(ACFM)	177659	177764	178245
dry standard.....(DSCFM)	131653	131183	132198
Isokinetic variation.....(%)	96.8	101.8	98.6
Particulate concentration...			
actual.....(GR/ACF)	0.01016	0.00568	0.00734
dry standard.....(GR/DSCF)	0.01371	0.00770	0.00990
Particle mass rate...(LB/HR)	15.47	8.65	11.22

3.3 Results of Sulfur Dioxide Determinations

Test No. 1
No. 2 WB & H No. 4 Scrubber Stack

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

	Run 1
Date of run	08-04-86
Time run start/end.....(HRS)	1522/1542
Barometric pressure..(IN.HG)	28.30
Meter temperature....(DEG-F)	91.60
Meter correction coefficient	1.0033
Volume through gas meter....	
at meter conditions...(CF)	15.260
standard conditions..(SCF)	13.920
Total sampling time....(MIN)	20.0
Moisture content.....(%V/V)	15.46
Oxygen content....(%V/V DRY)	19.00
Milliequivalents of SO4 in..	
gas sample.....	2.8449
Sulfur dioxide concentration	
(GR/DSCF).....	0.1010
(MG/DSCM).....	231
(PPM-DRY).....	87
(PPM-WET).....	73
SO2 Emission rate....(LB/HR)	123.82
Sulfur dioxide emission.....	
.....factor (LB/MMBTU)*	1.588

* F = 10006 DSCF/MMBTU

Test No. 1
No. 2 Machine WB & H No. 4 Scrubber Stack

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

	Run 1	Run 2	Run 3
Date of run	08-05-86	08-05-86	08-05-86
Time run start/end.....(HRS)	800-905	927-1031	1050-1154
Barometric pressure..(IN.HG)	28.23	28.23	28.23
Meter temperature....(DEG-F)	72.70	81.70	91.00
Meter correction coefficient	1.0033	1.0033	1.0033
Volume through gas meter....			
at meter conditions...(CF)	46.680	49.720	49.400
standard conditions..(SCF)	43.996	46.107	45.029
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	11.98	12.21	11.41
Oxygen content....(%V/V DRY)	19.00	19.00	19.00
Milliequivalents of SO4 in..			
gas sample.....	9.9201	10.5407	10.3173
Sulfur dioxide concentration			
(GR/DSCF).....	0.1114	0.1130	0.1132
(MG/DSCM).....	255	259	259
(PPM-DRY).....	96	97	97
(PPM-WET).....	84	85	86
SO2 Emission rate....(LB/HR)	125.76	127.06	128.33
Sulfur dioxide emission.....			
.....factor (LB/MMBTU)*	1.752	1.777	1.781

* F = 10006 DSCF/MMBTU

Test No. 1
No. 2 Machine WB & H No. 4 Scrubber Stack

3.4 Results of Opacity Observations - EPA Method 9

Percent Opacity	Optical Density	Relative Frequency (%)
0	.0000	100
5	.0223	0
10	.0458	0
15	.0706	0
20	.0969	0
25	.1249	0
30	.1549	0
35	.1871	0
40	.2219	0
45	.2596	0
50	.3010	0
55	.3468	0
60	.3979	0
65	.4559	0
70	.5229	0
75	.6021	0
80	.6990	0
85	.8239	0
90	1.0000	0
95	1.3010	0
99	2.0000	0
0	.0000	Time Average

Observer: C. Mosser
Cert Date: 4-29-86
Date of Observation: 8-05-86
Time of Observation: 1230-1330

Interpoll Inc.
(612)786-6020

Meter Box Calibration
Data Sheet

Date of Calibration: July 7, 1986
Technician: J. Buresh
Barometric Pressure: 29.32

Meter Box No.: 4
Dry Test Meter Serial No.: 964552
Wet Test Meter No.: A1-20

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	0002.000	004.020	73	87	74	7.58	1.0014	1.716
1.2	3	99.88	.06	998.000	1001.023	73	88	74	7.48	1.0029	1.755
2.0	4	99.89	.07	006.000	009.032	72.8	90	76	5.78	1.0021	1.802
3.3	5	99.90	.085	0010.000	0015.079	72.5	100	78	7.59	1.0054	1.789
4.7	5	99.95	.12	0027.000	0032.105	72.5	104	82	6.82	1.0045	1.800
									Average:	1.0033	1.772

A-1

Interpoll Inc.
(612)786-6020

Meter Box Calibration and Usage Status

Date of Report: August 5, 1986

Meter Box No.: 4

Date of Last Calibration: July 7, 1986
Calibration Technician: J. Buresh
Wet Test Meter No.: American Meter A1-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
July 23-25, 1986	6-2251	34.31	505.77	471.46	471.46
July 30, 1986	6-2253	506.00	613.88	107.88	579.34
August 5, 1986	6-2255	614.10	775.80	161.70	741.04

*Total volume through meter since last calibration

Interpoll Inc.
(612)786-6020

Nozzle Calibration
Data Sheet

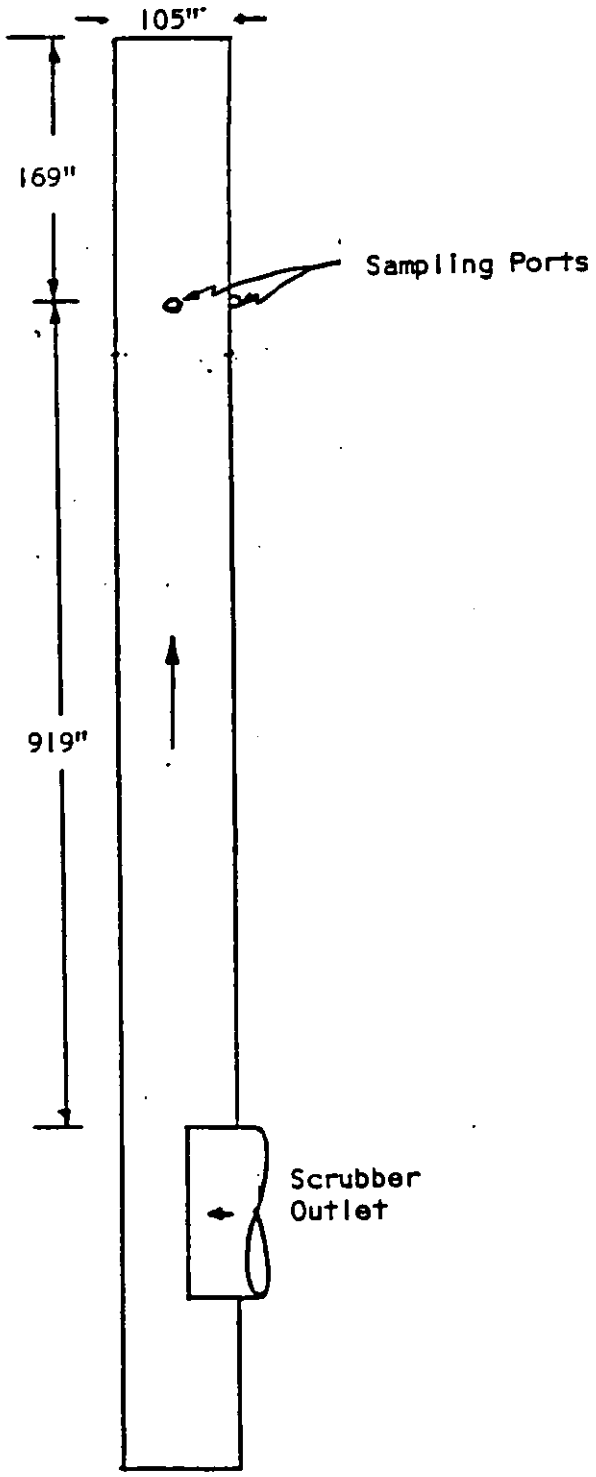
Date of Calibration: August, 1985 Nozzle Number 4-2
Technician: J. Buresh

Nozzle rotated by 36 degree increments and diameter measured to nearest 0.001 inch. Observed readings and average:

Position	Diameter (inches)
1	.250
2	.252
3	.253
Average:	.252

HOOD AND WINDBOX EXHAUST STACK

HIBBING TACONITE



NOT TO SCALE

Preliminary Data – Method 2

— Interpoll Inc. —

Job HIBBING TACONITE COMPANY

Source No2 Machine WBSH No1 Scrubber Stack Date 8-5-86

Test No. 1 Run No. _____

Stack dimensions: 105 in.

Dry bulb _____ °F Wet bulb _____ °F

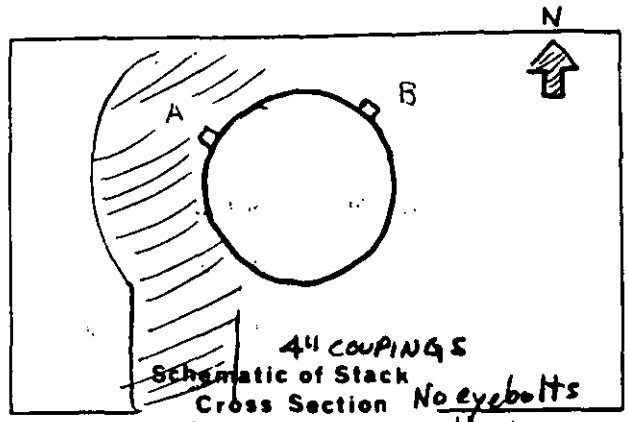
Rel. hum. _____ % B_{wo} ~15 %

Barometric pressure (P_b) 28.23 in. Hg

Static pressure (P_g) -.04 in. WC _____ in. Hg

Operators P. LONNES CURT MOSSER

Pitot No. 10-8 C_p .840 Port Length 9"



Schematic of Stack Cross Section

work w/ 1 Shepard Hook

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		
25				avg. 134 °F

S-0034R

EPA Method 4 and 6 Field Data Sheet

Barometric Pressure 28.30 IN.HG.

Job HIBBING TACONITE Co. Operators PL & CM

Source No 2 Machine WB&H No 4 Scrubber Stack Sampling Train No. 4 ΔH_a 1.77

Date 8-4-86 Test 1 Run 0 Gasmeter coeff. 1.0033 Amb. Temp. ___ °F

Sample Train: Leak check

pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☒

posttest: 0 cfm at 5 in. Hg. (vac.)

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
	(1522)	(614.10)										
	5	617.82		1.77		4.2		250	230	19.0	92	88
	10	621.64		1.77		4.2				19.0	93	89
	15	625.50		1.77		4.2		250	235	19.0	95	90
	20	629.36		1.77		4.2				19.0	96	90
	(1542)											
	Θ = 20	V_m = 15.28		$\overline{\Delta H}$ = 1.77							$\overline{T}_m$ = 91.6	

Laboratory Data:

Normality of barium perchlorate titrant (N) .00993

Volume of titrant used to titrate aliquot (V_t) 5.75 cc

Volume of titrant used to titrate blank (V_{tb}) .02 cc

Total volume of sample (V_{soln}) 500 cc

Volume of aliquot titrated (V_a) 10 cc

Impinger Number	Weights Tare	Final	Difference
IMPINGERS	263	280	17
DESICCANT	1348	1311	37
Total (M_{wo})			54 g

19.10
24.85

Sample Log Sheet

Job HIBBING TACONITE CO

Unit and Sampling Location No 2 Machine WB&H No 4 Scrubber Stack

Date 8-5-86 Test 1 Run 1

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

posttest: 0 cfm at 6 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 6148			
PW			
Total (M_n)			g

Impinger ☒ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
IMPINGERS	371	264	107
DESICCANT	1368	1348	20
Total (M_{wo})			127 g

Integrated Flue Gas Sampling Data

FG Train No. B-2 Box No. 7 Bag No. 1

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check 0 cc/min at 15 in. Hg. 320-P No. 3

Time	cc/min.	Time	cc/min.
(0802)			
	400		
(0905)			

Operator P.L. 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE Co. Operators PL & CM Pitot No. 10-8 C_p .840

Source No 2 Machine WBZH No 9 Scrubber Stack Sampling Train No. 4 $\Delta H_@$ 1.77 Bar. Press. 28.23 in.Hg. B_{wo} 15 %

Date 8-5-86 Test 1 Run 1 Gasmeter coeff. 1.0033 Amb. Temp. 62°F Nozzle No. 4-2 Nozzle Dia. .252 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
	(0800)	(629.60)							OVEN/CONT			
A-6	5	633.33	.58	1.73	3.31		130	250	250/60	19.2	64	64
5	10	637.22	.64	1.91	7.21	4.2	130			19.3	66	64
4	15	641.42	.74	2.21	1.41	5.3	130			19.3	70	66
3	20	645.57	.71	2.13	5.55	5.2	130	260	250/55	19.3	74	66
2	25	649.56	.64	1.93	9.50	4.6	130	~		19.3	76	67
1	30	652.77	.44	1.33	2.78	3.8	130	/		19.3	78	68
B-6	35	656.59	.58	1.76	6.57	4.1	130			19.2	75	70
5	40	660.60	.66	1.99	0.58		134	220	250/60	19.1	80	71
4	45	664.82	.72	2.18	4.79	5.3	134			19.2	82	72
3	50	668.99	.70	2.12	8.96	5.2	134			19.1	83	72
2	55	692.97	.65	1.97	2.98	4.8	134			19.0	84	73
1	60	696.28	.43	1.31	6.26	3.8	134	260	250/60	19.0	85	75
	(0905)											
	$\theta = 60$	$V_m = 46.68$		$\overline{\Delta H} = 1.89$							$\overline{T_m} = 72.7$	

C-4

Sample Log Sheet

Job Hibbing Taconite Co

Unit and Sampling Location No 3 Machine WB&H No 4 Scrubber Stack

Date 8-5-86 Test 1 Run 2

Sample Train: Leak check pretest : < 0.02 cfm at 15 in. Hg. (vac.) ☑
posttest: 0 cfm at 6 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER # 6142			
PW			
Total (Mn)			g

Impinger ☒ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
IMPINGERS	379	265	114
DESICCANT	1363	1341	22
Total (M_{wo})			136 g

Integrated Flue Gas Sampling Data

FG Train No. B-2 Box No. 7 Bag No. 2

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check 0 cc/min at 15 in. Hg. 320-P No. 3

Time	cc/min.	Time	cc/min.
(0930)			
	400		
	↓		
(1631)			

Operator P.L. 320-P Reading _____ % v/v

EPA ...hod ...eld ...s Sh...

Job HIBBING TACONITE Co Operators PL & CM Pitot No. 10-8 C_p .840

Source No 2 Machine W&H No 4 Scrubber Stack Sampling Train No. 4 $\Delta H_@$ 1.77 Bar. Press. 28.23 in.Hg. B_{wo} 10 %

Date 8-5-86 Test 1 Run 2 Gasmeter coeff. 1.003 Amb. Temp. ___ °F Nozzle No. 4-2 Nozzle Dia. .257 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
	(0927)	(676.50)							GUN/CONE			
B-6	5	680.53	.60	1.98	0.51	4.3	134	250	240/60	19.2	76	74
5	10	684.76	.66	2.18	4.73	5.0	134			19.3	82	75
4	15	689.23	.73	2.43	9.20		134			19.2	84	76
3	20	693.66	.72	2.40	3.65	5.7	134			19.3	84	76
2	25	697.88	.64	2.13	7.85		134	260	250/60	19.3	85	77
1	30	701.35	.44	1.47	1.35	3.8	134			19.3	86	77
A-6	35	705.14	.52	1.74	5.15	3.9	133			19.1	84	77
5	40	709.33	.64	2.14	9.36	4.9	132			19.2	86	79
4	45	713.78	.71	2.39	3.81	4.9	131	260	250/65	19.0	88	80
3	50	718.26	.71	2.40	8.28		131			19.0	90	80
2	55	722.63	.66	2.24	2.60	5.7	130			19.0	91	81
1	60	726.22	.45	1.53	6.17	3.8	130		250/60	19.0	92	82
	(1031)											
	θ = 60	V_m = 49.72		$\overline{\Delta H}$ = 2.09							$\overline{T}_M$ = 81.7	

C-6

Sample Log Sheet

Job HIBBING TACONITE COMPANY

Unit and Sampling Location No 2 Machine WB2H No 4 Scrubber Stack

Date 8-5-86 Test 1 Run 3

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

posttest: 0 cfm at 6 in. Hg. (vac.)

Particulate Sample Type and Number	Weights		
	Final	Tare	Difference
FILTER #6143			
PW			
Total (M_n)			g

Impinger ☒ Condenser ☐

Impinger Number	Weights		
	Final	Tare	Difference
IMPINGER	375	264	111
DESICCANT	1348	1336	12
Total (M_{wo})			122 g

Integrated Flue Gas Sampling Data

FG Train No. B-2 Box No. 7 Bag No. 3

Bag Material TEDLAR Bag Volume 44 L

Pretest leak check 0 cc/min at 15 in. Hg. 320-P No. 3

Time	cc/min.	Time	cc/min.
(1052)			
	400		
	↓		
	↓		
	↓		
(1154)	↓		

Operator P.L. 320-P Reading _____ % v/v

EPA Method 5 Field Data Sheet

Job HIBBING TACONITE CO Operators PL & DM Pitot No. 10-8 C_p .840

Source No 2 MACHINE WET H No 4 Scrubber Stack Sampling Train No. 4 $\Delta H_@$ 1.77 Bar. Press. 28.23 in.Hg. B_{wo} 12.7 %

Date 8-5-86 Test 1 Run 3 Gasmeter coeff. 1.0033 Amb. Temp. 75 °F Nozzle No. 4-2 Nozzle Dia. .252 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
	(1050)	(726.40)							OVEN/PROBE			
A-6	5	730.23	.55	1.75	0.20	3.8	135	250	245/60	19.2	85	84
5	10	734.36	.65	2.07	4.36	3.8	135			19.2	89	84
4	15	738.64	.69	2.21	8.66		135			19.1	93	84
3	20	743.12	.74	2.38	3.13	5.4	135			19.3	95	86
2	25	747.34	.65	2.10	7.33	5.0	135	255	250/60	19.4	96	86
1	30	750.84	.45	1.45	0.84	3.8	135			19.5	97	87
B-6	35	754.90	.61	1.97	4.93	4.3	135			19.2	96	88
5	40	759.27	.76	2.26	9.30		135			19.0	98	89
4	45	763.75	.73	2.37	3.76	5.7	135	260	255/60	19.1	98	89
3	50	768.24	.72	2.34	8.22	6.7	135			19.1	98	89
2	55	772.38	.62	2.01	2.35	4.9	135			19.1	98	89
1	60	775.80	.41	1.33	4.04 5.72	3.6	135	260	255/60	19.1	98	89
	(1154)											
	Θ = 60	V_m = 49.40		$\overline{\Delta H}$ = 2.02							$\overline{T_m}$ =	91.0

C-8

— Interpoll Inc —

S-0037R

~ 990 LTON/HR

6 IN WC across venturi

APPENDIX D

METHOD 9 FIELD DATA SHEETS

Visible Emissions Form

— Interpoll Inc. —

Company Hibbing Taconite Co. Date 8-5-86

Address Hibbing, MN. Observer C. Mosser

Re-Certification Date 4-29-86

Source No. 2 Machine WBH No. Scrubber Stack Source _____

Start 1230 hrs End 1330 hrs Start _____ hrs End _____ hrs

Location of Observer (direction & distance) 75 Ft.

Plume Description (color, etc) White

Background Description Mostly White Clouds

Ambient Temperature (°F) _____

Wind Speed (mph) 0-3 Direction NNW

Fuel Type 95% Petroleum Coke, 5% Natural Gas

Load (Specify) _____

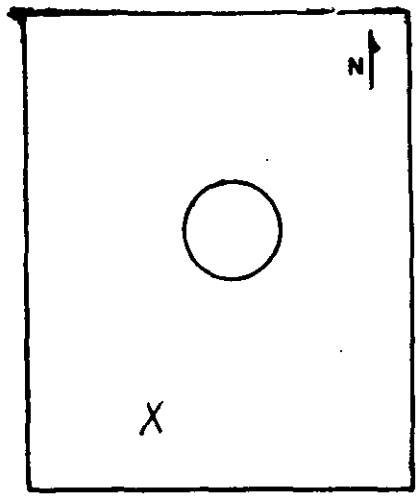
Emission Source Height (ft) _____

Outlet Dimensions (ins.) _____

Type of Source No. 1 _____

Source No. 2 _____

Observer position relative to plume and sun



Personnel present at time of observations: _____

— COMMON STACK —

Unit No. _____ Unit No. _____ Unit No. _____ Unit No. _____

Unit Load (Specify)

_____ _____ _____ _____

Fuel Type & Quantity:

_____ _____ _____ _____

_____ _____ _____ _____

S-0079

Plume Opacity Data — Method 9

— Interpoll Inc. —

Plant: Hibbing Taconite Co. Date: 8-5-86 Time: 1230 hrs

Source: No. 2 Machine WBH No. 4 Scrubber Stack Source: _____

	0	15	30	45		0	15	30	45
0	0	0	0	0	30	0	0	0	0
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0

	0	15	30	45		0	15	30	45
0					30				
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27		-			57				
28					58				
29					59				

Meteorological Conditions: Mostly cloudy

X																			
0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100

RELATIVE FREQUENCY:

Observer: C. Mosser

S-0080 R

MINNESOTA POLLUTION CONTROL AGENCY

AIR POLLUTION CONTROL ASSOCIATION

This is to certify that,

Curtis Mosser

attended and fulfilled the requirements of the

Visible Emission Evaluation Certification Course

offered by

The Air Pollution Control Association
Upper Midwest Section

In conjunction with the

The Minnesota Pollution Control Agency
Division of Air Quality

on

APRIL 29, 1986

During the course of the test an average deviation of less than 7.5% for a set of 25 white smoke and a set of 25 black smoke was maintained and none of the readings deviated by 20% or more.

By achieving the above accuracy, certification as a "Smoke Reader" is granted for a period of six months from the date of the test.

ROGER V. KARN
Instructor
Visible Emissions Program
MPCA, DAQ

Certificate Number 58-35

APPENDIX E

LABORATORY DATA SHEETS

3864

Interpoll Inc.
(612)786-6020

Pg ___ of ___

Chain of Custody
Sample Deposition Sheet

Job HIBBING TACONITE CO
Site No2 MACHINE WB&H Scrubber No 4 Stack
Team Leader PILONNES
Priority NORMAL
Date Submitted 8-7-86
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
3 3b	Probe Wash Solvent(s): Acetone	☒ As per EPA 5 ☐ _____ _____		
3	Filter: ☒ 4" glass fiber ☐ Stainless steel ☐ ERC	☒ As per EPA 5 ☐ _____ _____		
	Wet Catch	☐ Organic ☐ Inorganic ☐ Other		
3	Orsat			
3	SO_2	+ blank		
	SO_2 Audit Sample			EPA Control No(s).
	NO_x (Open box tops after unloading)	☐ Colorimetric ☐ Ion Chromatographic		Date / / & Time of arrival at Interpoll
	NO_x Audit Sample			EPA Control No(s).
1	Fuel Sample	Ult + prox		

Source Information

1) Type of source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☐ Other Taconite Pellet Induration Furnace
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: No 2 Machine WB & # Scrub # 4 Stack
Sampling Date: 8-5-86
Analysis Date: 8-5-86
Technician: Rcl

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
3864-04 8-5-86	1	1.20	19.00					
3864-08 8-5-86	2	1.20	19.00					
3864-12 8-5-86	3	1.20	19.00					

Form #L-200 R

Interpoll Inc.
(612)786-6020

EPA Method 3 Data Sheet (Orsat Analysis)

Technician _____ Date of Analysis 8-5-86

Orsat Analyzer No. _____ Leak Check Performed ☑ YES ☐ NO

Job _____ Source _____

City/State _____ Fuel Type _____ Test Site _____

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									
[illegible]	F		1	0.00	1.20	[illegible]	1.20	19.60	
	B		2	0.00	1.20	[illegible]	1.20	19.60	
			3						
			AVG				1.20	19.60	
[illegible]	F		1	[illegible]	1.00	[illegible]	1.00	19.00	
	B		2	[illegible]	1.20	[illegible]	1.20	19.00	
			3						
			AVG				[illegible]	[illegible]	
[illegible]	F		1	[illegible]	1.20	[illegible]	1.20	19.00	
	B		2	[illegible]	1.20	[illegible]	1.20	19.00	
			3						
			AVG				1.20	19.00	

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.

L-0192R

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 8-8-86
Technician Rcv

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 3.0 µg/cc

(1) interpoll

Job Hibbing Taconite Date 8-5-86
City/State _____ Log# 3864-13
Source Nu 2 Machine Wash
Test Site Stack
Sample type _____ Tech PL
Remarks: Blank Test/Run 1/0
1 of 1

Special Handling Required _____

Evaporating Dish No. 1 glass
Volume of acetone 135 cc
E. Dish Tare Wt. 17.0906 g
E. Dish + Sample Wt. 17.0910 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	2	3

L-0185/Y R

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

Filter Blank

Date of Analysis 8-8-84
Technician PCV

interpoll

1
Job Hibbing Taconite Date 8-5-86
City/State _____ Log# 3864-76
Source _____
Test Site _____
Sample type _____ Tech PL
Remarks: Blank Test/Run 1/0
1 of 1

Special Handling Required _____
Filter No. 6192
Filter Type 9116
Filter Tare Wt. 0.6068 g
Filter + Sample Wt. 0.6068 g
Comments _____

interpoll

2
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 _____

interpoll

3
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
0.0000		

L-0186/P

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

Date of Analysis 8-8-86
Technician RCV

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 3.0 µg/cc

(1)

interpoll

Job Hibbing Taconite Co. Date 8-5-86
City/State _____ Log # 3864-04
Source No2 Machine WB&H No. Scrubber
Test Site STACK
Sample type PW Tech PL
Remarks: Test/Run 1/1
1 of 1

Special Handling Required _____
Evaporating Dish No. 19
Volume of acetone 105 (1) cc
E. Dish Tare Wt. 101.7880 g
E. Dish + Sample Wt. 101.8187 (2) (3) g
Comments _____

(2)

interpoll

Job Hibbing Taconite Co Date 8-5-86
City/State _____ Log # 3864-05
Source No2 Machine WB&H No. Scrubber
Test Site STACK
Sample type PW Tech PL
Remarks: Test/Run 1/2
1 of 1

Special Handling Required _____
Evaporating Dish No. 45
Volume of acetone 115 (1) cc
E. Dish Tare Wt. 92.7949 g
E. Dish + Sample Wt. 92.8103 (2) (3) g
Comments _____

(3)

interpoll

Job Hibbing Taconite Co Date 8-5-86
City/State _____ Log # 3864-09
Source No2 Machine WB&H No Scrubber
Test Site STACK
Sample type PW Tech PL
Remarks: Test/Run 1/3
1 of 1

Special Handling Required _____
Evaporating Dish No. 417
Volume of acetone 95 (1) cc
E. Dish Tare Wt. 92.4721 g
E. Dish + Sample Wt. 92.4925 (2) (3) g
Comments _____

RESULTS:

1 / 0.0304 E-6 2 / 0.0151 3 / 0.0201

L-0185/Y R

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

Date of Analysis 8-8-86
Technician RCV

---

(1)

interpoll

Job Hibbing Taconite Date 8-5-86
City/State _____ Log# 3864-02
Source No 2 Machine WB & H scrub
Test Site Stack
Sample type _____ Tech PL
Remarks: Test/Run 1/1
1 of 1

Special Handling Required _____

Filter No. 6148
Filter Type 4"G
Filter Tare Wt. 0.5994 g
Filter + Sample Wt. 0.6084 g
Comments _____

---

(2)

interpoll

Job Hibbing Taconite Date 8-5-86
City/State _____ Log# 3864-02
Source No 2 Machine WB & H Scrub
Test Site Stack
Sample type _____ Tech PL
Remarks: Test/Run 1/2
1 of 1

Special Handling Required _____

Filter No. 6142
Filter Type 4"G
Filter Tare Wt. 0.5976 g
Filter + Sample Wt. 0.6055 g
Comments _____

---

(3)

interpoll

Job Hibbing Taconite Date 8-5-86
City/State _____ Log# 3864
Source No 2 Machine WB & H Scrub
Test Site Stack
Sample type _____ Tech PL
Remarks: Test/Run 1/3
1 of 1

Special Handling Required _____

Filter No. 6143
Filter Type 4"G
Filter Tare Wt. 0.5895 g
Filter + Sample Wt. 0.5983 g
Comments _____

RESULTS:

1	2	3
0.0087	0.0079	0.0088

0.0391	0.0230	0.0289

L-0186/P

INTERPOLL INC.

EPA Methods 6 & 8 Barium Perchlorate Titrant Standardization Sheet

Date of Standardization 8-7-86
Technician RCV
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 — Prepared on 5/02/86 by RCV
   Primary Standard — 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

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

$$N = \frac{0.25}{V_t - V_b} = \frac{0.25}{(25.20) - (.02)} = 0.00993 \text{ Normality}$$

L-214RRR

Job Name: Hibbing Taconite Co
Test/Run: 1/0
Log No.: _____

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 8-4-86
Technician P.L

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (_____Samp.+ Bottle) - (_____Bottle) = _____cc

pH of original sample 2 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 Co Date 8-4-85
City/State _____ Log # _____
Source No2 Machine WB&H No Scrubber Stock
Test Site _____
Sample type Soln Tech PL
Remarks: Test/Run 1/0
1 of 1

Step 2 Orig. sample brought to volume (V_{soln}):
☐ 100 cc
☐ 250 cc
☒ 500 cc
☐ ___ 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) .00993 Volume of titrant for blank (V_b) .02

	Trial 1	Trial 2	Trial 3	Average
Starting volume of buret	19.10 cc	24.85 cc	_____ cc	
Final volume of buret	24.85 cc	30.60 cc	_____ cc	
Volume of titrant for aliquot (V_s)	5.75 cc	5.75 cc	_____ cc	5.75 cc

L-230RR

Job Name: Hibbing Taconite
Test/Run: 1/1
Log No.: 3864-03

Interpoll Inc.
(612)786-6020
EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 8-9-86
Technician RCL

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (371.4 Samp.+ Bottle) - (64.1 Bottle) = 307.3 cc

pH of original sample 3.5 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 8-5-86
City/State ____ Log #3864-03
Source No 2 machine w/B&W Screen
Test Site Stack
Sample type SO_2 Tech RL
Remarks: Test/Run 1/1
____ of ____

Step 2 Orig. sample brought to volume (V_{soln}):
☐ 100 cc
☐ 250 cc
☑ 500 cc
☐ ___ 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	0.05 cc	0.00 cc	____ cc	
Final volume of buret	20.05 cc	20.00 cc	____ cc	
Volume of titrant for aliquot (V_s)	20.00 cc	20.00 cc	____ cc	20.00 cc

E-10

L-230RR

Job Name: Hibbing Taconite
Test/Run: 1/2
Log No.: 3864-07

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 8-9-86
Technician RCW

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (378.5 Samp.+ Bottle) - (65.4 Bottle) = 313.1 cc

pH of original sample <3.5 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 #1 Date 8-5-86
City/State _____ Log #3864-07
Source #1 & 2 Machine #B/F Scrub
Test Site Stack
Sample type SO2 Tech PL
Remarks: Test/Run 1/2
1 of 1

Step 2 Orig. sample brought to volume (V_{soln}):
☐ 100 cc
☐ 250 cc
☒ 500 cc
☐ ___ 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	21.25 cc	21.25 cc	____ cc	
Volume of titrant for aliquot (V_s)	21.25 cc	21.25 cc	____ cc	21.25 cc

E-11

L-230RR

Job Name: Hibbing Taconite
Test/Run: 1/3
Log No.: 3864-11

Interpoll Inc.
(612)786-6020

EPA Method 6
Barium/Thorin I Sulfate
Titration Data Sheet

Date of Analysis 8-5-86
Technician RCU

Step 1 SAMPLE RECOVERY & PREPARATION

Original sample volume (375.0 Samp.+ Bottle) - (64.4 Bottle) = 310.6 cc

pH of original sample 3.5 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 8-5-86
City/State _____ Log # 3864-11
Source No 2 Machine WB 4A Scrub
Test Site Stack
Sample type SO2 Tech PL
Remarks: Test/Run 1/3
1 of 1

Step 2 Orig. sample brought to volume (V_{soln}):
☐ 100 cc
☐ 250 cc
☑ 500 cc
☐ ___ 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) 0.00995 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	20.80 cc	20.80 cc	___ cc	
Volume of titrant for aliquot (V_s)	20.80 cc	20.80 cc	___ cc	20.80 cc

E-12

L-230RR

Interpoll Inc.
(612)786-6020

MPCA Exhibit C for Process Emissions

JOB Hibbing Taconite
SOURCE No 2 Machine Wind Box & Hood Exhaust No. 4 Scrubber Stack
DATE 8-5-86

C. Equipment & Operating Data

1. Process Equip. No./Ident. No 2 Machine.
2. Process Equip. Description Induration Furnace Wet Venturi Scrubber.
3. Process equipment operating under normal operating conditions:
   No X. Yes ____. Above rated capacity

D. Instrument Data on Process Equipment

1. Include copy of production records or instrumentation which indicates rate of production or operation of the equipment, i.e. units per hour, lbs. per hour, pressure, air flow, etc.

E. Air Pollution Control Equipment

1. Type/model control equipment Environeering Venturi Rod Wet Scrubbers Model A-33
2. Air pressure drop across the control equipment 6".
3. Air flow through the control equipment 178000 ACFM.
4. Was the control equipment operating normally? Yes.
5. Data of last major maintenance/cleaning of control equipment
   June 1986.

F. Plant Manager's Certification

I certify that the information submitted herein is accurate and correct and that no information requested was withheld from MPCA, Division of Air Quality.

By Bob Ives, Position ____

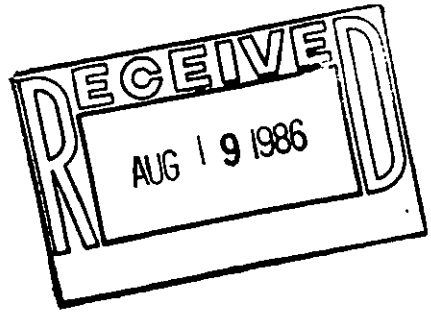
S-349R

HIBBING TACONITE CO.
COMPLIANCE TEST ON PETROLEUM COKE AS AN ALTERNATE FUEL

OPERATING DATA

FUEL CONSUMPTION		
NATURAL GAS	16	MCF
PETROLEUM COKE	17870	LBS
FUEL BTU VALUES		
NATURAL GAS	1004	BTU/CF
PETROLEUM COKE	15045	BTU/LB *
CONSUMED BTU		
NATURAL GAS	16064000	BTU
PETROLEUM COKE	268854150	BTU
TOTAL	284918150	BTU
PELLET PRODUCTION	1610	DLT
OPERATING TIME	4	HRS
PELLET PRODUCTION RATE	403	DLTPH
CONSUMED BTU RATE		
NATURAL GAS	4016000	BTU/HR
PETROLEUM COKE	67213538	BTU/HR
TOTAL	71229538	BTU/HR
PETROLEUM COKE REPLACEMENT	94.36	PERCENT

* PER LERCH BROS. ANALYSIS (TELECON 8/8/86)



COMMENTS

RATED CAPACITY:

THE QUESTION OF RATED CAPACITY WAS RAISED IN REGARD TO THE COMPLIANCE TEST. THE DESIGN RATED CAPACITY IS 341 DLTPH. DURING THE COMPLIANCE TEST THE AVERAGE PRODUCTION RATE WAS 403 DLTPH, WHICH IS 118% OF DESIGN RATED CAPACITY.

DUST COLLECTION SYSTEM:

SEVERAL QUESTIONS WERE RAISED CONCERNING THE DUST COLLECTION SYSTEM. THE FOLLOWING NARRATIVE WILL ADDRESS THE QUESTIONS ASKED. THERE ARE TWO EXHAUSTS FROM EACH OF THE PELLETIZING MACHINES AT HIBBING TACONITE COMPANY. THESE ARE THE WINDBOX AND HOOD EXHAUSTS.

IN THE CASE OF THE WINDBOX EXHAUST IT IS PRECLEANED ON THE INLET SIDE OF THE FAN WITH A MULTITUBE COLLECTOR. THE MULTITUBE COLLECTOR SERVES TO PROTECT THE FAN FROM LARGE PARTICULATE MATERIAL.

THE OUTLET OF BOTH THE WINDBOX AND HOOD EXHAUST FANS REPORTS TO A COMMON HEADER. THE HEADER, IN TURN, EXHAUSTS TO THE INLET SIDE OF FOUR ENVIRONEERING VENTURI ROD WET SCRUBBERS, EACH OF WHICH HAS AN EXHAUST STACK.

DURING THE COMPLIANCE TEST THE PRESSURE DROP ACROSS THE VENTURI RODS WAS MONITORED AND FOUND TO BE 6 INCHES OF WATER. THE WATER RATE TO THE SCRUBBERS IS ORIFICE CONTROLLED AT 1000 GPM. THERE ARE NO PROVISIONS FOR PRESSURE DROP MEASUREMENT ACROSS THE MULTITUBE COLLECTOR.

Interpoll, Inc.
Fuel Laboratory
(612) 786-6020

Date: 8/14/86

JOB: Hibbing Taconite

SAMPLE LOG NO: 3864-15-3698

SAMPLE DESCRIPTION: Petroleum Coke Test 1 8-5-86

PROXIMATE AND ULTIMATE ANALYSIS WT %

Parameter	Moisture & Ash Free	Moisture Free	as Received
PROXIMATE ANALYSIS WT%			
Moisture, Total			2.08
Ash		0.25	0.25
Volatile Matter	15.57	15.53	15.21
Fixed Carbon (by difference)	84.43	84.21	82.46
Heating Value, BTU/LB	15,541	15,501	15,178
Sulfur	4.54	4.52	4.43
ULTIMATE ANALYSIS, WT%			
Moisture, Total			2.08
Ash		0.25	0.25
Carbon	89.99	89.76	87.89
Hydrogen	4.14	4.13	4.04
Oxygen (by difference)	0.01	0.01	0.01
Nitrogen	1.32	1.32	1.29
Sulfur	4.54	4.52	4.43

10006

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, 1985). 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.

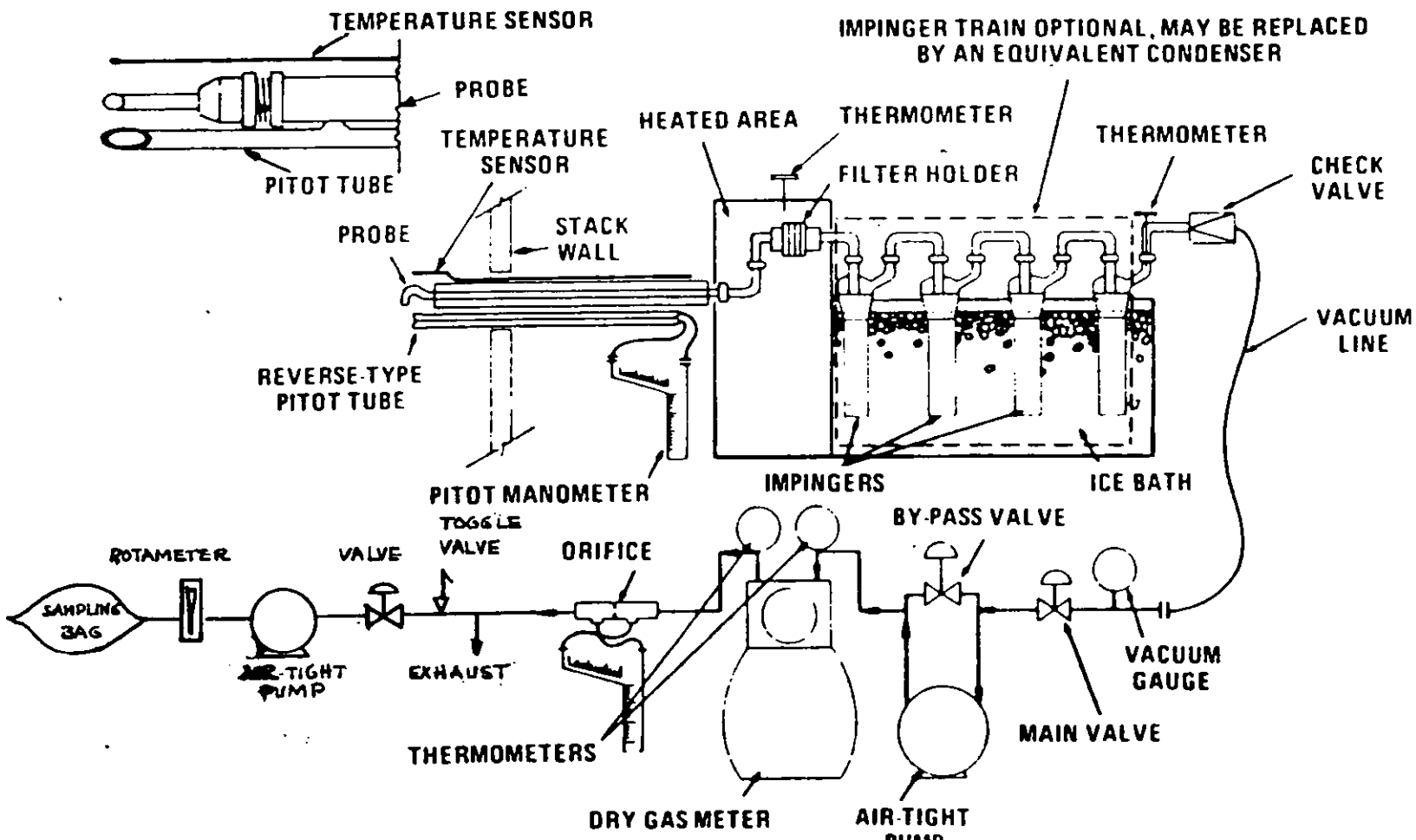
Particulate samples were collected as follows: The sample gas was drawn in through the sampling probe isokinetically and passed through a 4-inch diameter Gelman Type A/E glass fiber filter. The particulates were removed at this point and collected on the filter. The gases then passed through an ice-cooled 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.

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 ^{o}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 ^{o}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 ^{o}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.

3a P2(7)



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, 1985). 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.

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

$$V_{m(std)} = 17.65\ V_m\ \gamma\ \left(\frac{P_{bar} + \overline{\Delta H}/13.6}{T_{m(avg)}}\right)$$

$$V_{w(std)} = 0.0472\ V_{Is}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

$$I = 0.0944\ \left(\frac{T_{s(avg)}\ V_{m(std)}}{P_s\ V_s\ A_n\ \theta\ (1 - B_{ws})}\right)$$

$$C_s = \frac{15.43\ M_p}{V_{m(std)}}$$

$$C_a = \frac{272.3\ M_p\ P_s}{T_{s(avg)}\ (V_{w(std)} + V_{m(std)})}$$

$$(\dot{m}_p)_1 = 8.5714 \times 10^{-3}\ C_s\ Q_{s,d}$$

$$(\dot{m}_p)_2 = \frac{1.3228 \times 10^{-1}\ M_p\ A}{\theta\ A_n}$$

$$\dot{m}_p = \frac{(\dot{m}_p)_1 + (\dot{m}_p)_2}{2}$$

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

vp_{tdb} = Vapor pressure at T_{db}, IN. HG.

$v_{P_{twb}}$ = 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

$$V_{std} = 17.64 \frac{V_m P_b \gamma}{T_m} \quad \text{(MIDGET IMPINGER VERSION)}$$

$$V_{std} = \frac{17.64\ V_m\ (P_b + \frac{\overline{\Delta H}}{13.6})\ \gamma}{T_m} \quad \text{(LARGE IMPINGER VERSION)}$$

$$MEQ = (V_t - V_{tb})\ N\ (\frac{V_{soln}}{V_a})\ DF$$

$$C_s = \frac{7.06 \times 10^{-5}\ (V_t - V_{tb})\ N\ (\frac{V_{soln}}{V_a})}{V_{std}}$$

$$E = \frac{20.90\ C_s F_d}{20.90 - \overline{B'}_{O_2}} = \frac{F_c C_s}{\overline{B'}_{CO_2}}$$

$$C_s\ (MG/DSCM) = 1.60186 \times 10^7\ C_s$$

$$C_s\ (GR/DSCF) = 7000\ C_s$$

$$C_s\ (ppm, dry) = 6.02119 \times 10^6\ C_s$$

$$C_s\ (ppm, wet) = 6.02119 \times 10^6\ C_s\ (1 - \frac{MC}{100})$$

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