Interpoll Laboratories, Inc.
4500 Ball Road N.E.
Circle Pines, Minnesota 55014-1819

TEL: (612) 786-6020
FAX: (612) 786-7854

RESULTS OF THE MARCH/APRIL 1992 EMISSION PERFORMANCE TESTS ON THE NO. 4 & 5 SCRUBBER STACKS AT THE USS MINNESOTA ORE OPERATIONS FACILITY IN MOUNTAIN IRON, MINNESOTA

Submitted to:

USS
MINNESOTA ORE OPERATIONS
P.O. Box 417
Mountain Iron, Minnesota 55768

Attention:

Jane Kingston

Approved by:

Daniel Despen
Manager
Field Testing Support Group

Report Number 2-3526
April 23, 1992
SP/slp

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APPENDICES:

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 (°F)	degrees Fahrenheit
DIA.	diameter
FP	finished product for plant
FT/SEC	feet per second
g	gram
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g/dscm	grams per dry standard cubic meter
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/10^6BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
LTPD	long tons per day
MW	megawatt
mg/Nm^3	milligrams per dry standard cubic meter
ug/Nm^3	micrograms per dry standard cubic meter
microns (um)	micrometer
MIN.	minutes
ng	nanograms
ohm-cm	ohm-centimeter
PM	particulate matter
PPH	pounds per hour
PPM	parts per million
ppmC	parts per million carbon
ppm,d	parts per million, dry
ppm,w	parts per million, wet
ppt	parts per trillion
PSI	pounds per square inch
SQ.FT.	square feet
TPD	tons per day
ug	micrograms
v/v	percent by volume
w/w	percent by weight
<	$\leq$ (when following a number)

Standard conditions are defined as 68 °F (20 °C) and 29.92 IN. of mercury pressure.

1 INTRODUCTION

On March 31 and April 2, 1992 Interpoll Laboratories Personnel conducted a Particulate and Sulfur Dioxide Test on the No. 4 and 5 Scrubber Stacks at the US Steel Facility in Mountain Iron, Minnesota. Duane Van Hoever and Gary Hove performed the on-site portion of the test. Coordination between testing activities and plant operation was provided by Anthony Colrich of US Steel. A member of the Minnesota Pollution Control Agency did not witness the test.

The sources tested are Multiple Throat Venturi Type Wet Scrubbers. The scrubbers are used to remove dust from the Pelletizing Lines 4 & 5.

Particulate evaluations were performed in accordance with EPA Methods 1 - 5, and 9, CFR Title 40, Part 60, Appendix A (revised July 1, 1991). A preliminary determination of the gas linear velocity profile was made before the first particulate determination to allow selection of the appropriate nozzle diameter required for isokinetic sample withdrawal. An Interpoll Labs sampling train which meets or exceeds specifications in the above-cited reference was used to extract particulate samples by means of a heated stainless steel-lined probe. Wet catch samples were collected in the back half of the Method 5 sampling train and analyzed as per Minnesota Rules part 7005.0500. Sulfur dioxide sampling and analysis was performed in accordance with EPA Method 6.

An integrated flue gas sample was extracted simultaneously with each particulate sample using a specially designed gas sampling system. Integrated flue gas samples were collected in 44-liter Tedlar bags housed in a protective aluminum container. After sampling was complete, the bags were 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 was conducted from 4 test ports oriented at 90 degrees on

the stack. The test ports are located 2.86 diameters downstream and 3.57 diameters upstream of the nearest flow disturbances. A 24-point traverse was used to collect representative particulate samples. Each traverse point was sampled 2.5 minutes to give a total sampling time of 60 minutes per run.

The important results of the test 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

The results of the particulate emission tests are summarized in Tables 1 and 2. The particulate concentrations averaged .0118 and .0080 GR/DSCF on the No. 4 and 5 scrubber stacks respectively. The corresponding emission rates are 46 and 32 LB/HR.

The results of the sulfur dioxide tests are summarized in Table 3. The sulfur dioxide concentrations averaged 18 and 15 ppm,d on the No. 4 & 5 scrubber stacks respectively. The corresponding emission rates are 79 and 71 LB/HR.

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 test was performed.

Table 1. Summary of the Results of the March 31, 1992 Particulate Emission Test on the No. 4 Scrubber Stack at the USS Minnesota Ore Operations Facility Located in Mountain Iron, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		03-31-92	03-31-92	03-31-92
Time runs were done	(HRS)	1000/1109	1144/1249	1322/1433
Process rate	(LTONS/HR)	569 508	510 509	507 569
Volumetric flow				
actual	(ACFM)	587824	562292	577500
standard	(DSCFM)	465585	443513	455749
Gas temperature	(DEG-F)	116	116	117
Moisture content	(%V/V)	8.04	8.45	8.37
Gas composition	(%V/V,dry)			
carbon dioxide		2.40	2.30	2.50
oxygen		18.00	18.20	18.00
nitrogen		79.60	79.50	79.50
Isokinetic variation	(%)	97.4	99.5	98.8
Particulate concentration				
actual	(GR/ACF)	.00969	.00912	.00914
standard	(GR/DSCF)	.0122	.0116	.0116
Part. emission rate	(LB/HR)	48.83	43.99	45.26

Note: Dry + Organic Wet Catch

Table 2. Summary of the Results of the April 2, 1992 Particulate Emission Test on the No. 5 Scrubber Stack at the USS Minnesota Ore Operations Facility Located in Mountain Iron, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		04-02-92	04-02-92	04-02-92
Time runs were done	(HRS)	745/ 849	1050/1200	1225/1332
Process rate	(LTONS/HR)	556 496	563 503	560 500
Volumetric flow				
actual	(ACFM)	560886	573842	579439
standard	(DSCFM)	453898	463325	464730
Gas temperature	(DEG-F)	116	117	119
Moisture content	(%V/V)	7.86	7.96	8.13
Gas composition	(%V/V,dry)			
carbon dioxide		2.20	2.20	2.20
oxygen		18.10	18.00	17.90
nitrogen		79.70	79.80	79.90
Isokinetic variation	(%)	99.8	99.8	100.8
Particulate concentration				
actual	(GR/ACF)	.00611	.00648	.00680
standard	(GR/DSCF)	.00755	.00803	.00849
Part. emission rate	(LB/HR)	29.36	31.89	33.81

Note: Dry + Organic Wet Catch

Table 3 Summary of the Results of the March 31 and April 1, 1992 Sulfur Dioxide Emission Test on the No. 4 & 5 scrubber stacks at the USS Minnesota Ore Operations Facility in Mountain Iron, Minnesota.

Test/Run	Date	Time (HRS)	Concentration (ppm,d)	Emission Rate (LB/HR)
(No. 4 Scrubber Stack)				
1/1	3-31-92	1000-1109	18	81.9
1/2	3-31-92	1144-1249	17	75.5
1/3	3-31-92	1322-1433	18	79.8
(No. 5 Scrubber Stack)				
3/1	4-02-92	0745-0849	17	78.3
3/2	4-02-92	1050-1200	14	64.8
3/3	4-02-92	1225-1332	15	69.1

3 RESULTS

The results of all field and laboratory evaluations are presented in this section. Gas composition (Orsat and moisture) are presented first followed by the computer printout of the particulate and opacity results. Preliminary measurements including test port locations are given in the appendices.

The results have been calculated on a personal 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.

3.1 Results of Orsat and Moisture Determinations

Test No. 1
No. 4 Scrubber Stack

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

	Run 1	Run 2	Run 3
Date of run	03-31-92	03-31-92	03-31-92
Dry basis (orsat)			
carbon dioxide.....	2.40	2.30	2.50
oxygen.....	18.00	18.20	18.00
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.60	79.50	79.50
Wet basis (orsat)			
carbon dioxide.....	2.21	2.11	2.29
oxygen.....	16.55	16.66	16.49
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	73.20	72.78	72.85
water vapor.....	8.04	8.45	8.37
Dry molecular weight.....	29.10	29.10	29.12
Wet molecular weight.....	28.21	28.16	28.19
Specific gravity.....	0.974	0.973	0.974
Water mass flow.....(LB/HR)	114210	114834	116758
FO	1.208	1.174	1.160

Test No. 3
No. 5 Scrubber Stack

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

	Run 1	Run 2	Run 3
Date of run	04-02-92	04-02-92	04-02-92
Dry basis (orsat)			
carbon dioxide.....	2.20	2.20	2.20
oxygen.....	18.10	18.00	17.90
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.70	79.80	79.90
Wet basis (orsat)			
carbon dioxide.....	2.03	2.02	2.02
oxygen.....	16.68	16.57	16.44
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	73.44	73.45	73.40
water vapor.....	7.86	7.96	8.13
Dry molecular weight.....	29.08	29.07	29.07
Wet molecular weight.....	28.21	28.19	28.17
Specific gravity.....	0.974	0.974	0.973
Water mass flow.....(LB/HR)	108599	112437	115397
FO	1.273	1.318	1.364

3.2 Results of Particulate Loading Determinations

Test No. 1
No. 4 Scrubber Stack

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

	Run 1	Run 2	Run 3
Date of run	03-31-92	03-31-92	03-31-92
Time run start/end.....(HRS)	1000/1109	1144/1249	1322/1433
Static pressure.....(IN.WC)	-0.74	-0.74	-0.74
Cross sectional area (SQ.FT)	153.94	153.94	153.94
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	3.0	4.0	3.0
impingers.....(GRAMS)	93.0	95.0	95.0
desiccant.....(GRAMS)	13.0	13.0	15.0
total.....(GRAMS)	109.0	112.0	113.0
Total particulate material..			
.....collected(grams)	0.0466	0.0429	0.0438
Gas meter coefficient.....	1.0007	1.0007	1.0007
Barometric pressure..(IN.HG)	28.19	28.19	28.19
Avg. orif.pres.drop..(IN.WC)	3.13	3.00	3.23
Avg. gas meter temp..(DEF-F)	52.2	61.5	72.9
Volume through gas meter....			
at meter conditions...(CF)	60.00	59.49	61.95
standard conditions.(DSCF)	58.77	57.21	58.34
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.247	.247	.247
Avg.stack gas temp ..(DEG-F)	116	116	117
Volumetric flow rate.....			
actual.....(ACFM)	587824	562292	577500
dry standard.....(DSCFM)	465585	443513	455749
Isokinetic variation.....(%)	97.4	99.5	98.8
Particulate concentration...			
actual.....(GR/ACF)	0.00969	0.00912	0.00914
dry standard.....(GR/DSCF)	0.01224	0.01157	0.01159
Particle mass rate...(LB/HR)	48.827	43.985	45.256

Test No. 3
No. 5 Scrubber Stack

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

	Run 1	Run 2	Run 3
Date of run	04-02-92	04-02-92	04-02-92
Time run start/end.....(HRS)	745/ 849	1050/1200	1225/1332
Static pressure.....(IN.WC)	-0.45	-0.45	-0.45
Cross sectional area (SQ.FT)	153.94	153.94	153.94
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	3.0	0.0	0.0
impingers.....(GRAMS)	91.0	90.0	98.0
desiccant.....(GRAMS)	14.0	20.0	16.0
total.....(GRAMS)	108.0	110.0	114.0
Total particulate material..			
.....collected(grams)	0.0292	0.0312	0.0334
Gas meter coefficient.....	1.0007	1.0007	1.0007
Barometric pressure..(IN.HG)	28.70	28.70	28.70
Avg. orif.pres.drop..(IN.WC)	3.11	3.26	3.31
Avg. gas meter temp..(DEF-F)	45.7	62.7	60.6
Volume through gas meter....			
at meter conditions...(CF)	59.12	61.34	61.87
standard conditions.(DSCF)	59.70	59.95	60.72
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.249	.247	.247
Avg.stack gas temp ..(DEG-F)	116	117	119
Volumetric flow rate.....			
actual.....(ACFM)	560886	573842	579439
dry standard.....(DSCFM)	453898	463325	464730
Isokinetic variation.....(%)	99.8	99.8	100.8
Particulate concentration...			
actual.....(GR/ACF)	0.00611	0.00648	0.00680
dry standard.....(GR/DSCF)	0.00755	0.00803	0.00849
Particle mass rate...(LB/HR)	29.362	31.891	33.809

3.3 Results of Sulfur Dioxide Determinations

Test No. 1
No. 4 Scrubber Stack

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

	Run 1	Run 2	Run 3
Date of run	03-31-92	03-31-92	03-31-92
Time run start/end.....(HRS)	1000-1109	1144-1249	1322-1433
Barometric pressure..(IN.HG)	28.19	28.19	28.19
Meter temperature....(DEG-F)	52.20	61.50	72.90
Meter correction coefficient	1.0007	1.0007	1.0007
Volume through gas meter....			
at meter conditions...(CF)	60.000	59.490	61.950
standard conditions..(SCF)	58.768	57.210	58.336
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content......(%V/V)	8.04	8.45	8.37
Oxygen content....(%V/V DRY)	18.00	18.20	18.00
Milliequivalents of SO4 in..			
gas sample.....	2.4400	2.3000	2.4100
Sulfur dioxide concentration			
(GR/DSCF).....	0.0205	0.0199	0.0204
(MG/DSCM).....	47	45	47
(PPM-DRY).....	18	17	18
(PPM-WET).....	16	16	16
SO2 Emission rate....(LB/HR)	81.90	75.54	79.77

Test No. 3
No. 5 Scrubber Stack

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

	Run 1	Run 2	Run 3
Date of run	04-02-92	04-02-92	04-02-92
Time run start/end.....(HRS)	0745-0849	1050-1200	1225-1332
Barometric pressure..(IN.HG)	28.70	28.70	28.70
Meter temperature....(DEG-F)	45.70	62.70	60.60
Meter correction coefficient	1.0007	1.0007	1.0007
Volume through gas meter....			
at meter conditions...(CF)	59.120	61.340	61.870
standard conditions..(SCF)	59.700	59.950	60.719
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content......(%V/V)	7.86	7.96	8.13
Oxygen content....(%V/V DRY)	18.10	18.00	17.90
Milliequivalents of SO4 in..			
gas sample.....	2.4300	1.9800	2.1300
Sulfur dioxide concentration			
(GR/DSCF).....	0.0201	0.0163	0.0173
(MG/DSCM).....	46	37	40
(PPM-DRY).....	17	14	15
(PPM-WET).....	16	13	14
SO2 Emission rate....(LB/HR)	78.27	64.83	69.07

APPENDIX A

VOLUMETRIC FLOW RATE DETERMINATION

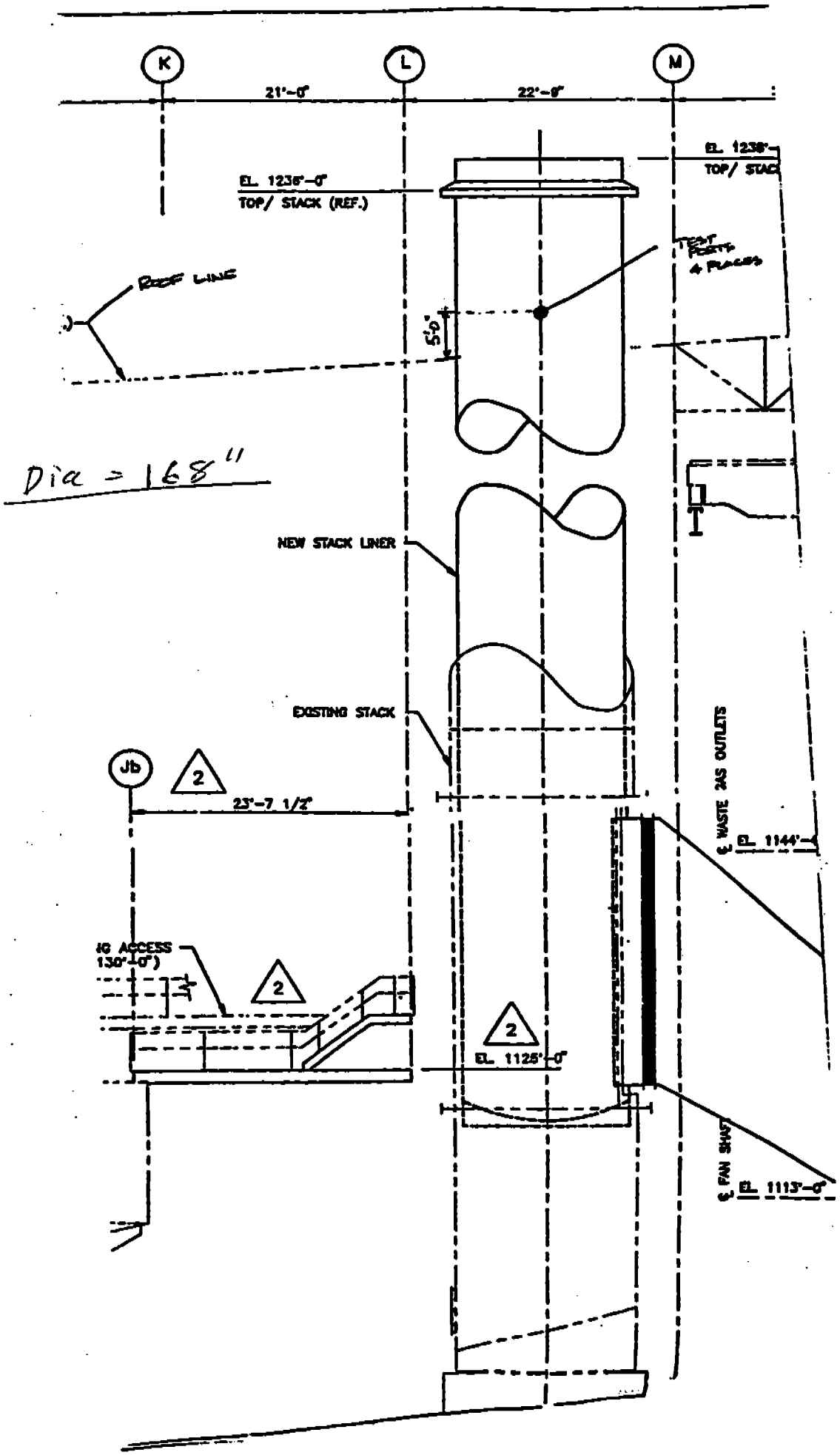
Test No. 1
No. 4 Scrubber Stack

Results of Volumetric Flow Rate Determination-------Method 2

Date of Determination.....	03-31-92
Time of Determination.....(HRS)	930
Barometric pressure.....(IN.HG)	28.19
Pitot tube coefficient.....	.84
Number of sampling ports.....	2
Total number of points.....	12
Shape of duct.....	Round
Stack diameter.....(IN)	168
Duct area.....(SQ.FT)	153.94
Direction of flow.....	UP
Static pressure.....(IN.WC)	-.74
Avg. gas temp.....(DEG-F)	117
Moisture content.....(% V/V)	8.04
Avg. linear velocity.....(FT/SEC)	56.7
Gas density.....(LB/ACF)	.06304
Molecular weight.....(LB/LBMOLE)	29.10
Mass flow of gas.....(LB/HR)	1981357
Volumetric flow rate.....	
actual.....(ACFM)	523822
dry standard.....(DSCFM)	414510

APPENDIX B

LOCATION OF TEST PORTS


K
L
M
21'-0"
22'-9"
EL. 1236'-0"
TOP/ STACK (REF.)
EL. 1238'-
TOP/ STAC
TEST PORTS 4 PLACES
ROOF LINE
5'-0"
Dia = 168"
NEW STACK LINER
EXISTING STACK
Jb
2
23'-7 1/2"
WASTE 2AS OUTLETS
EL. 1144'-
IG ACCESS
130'-0")
2
2
EL. 1125'-0"
FAN SHAFT
EL. 1113'-0"

APPENDIX C

FIELD DATA SHEETS

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job U.S. Steel / Minntac

Source No 4 Scrubber Stack

Test 1 Run ____ Date 3/3/92

Stack dimen. 168 IN.

Dry bulb ____ °F Wet bulb ____ °F

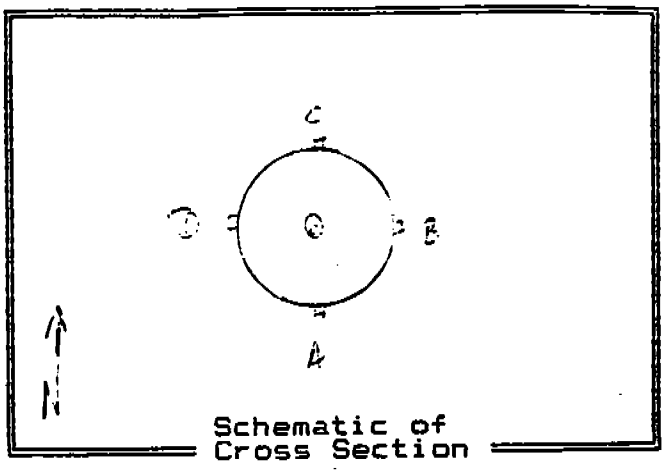
Manometer: ☒ Reg. ☐ Exp. ☐ Elec.

Barometric pressure 28.19 in Hg

Static pressure -.74 in WC

Operators D. Von Haden + Gary Hove

Pitot No. 133-6 Cp .84



Schematic of Cross Section

Traverse Point No.		Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
			Port length: 16 in.		Time start: 0730 hrs	
	A 1	.021	3.53	19.53	.72	
	2	.067	11.26	27.26	.90	
	3	.118	19.82	35.82	.97	
	4	.177	29.24	45.74	.94	
	5	.250	42.00	58.00	.85	117
	6	.356	59.81	75.81	.81	
	B 1				.80	
	2				.84	
	3				.87	
	4				.88	
	5				.85	
	6				.85	
	C 1					
	2					
	3					
	4					
	5					
	6					
	D 1					
	2					
	3					
	4					
	5					
	6					

Temp. meas. tool & S/N:

Time end: hrs

R or nothing= reg. manometer; S= expanded; E = electronic

S-392.1

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job US STEEL - MINTAC Date 3-31-92 Test 1 Run 1
Source NO 4 SCRUBBER STACK No. of traverse points 24
Method _____ Filter holder: GLASS Filter type: CF

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: .00 cfm at 15 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 1

Recovery solvent(s)
☒ acetone 1
☐ other(s) _____

No. of probe wash bottles: 1
Sample recovered by: GH

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	593	499	93
Impinger No. 2			
Impinger No. 3			
Condenser	502	499	3
Desiccant	1379	1366	13
Total			109

Integrated Gas Sampling Data:

Bag Pump No. B4 Box No. 20 Bag No. 1
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: .00 cc/min at 15 in. Hg.
Time start: 100 (HRS) Time end: 1109 (HRS)
Sampling rate: 400 cc/min Operator: GH
S/N of O_2 Analyzer used to monitor train outlet: ~~A8~~ 12

CF-023

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job U.S. STEEL / MINNTAC
Source Unit 4 Scrubber Stack
Date 3/3/92 Test 1 Run 1

Operators D.K.H & D.H
Meter Box No. 6 ΔH 4.78 IN WC
Barometer corr. +.007

Pitot No. 1236 Cp .84
Bar. Press. 28.19 inHg H2O 13.6
Nozzle No. 7-4 Nozzle Dia .242 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
	1000	218.05											
3 6	2.5	220.46	1.05	2.84	0.92	9	117	256	244	40	54	51	18.4
5	5	224.80	.97	2.64	2.74	9	116				55	52	18.1
4	7.5	225.11	.95	2.63	5.05	9	116				58	52	18.2
3	10	227.46	.95	2.75	7.41	9	117	254	249	41	61	53	18.2
2	12.5	229.91	1.1	3.19	9.96	9	118				61	54	18.3
1	15	232.24	.94	2.74	2.20	9	116				61	55	18.2
4 6	17.5	234.74	1.0	2.91	4.75	9	116	255	250	43	61	55	18.3
5	20	237.10	1.0	2.91	7.19	9	117				61	55	18.3
4	22.5	239.66	1.1	3.19	9.73	10	117				61	54	18.2
3	25	242.16	1.1	3.20	2.29	9	116	254	252	44	61	55	18.4
2	27.5	244.34	.74	2.16	4.39	8	117	9			63	57	18.5
1	30	245.99	.40	1.17	5.95	5	116				64	58	18.5
6	32.5	248.53	1.1	3.23	8.52	10	116	256	250	37	65	59	18.2
5	35	251.22	1.3	3.80	1.31	13	117				64	59	18.3
4	37.5	253.99	1.5	3.85	3.94	14	116				63	57	18.4
3	40	256.72	1.5	4.36	6.92	15	117	257	257	40	62	57	18.4
2	42.5	259.60	1.4	4.09	9.80	15	115				59	56	18.4
1	45	262.34	1.3	3.78	2.57	15	116				57	55	18.4
6	47.5	265.76	1.1	3.19	5.17	12	116	259	253	42	58	53	18.8
5	50	267.30	1.2	~~3.47~~	7.77	12	117				55	53	18.7
4	52.5	270.05	1.1	3.17	0.30	14	117				56	54	18.8
3	55	272.99	1.2	3.47	2.95	15	116	254	255	40	56	54	18.7
2	57.5	275.41	1.1	3.18	5.49	14	117				55	52	18.7
1	60	278.05	1.1	3.17	8.02	14	116				55	52	18.4
	1109												
	θ = 60	Vm = 60		ΔH 3.13							Avg.	52.2	

C-3

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job US STEEL - MINTAC Date 3-31-92 Test 1 Run 2
Source NO 4 SCRUBBER STACK No. of traverse points 24
Method _____ Filter holder: GLASS Filter type: G.F

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
Postest: .00 cfm at 15 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 1

Recovery solvent(s)
☒ acetone
☐ other(s) _____

No. of probe wash bottles: 1
Sample recovered by: DIF

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		-	
Impinger No. 2	593	498	95
Impinger No. 3			
Condenser	496	492	4
Desiccant			13
	1383	1370	
Total			112

Integrated Gas Sampling Data:

Bag Pump No. B-4 Box No. 20 Bag No. 2
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 00 cc/min at 15 in. Hg.
Time start: 1144 (HRS) Time end: 1249 (HRS)
Sampling rate: 400 cc/min Operator: DH
S/N of O_2 Analyzer used to monitor train outlet: 12

CF-023

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job: US Steel - Minntac
Source: NO 4 SCRUBBER
Date: 3-31-92 Test 1 Run 2

Operators: DVH & GH
Meter Box No. 6 ΔH 1.78 IN WC
Counter coeff.: 1.0007

Pitot No. V23-6 Cp .84
Bar. Press. 28.19 inHg NZD 2 x
Nozzle No. 2-4 Nozzle Dia .247 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
	1144	278.59											
C-6	2.5	281.13	1.1	3.35	1.13	9	116	245	249	39	55	52	19.4
5	5	283.70	1.1	3.26	3.20	9	117			39	60	53	19.0
4	7.5	286.48	1.1	3.28	6.28	10	116			40	60	54	18.9
3	10	288.00	1.2	3.58	8.98	10	116	249	251	41	55	52	18.8
2	12.5	291.59	1.2	3.53	1.65	10	117				56	53	18.7
1	15	294.10	1.1	3.27	4.22	11	116				57	53	18.7
A 6	17.5	296.66	.99	2.95	6.67	11	116	250	255	40	57	53	18.7
5	20	299.20	1.1	3.27	9.24	10	116				57	54	18.6
4	22.5	301.74	1.1	3.27	1.82	10	116				59	55	18.6
3	25	304.33	1.2	3.58	4.54	10	116	259	255	42	61	57	18.7
2	27.5	307.00	1.1	3.28	7.10	10	116				61	55	18.7
1	30	310.00	1.2	3.97	009	11	117				66	59	18.8
A 6	32.5	312.00	.90	2.71	2.45	6	117	259	255	39	66	59	18.7
5	35	314.65	.85	2.57	4.75	7	116				63	65	18.7
4	37.5	317.01	.85	2.58	7.04	9	116				67	63	18.7
3	40	319.32	.89	2.70	9.42	10	117	259	251	40	70	63	18.8
2	42.5	321.72	.90	2.73	1.89	10	117				72	64	18.9
1	45	324.04	.89	2.71	4.18	9	117				73	65	18.9
B 6	47.5	326.33	.84	2.57	6.49	9	116	259	254	42	72	66	19.1
5	50	328.70	.84	2.57	8.80	9	116				72	66	19.1
4	52.5	331.05	.82	2.51	1.09	9	116				72	65	18.7
3	55	333.38	.85	2.60	3.42	9	116	260	252	44	71	66	18.5
2	57.5	335.81	.90	2.75	5.81	10	116				69	65	18.2
1	60	338.09	.81	2.47	8.07	10	114				67	63	18.2
	1349												
	θ = 60	Vm 59.49		ΔH 3.00							Avg. = 61.5		

C-5

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job US STEEL MINTAC Date 3-31-92 Test 1 Run 3
Source NO 4 SCRUBBER STACK No. of traverse points 24
Method _____ Filter holder: GLASS Filter type: GF 41

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: .00 cfm at 15 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 1

Recovery solvent(s)
☒ acetone
☐ other(s) _____

No. of probe wash bottles: 1
Sample recovered by: CH

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	590	495	95
Impinger No. 3			
Condenser	501	499	3
Desiccant	1394	1379	15
Total			113

Integrated Gas Sampling Data:

Bag Pump No. B8 Box No. 20 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: .001 cc/min at 15 in. Hg.
Time start: 1320 (HRS) Time end: 1433 (HRS)
Sampling rate: 400 cc/min Operator: CH
S/N of O_2 Analyzer used to monitor train outlet: 12

CF-023

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job US STEEL - MINTAC
Source NO 4 SCRUBBER STACK
Date 3-21-92 Test 1 Run 3

Operators RWH
Meter Box No. 6 ΔH 1.70 IN WC
Cyclone coeff. 1.0007

Pitot No. 1236 Cp .84
Bar. Press. 28.19 inHg H2O 9 x
Nozzle No. 7-4 Nozzle Dia .247 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas In	Gas Out	Oxygen (x v/v)
	1330	338.40											
6	2.5	340.70	.75	2.26	0.53	7	116	250	249	39	58.6	55.6	19.2
5	5	342.87	.80	2.90	2.76	7	116				59	59	19.1
4	7.5	344.99	.80	2.40	4.91	7	116				60	59	19.0
3	10	347.30	.95	2.85	7.39	7	117	250	248	40	63	61	18.9
2	12.5	349.70	.95	2.86	9.82	8	117				65	62	18.9
1	15	352.22	.90	2.72	12.19	9	117				68	65	18.7
6	17.5	354.32	.96	2.92	4.65	11	116	255	249	44	72	69	18.9
5	20	357.00	1.1	3.57	7.30	11	116				73	69	18.8
4	22.5	359.67	.95	2.91	9.96	11	117				73	70	18.6
3	25	362.30	1.1	3.37	2.42	11	117	257	250	40	75	71	18.7
2	27.5	364.72	.87	2.68	4.79	10	116				76	72	18.7
1	30	367.01	.95	2.93	7.27	8	116				77	72	18.7
6	32.5	369.35	1.0	3.09	9.82	9	116	259	256	41	77	73	18.8
5	35	372.01	1.1	3.39	2.49	10	117				76	73	18.7
4	37.5	375.00	1.3	4.00	5.38	12	116				77	73	18.7
3	40	378.01	1.3	4.01	8.38	13	116	259	257	44	77	73	18.6
2	42.5	380.50	1.2	3.70	1.07	13	116				78	74	18.6
1	45	383.23	1.2	3.71	3.87	13	116				78	76	18.6
6	47.5	386.00	1.1	3.40	6.54	13	115	251	254	39	80	79	18.7
5	50	389.21	1.1	3.42	9.24	13	118				85	81	18.7
4	52.5	392.02	1.2	3.75	2.06	14	117				85	81	18.7
3	55	394.92	1.2	3.75	4.89	14	117	253	248	41	84	81	18.8
2	57.5	397.59	1.3	4.06	7.83	14	114				85	82	18.9
1	60	400.35	1.1	3.45	0.53	14	116				85	82	18.4
	1433												
	θ = 60	Vm = 61.95		ΔH 3.23							Avg. = 72.9		

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S-0037R

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job US STEEL

Source NO 5 SCRUBBER

Test 3 Run ___ Date 4-2-92

Stack dimen. 168 IN.

Dry bulb ___ °F Wet bulb ___ °F

Manometer: ☒ Reg. ☐ Exp. ☐ Elec.

Barometric pressure 28.70 in Hg

Static pressure -.45 in WC

Operators DUH & GH

Pitot No. 23-6 Cp .84

Schematic of Cross Section

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length: in.		Time start: hrs	
A	1				
	2				
	3				
	4				
	5				
	6				
B	1				
	2				
	3				
	4				
	5				
	6				
C	1				
	2				
	3				
	4				
	5				
	6				
D	1				
	2				
	3				
	4				
	5				
	6				
Temp. meas. tool & S/N:				Time end:	hrs

R or nothing= reg. manometer; S= expanded; E = electronic S-392.1

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job US STEEL MINTAC Date 4-2-92 Test 3 Run 1
Source NO 5 SCRUBBER STACK No. of traverse points 24
Method _____ Filter holder: GLASS Filter type: GF 4"

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: .0 cfm at 16 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 1

Recovery solvent(s)
☒ acetone 1
☐ other(s) _____

No. of probe wash bottles: 1
Sample recovered by: _____

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	586	495	91
Impinger No. 3	-		
Condenser	505	502	3
Desiccant	~~1343~~	1329	14
Total			108

Integrated Gas Sampling Data:

Bag Pump No. B-8 Box No. 15 Bag No. 1

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: .00 cc/min at 15 in. Hg.

Time start: 0750 (HRS) Time end: 0849 (HRS)

Sampling rate: 400 cc/min Operator: DVH & CH

S/N of O_2 Analyzer used to monitor train outlet: 12

CF-023

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job US STEEL MINTAC
Source STL NO 5 SCRUBBER STACK
Date 4-2-92 Test 3 Run 1

Operators DJH & GH
Meter Box No. 6 ΔH 1.75 IN WC
Cosmeter coeff. 1.0007

Pitot No. V23-6 Cp .84
Bar. Press. 28.70 inHg H2O 8 X
Nozzle No. 2-4 Nozzle Dia .247 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dev. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xx/x)
	7:45	566.32											
6	2.5	568.41	.80	2.40	8.46	9	114	245	242	40	38	38	19.0
5	5.0	570.55	.85	2.57	11.69	9	114				41	39	17.0
4	7.5	572.73	.75	2.27	2.78	9	116				42	39	16.5
3	10	575.00	.84	2.54	5.00	9	117				43	39	16.0
2	12.5	577.20	.80	2.42	7.16	9	117	247	245	40	45	40	15.2
1	15	579.47	.80	2.43	9.34	9	117				46	41	17.6
6	17.5	581.60	.80	2.43	11.51	9	117				46	41	18.1
5	20	584.15	.95	3.13	4.08	9	117	249	248	39	48	43	18.1
4	22.5	586.60	1.0	3.05	6.52	9	116				49	43	18.2
3	25	588.99	1.0	3.06	8.97	9	116				49	43	18.0
2	27.5	591.55	1.1	3.36	1.53	9	116	250	251	39	50	45	17.7
1	30	594.04	1.1	3.37	4.10	10	116				50	45	17.5
6	32.5	596.70	1.2	3.67	6.78	12	116				47	44	17.3
5	35	599.27	1.1	3.36	9.34	12	116	251	253	40	48	44	16.8
4	37.5	601.85	1.1	3.36	1.90	12	116				49	45	16.9
3	40	604.60	1.4	4.28	4.80	14	116				50	45	16.5
2	42.5	607.50	1.4	4.28	7.69	14	116	256	255	40	49	47	16.7
1	45	610.04	1.4	4.39	0.58	14	115				50	45	16.8
6	47.5	612.15	.90	2.76	2.91	9	116				49	46	17.0
5	50	615.00	1.0	3.06	5.36	10	116	257	258	43	49	46	16.9
4	52.5	617.60	1.0	3.37	7.93	10	116				50	46	17.0
3	55	620.32	1.0	3.07	0.39	12	116				51	47	17.0
2	57.5	622.90	1.0	3.08	2.85	13	116	257	257	39	51	45	17.1
1	60	625.44	1.0	3.08	5.31		116				52	45	17.0
	849												
	θ = 60	Vs = 59.12		ΔH = 3.11							Avg. = 45.7		

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INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job US STEEL MINTAC Date 4-2-92 Test 3 Run 2
Source NO 5 SCRUBBER No. of traverse points 24
Method _____ Filter holder: GLASS Filter type: G.F 4"

Sample Train Leak Check:

Pretest: 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: 0 cfm at 15 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 1

Recovery solvent(s)
☒ acetone
☐ other(s)

No. of probe wash bottles: 1
Sample recovered by: _____

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	576	490	86
Impinger No. 2	503	499	4
Impinger No. 3			
Condenser			
Desiccant	1444	1434	20
Total			110

Integrated Gas Sampling Data:

Bag Pump No. B-8 Box No. 15 Bag No. 2
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: .020 cc/min at 15 in. Hg.
Time start: 1050 (HRS) Time end: 1200 (HRS)
Sampling rate: 400 cc/min Operator: GH
S/N of O_2 Analyzer used to monitor train outlet: 12

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job: US STEEL MINTAC
Source: NO 5 SCRUBBER STACK
Date: 4-2-92 Test: 3 Run: 2

Operators: DJH & CH
Meter Box No.: 6 ΔH: 1.78 IN WC
Barometer coeff.: 1.0007

Pitot No.: V23-6 Cp: .84
Bar. Press.: 28.70 inHg H2O: 8 x
Nozzle No.: 7-4 Nozzle Dia: .247 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgs. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas In	Gas Out	Oxygen (xv/v)
	1050	625.40											
C 6	2.5	628.44	1.1	3.31	8.44	10	114	250	251	39	57	57	17.0
5	5	631.00	1.1	3.38	1.03	10	115				58	57	17.0
4	7.5	633.52	1.0	3.07	3.51	11	116				59	57	17.0
3	10	635.98	1.0	3.08	5.97	11	115	253	253	40	60	57	16.9
2	12.5	638.62	.99	3.05	8.46	11	116				61	58	16.9
1	15	640.98	.98	3.03	0.93	11	115				62	58	16.9
B 6	17.5	643.74	1.1	3.40	3.54	12	115	255	256	40	63	59	17.0
5	20	646.36	1.1	3.40	6.16	12	115				63	59	17.1
4	22.5	648.79	1.1	3.40	8.77	12	115				63	59	17.1
3	25	651.70	1.4	4.31	1.71	14	117	256	258	40	65	61	17.0
2	27.5	654.50	1.4	4.34	4.67	14	115				66	62	16.8
1	30	657.22	1.4	4.35	7.63	14	115				66	62	16.9
A 6	32.5	660.00	1.0	3.11	0.14	13	115	258	260	39	65	62	17.0
5	35	662.53	1.1	3.42	2.77	13	115				63	62	16.9
4	37.5	665.27	1.0	3.09	5.27	13	117				66	62	16.9
3	40	667.90	1.1	3.41	7.89	13	114	260	262	40	65	62	16.8
2	42.5	670.49	1.1	3.41	0.52	13	117				65	62	16.6
1	45	673.16	1.1	3.39	3.14	13	120				65	63	16.6
6	47.5	675.44	.85	2.63	5.44	10	120	262	256	42	67	64	16.5
5	50	677.83	.85	2.63	7.76	10	120				67	64	17.1
4	52.5	680.18	.85	2.63	0.07	10	120				70	66	17.1
3	55	682.46	.89	2.76	2.44	10	118	259	257	39	70	66	17.0
2	57.5	684.85	.90	2.81	4.83	10	119				71	65	17.1
1	60	687.24	.90	2.81	7.23	10	119				71	65	
	1200												
	θ = 60	Vm = 61.34		ΔH = 3.36							Avg. = 67.7		

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job US STEEL MINTAC Date 4-2-92 Test 3 Run 3
Source NO 5 SC ROBBER STACK No. of traverse points 24
Method _____ Filter holder: GLASS Filter type: GF 4"

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: 0 cfm at 15 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 1

Recovery solvent(s)
☒ acetone
☐ other(s)

No. of probe wash bottles: 1
Sample recovered by: _____

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	595	498	97
Impinger No. 2			
Impinger No. 3	495	484	1
Condenser			
Desiccant	1359	1343	16
Total			114

Integrated Gas Sampling Data:

Bag Pump No. B-8 Box No. 15 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: .00 cc/min at 15 in. Hg.
Time start: _____ (HRS) Time end: _____ (HRS)
Sampling rate: 400 cc/min Operator: DJH + GH
S/N of O_2 Analyzer used to monitor train outlet: 12

CF-023

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job US STEEL MINTAC — Operators DUH-CH — Pitot No. V23-6 — Cp .84
Source NO 5 SCRUBBER STACK — Meter Box No. 6 — ΔH 1.78 IN WC — Bar. Press. 28.70 inHg — H2O 8 x
Date 4-2-92 — Test 3 — Run 3 — Counter coeff. 1.0007 — Nozzle No. 2-4 — Nozzle Dia .249 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas In	Gas Out	Oxygen (xx/x)
	1325	687.60											
@C 6	25	690.09	.95	2.93	0.03	10	120	240	243	39	56	56	18.2
5	5	692.59	.85	2.60	2.30	9	119				57	56	17.3
4	7.5	694.85	.82	2.54	4.58	9	120				61	57	16.9
3	10	696.99	.85	2.60	6.86	8	120	244	247	40	62	59	16.7
2	12.5	699.30	.86	2.64	9.17	8	120				63	59	16.7
1	15	701.32	.65	2.00	1.87	7	120				64	60	16.7
D 6	17.5	703.78	1.0	3.08	3.67	10	120	251	238	41	65	61	16.7
5	20	706.38	1.1	3.39	6.29	11	119				65	61	16.5
4	22.5	708.91	1.1	3.40	8.91	12	119				67	62	16.8
3	25	711.67	1.2	3.70	1.65	13	120	254	246	40	68	63	16.8
2	27.5	714.35	1.2	3.71	4.39	13	120				70	64	16.8
B 1	30	717.13	1.1	3.42	7.03	13	119				69	64	16.7
6	32.5	719.48	.95	2.95	9.15	10	119	255	257	41	67	65	16.5
5	35	721.98	.96	2.98	1.94	11	119				69	65	16.4
4	37.5	724.52	1.1	3.41	4.58	11	120				69	64	16.4
3	40	727.42	1.1	3.41	7.21	11	120	256	252	43	68	64	16.6
2	42.5	729.84	1.1	3.41	9.84	11	120				69	65	16.4
A 1	45	732	1.1	3.42	2.49	12	120				67	65	16.5
6	47.5	735.72	1.2	3.72	5.22	13	119	257	257	39	64	62	16.4
5	50	737.83	1.1	3.39	7.84	13	119				64	62	16.4
4	52.5	740.51	1.2	3.70	0.57	13	119				65	62	16.5
3	55	743.51	1.4	4.31	3.57	14	119				62	61	16.5
2	57.5	746.46	1.4	4.30	6.46	15	119				63	61	17.0
1	60	749.47	1.4	4.30	9.40	13	119				63	61	17.1
	(1332)												
	θ 60	Vm = 61.87		ΔH = 3.31							Avg. = 60.6		

APPENDIX D

INTERPOLL LABORATORIES ANALYTICAL DATA

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job: U.S. STEEL MINTAC
Team Leader: GR
Date Submitted: 4-3-92
Test No.: 1
Date of Analysis: 4-6-92

Source: NO. 4 SCRUBBER
Test Site: STACK
Date of Test: 3-31-92
No. of Runs Completed: 3
Technician: R. Calvin

Test/ Run	Sample Log Number and Type	No. of An.	Buret Readings (ml) Zero Pt.	After CO_2	After O_2	Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
1/1	5723-09	1	0.00	2.40	20.40	2.40	18.00	1.21
		2	0.00	2.40	20.40	2.40	18.00	1.21
	☑ B ☐ F	Avg				2.40	18.00	
1/2	-14	1	0.00	2.30	20.50	2.30	18.20	1.17
		2	0.00	2.30	20.50	2.30	18.20	1.17
	☑ B ☐ F	Avg				2.30	18.20	
1/3	-19	1	0.00	2.50	20.50	2.50	18.00	1.16
		2	0.00	2.50	20.50	2.50	18.00	1.16
	☑ B ☐ F	Avg				2.50	18.00	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

☑ Ambient Air QA Check
☑ Orsat Analyzer System Leak Check
☐ F_o Within EPA M-3 Guidelines for fuel type.

Where $F_o = \frac{20.9 - O_2}{CO_2}$

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

EPA Method 3 Guidelines

Fuel Type	F0 Range
Coal:	
Anthracite/Lignite	1.016-1.130
Bituminous	1.083-1.230
Oil:	
Distillate	1.260-1.413
Residual	1.210-1.370
Gas:	
Natural	1.600-1.836
Propane	1.434-1.586
Butane	1.405-1.553
Wood/Wood Bark	1.000-1.130

LSC-04-BR

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EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job U.S. STEEL - MINTAC
Team Leader GH
Date Submitted 4-3-92
Test No. 3
Date of Analysis 4-6-92

Source NO 5 Scrubber
Test Site Stack
Date of Test 4-2-92
No. of Runs Completed 3
Technician A. G[illegible]

Test/Run	Sample Log Number and Type	No. of An.	Buret Readings (ml) Zero Pt.	After CO_2	After O_2	Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
3/1	5723-28	1	0.00	2.20	20.30	2.20	18.10	1.27
		2	0.00	2.20	20.30	2.20	18.10	1.27
	☑ B ☐ F	Avg				2.20	18.10	
3/2	-33	1	0.00	2.20	20.20	2.20	18.00	1.32
		2	0.00	2.20	20.20	2.20	18.00	1.32
	☑ B ☐ F	Avg				2.20	18.00	
3/3	-38	1	0.00	2.20	20.10	2.20	17.90	1.36
		2	0.00	2.20	20.10	2.20	17.90	1.36
	☑ B ☐ F	Avg				2.20	17.90	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

☑ Ambient Air QA Check
☑ Orsat Analyzer System Leak Check
☐ F_o Within EPA M-3 Guidelines for fuel type.

Where $F_o = \frac{20.9 - O_2}{CO_2}$

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

EPA Method 3 Guidelines

Fuel Type	F0 Range
Coal:	
Anthracite/Lignite	1.016-1.130
Bituminous	1.083-1.230
Oil:	
Distillate	1.260-1.413
Residual	1.210-1.370
Gas:	
Natural	1.600-1.836
Propane	1.434-1.586
Butane	1.405-1.553
Wood/Wood Bark	1.000-1.130

LSC-04-BR

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EPA Method 5 Data Reporting Sheet
Impinger Catch/Minnesota Protocol

Job: US Steel MINTAC
Team Leader: GH
Date Submitted: 4-6-92
Test No.: 1
Date of Analysis: 4-8-92

Source: #4 Scrubber
Test Site: Stack
Date of Test: 3-31-92
No. of Runs Completed: 3
Technician: C. Helgeson

0	Test 1 Run 0 Field Blank Log Number 5723-03 Comments	Dish No. 117 Dish Tare Wt. 47.3714 g Dish+Sample Wt. 47.3719 g Sample Wt. 0.0005 g
1	Test 1 Run 1 Log Number -07 Comments	Dish No. 99 Dish Tare Wt. 44.5319 g Dish+Sample Wt. 44.5341 g Sample Wt. 0.0022 g
2	Test 1 Run 2 Log Number -12 Comments	Dish No. 112 Dish Tare Wt. 47.3849 g Dish+Sample Wt. 47.3867 g Sample Wt. 0.0018 g
3	Test 1 Run 3 Log Number -17 Comments	Dish No. 507 Dish Tare Wt. 47.8423 g Dish+Sample Wt. 47.8447 g Sample Wt. 0.0024 g
4	Test ____ Run ____ Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g
5	Test ____ Run ____ Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g

Blank Solvent Wt. 0.0005g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0017	0.0013	0.0019		

LSC-03

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EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job US Steel
Team Leader GH
Date Submitted 4-6-92
Test No. 1
Date of Analysis 4-7-92
Transport Leakage ☒ None ☐ _____ ml

Source #4 Scrubber
Test Site Stack
Date of Test 3-31-92
No. of Runs Completed 3
Technician C Helgeson
Solvent Acetone

0	Test 1 Run 0 Field Blank Log Number 5723-01 Vol. of Solvent 100 ml *Solvent Residue 4.0 ug/ml	Dish No. 3 Dish Tare Wt. 52.1209 g Dish+Sample Wt. 52.1213 g Sample Wt. 0.0004 g
1	Test 1 Run 1 Vol. of Solvent 150 ml Log Number -05 Comments	Dish No. 24 Dish Tare Wt. 56.8238 g Dish+Sample Wt. 56.8387 g Sample Wt. 0.0149 g
2	Test 1 Run 2 Vol. of Solvent 150 ml Log Number -10 Comments	Dish No. 57 Dish Tare Wt. 50.0208 g Dish+Sample Wt. 50.0319 g Sample Wt. 0.0111 g
3	Test 1 Run 3 Vol. of Solvent 170 ml Log Number -15 Comments	Dish No. 100 Dish Tare Wt. 45.9697 g Dish+Sample Wt. 45.9794 g Sample Wt. 0.0097 g
4	Test ____ Run ____ Vol. of Solvent ____ ml Log Number ____ Comments	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g
5	Test ____ Run ____ Vol. of Solvent ____ ml Log Number ____ Comments	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g

*Solvent Residue ___ ug/ml = [(Sample Wt. ____ g)(10⁶)]/Vol. of Sol. ____ ml
EPA-M5 Acetone Residue Blank Spec. ≤ 7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0143	0.0105 D-4	0.0090		

LSC-01YR

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EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job U S Steel Mintac / Mr Iron Mn. Source #4 scrubber
Team Leader GH Test Site Stack
Date Submitted _____ Date of Test 3-31-92
Test No. 1 No. of Runs Completed 3
Date of Analysis 4-6-92 Technician C. Helgeson

0	Test 1 Run 0 Field Blank Log Number 5723-02 Comments _____	Filter No. 4096 Filter Type 4" GF Filter Tare Wt. .9342 g Filter+Sample Wt. .9342 g Sample Wt. 0.0000 g
1	Test 1 Run 1 Log Number -06 Comments _____	Filter No. 4154 Filter Type 4" GF Filter Tare Wt. .9419 g Filter+Sample Wt. .9725 g Sample Wt. 0.0306 g
2	Test 1 Run 2 Log Number -11 Comments _____	Filter No. 4077 Filter Type 4" GF Filter Tare Wt. .9621 g Filter+Sample Wt. .9932 g Sample Wt. 0.0311 g
3	Test 1 Run 3 Log Number -16 Comments _____	Filter No. 4156 Filter Type 4" GF Filter Tare Wt. .9377 g Filter+Sample Wt. .9706 g Sample Wt. 0.0329 g
4	Test ____ Run ____ Log Number _____ Comments _____	Filter No. _____ Filter Type _____ Filter Tare Wt. _____ g Filter+Sample Wt. _____ g Sample Wt. _____ g
5	Test ____ Run ____ Log Number _____ Comments _____	Filter No. _____ Filter Type _____ Filter Tare Wt. _____ g Filter+Sample Wt. _____ g Sample Wt. _____ g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0306	0.0311	0.0329		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0466	0.0429	0.0438		

LSC-02PR

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EPA Method 5 Data Reporting Sheet
Impinger Catch/Minnesota Protocol

Job U.S. Steel MINTAC — Source #5 Scrubber
Team Leader GA — Test Site Stack
Date Submitted 4-6-92 — Date of Test 4-2-92
Test No. 3 — No. of Runs Completed 3
Date of Analysis 4-8-92 — Technician C. Helgeson

0	Test ____ Run 0	Dish No. ____
	Field Blank	Dish Tare Wt. ____ g
	Log Number ____	Dish+Sample Wt. ____ g
	Comments ____	Sample Wt. ____ g
1	Test 3 Run 1	Dish No. 7
	Log Number 5723-26	Dish Tare Wt. 50.0326 g
	Comments ____	Dish+Sample Wt. 50.0363 g
	____	Sample Wt. 0.0037 g
2	Test 3 Run 2	Dish No. 29
	Log Number -31	Dish Tare Wt. 49.8008 g
	Comments ____	Dish+Sample Wt. 49.8027 g
	____	Sample Wt. 0.0019 g
3	Test 3 Run 3	Dish No. 30
	Log Number -36	Dish Tare Wt. 47.2620 g
	Comments ____	Dish+Sample Wt. 47.2637 g
	____	Sample Wt. 0.0017 g
4	Test ____ Run ____	Dish No. ____
	Log Number ____	Dish Tare Wt. ____ g
	Comments ____	Dish+Sample Wt. ____ g
	____	Sample Wt. ____ g
5	Test ____ Run ____	Dish No. ____
	Log Number ____	Dish Tare Wt. ____ g
	Comments ____	Dish+Sample Wt. ____ g
	____	Sample Wt. ____ g

Blank Solvent Wt. ____ g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0032	0.0014D-6	0.0012		

LSC-03.GF

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EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job U.S. Steel Minntac Mt Iron Mn. Source #5 Scrubber
Team Leader GH Test Site Stack
Date Submitted ____ Date of Test 4-2-92
Test No. 3 No. of Runs Completed 3
Date of Analysis 4-6-92 Technician C. Helgeson
Transport Leakage (None) ____ ml Solvent Acetone

0	Test ____ Run 0 Field Blank Log Number ____ Vol. of Solvent ____ ml *Solvent Residue 4.0 ug/ml	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g
1	Test 3 Run 1 Vol. of Solvent 120 ml Log Number 5723-24 Comments ____	Dish No. 204 Dish Tare Wt. 47.4657 g Dish+Sample Wt. 47.4761 g Sample Wt. 0.0104 g
2	Test 3 Run 2 Vol. of Solvent 170 ml Log Number -29 Comments ____	Dish No. 406 Dish Tare Wt. 49.6191 g Dish+Sample Wt. 49.6310 g Sample Wt. 0.0119 g
3	Test 3 Run 3 Vol. of Solvent 160 ml Log Number -34 Comments ____	Dish No. 409 Dish Tare Wt. 46.1909 g Dish+Sample Wt. 46.2048 g Sample Wt. 0.0139 g
4	Test ____ Run ____ Vol. of Solvent ____ ml Log Number ____ Comments ____	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g
5	Test ____ Run ____ Vol. of Solvent ____ ml Log Number ____ Comments ____	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g

*Solvent Residue ____ ug/ml = [(Sample Wt. ____ g)(10⁶)]/Vol. of Sol. ____ ml
EPA-M5 Acetone Residue Blank Spec. ≤ 7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0049	0.0112 D-7	0.0133		

LSC-01YR

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EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job U.S Steel - Mintac MT Iron Mn
Team Leader GA
Date Submitted
Test No. 3
Date of Analysis 4-6-92

Source #5 Scrubber
Test Site Stack
Date of Test 4-2-92
No. of Runs Completed 3
Technician C. Helgeson

0	Test Run 0 Field Blank Log Number Comments	Filter No. Filter Type Filter Tare Wt. g Filter+Sample Wt. g Sample Wt. g
1	Test 3 Run 1 Log Number 5723-25 Comments	Filter No. 4101 Filter Type 4" GF Filter Tare Wt. .9319 g Filter+Sample Wt. .9480 g Sample Wt. 0.0161 g
2	Test 3 Run 2 Log Number -30 Comments	Filter No. 4100 Filter Type 4" GF Filter Tare Wt. .9311 g Filter+Sample Wt. .9497 g Sample Wt. 0.0186 g
3	Test 3 Run 3 Log Number -35 Comments	Filter No. 4103 Filter Type 4" GF Filter Tare Wt. .9526 g Filter+Sample Wt. .9715 g Sample Wt. 0.0189 g
4	Test Run Log Number Comments	Filter No. Filter Type Filter Tare Wt. g Filter+Sample Wt. g Sample Wt. g
5	Test Run Log Number Comments	Filter No. Filter Type Filter Tare Wt. g Filter+Sample Wt. g Sample Wt. g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0161	0.0186	0.0189		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0292	0.0312	0.0334		

LSC-02PR

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EPA Method 6 Sulfur Dioxide Calculation Data Sheet[1]

Job: US Steel
Team leader: 6H
Date submitted: 4-6-92
Test Number: 1
Date of analysis: 4-8-92

Source: #4 Scrubber
Test Site: Stack
Date of Test: 3-31-92
No. of Runs Completed: 3
Technician: C. Hellyeson

MEQ Calculation

$$MEQ = \frac{DF\ N\ (V_s - V_b)\ V_s}{V_a}$$

DF = Dilution Factor
N = Normality of Titrant
V_s = Volume of Titrant Sample (ml)
V_b = Volume of Titrant Blank (ml)
V_s = Final Volume of sample (ml)
V_a = Volume of Aliquot (ml)

Water Catch

Test 1 Run 1: MEQ = $\frac{(1.0)(.0100)(1.50-.15)(510)}{(20.0)}$ = 0.344 MEQ

Test 1 Run 2: MEQ = $\frac{(1.0)(.0100)(1.50-.15)(510)}{(20.0)}$ = 0.344 MEQ

Test 1 Run 3: MEQ = $\frac{(1.0)(.0100)(1.60-.15)(510)}{(20.0)}$ = 0.370 MEQ

3% Peroxide Catch

Test 1 Run 1: MEQ = $\frac{(1.0)(.0100)(8.55-.15)(500)}{(20.0)}$ = 2.10 MEQ

Test 1 Run 2: MEQ = $\frac{(1.0)(.0100)(8.00-.15)(500)}{(20.0)}$ = 1.96 MEQ

Test 1 Run 3: MEQ = $\frac{(1.0)(.0100)(8.30-.15)(500)}{(20.0)}$ = 2.04 MEQ

Total MEQ Per Run:

Test 1 Run 1 = 2.44 MEQ
Test 1 Run 2 = 2.30 MEQ
Test 1 Run 3 = 2.41 MEQ

Comments: _____

1 Form to be used in conjunction with combination method 5 and 6 train.

S-421A

Interpoll Laboratories
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EPA Method 6 Sulfur Dioxide Calculation Data Sheet[1]

Job U. S. Steel
Team leader C H
Date submitted 4-7-92
Test Number 3
Date of analysis 4-7-92

Source #5 Scrubber
Test Site Stack
Date of Test 4-2-92
No. of Runs Completed 3
Technician C. Holgeson

MEQ Calculation

$$MEQ = \frac{DF\ N\ (V_s - V_b)\ V_s}{V_a}$$

DF = Dilution Factor
N = Normality of Titrant
V_s = Volume of Titrant Sample (ml)
V_b = Volume of Titrant Blank (ml)
V_s = Final Volume of sample (ml)
V_a = Volume of Aliquot (ml)

Water Catch

Test 3 Run 1 MEQ = $\frac{(1.0)(.0100)(1.45-.15)(510)}{(20.0)}$ = 0.332 MEQ

Test 3 Run 2 MEQ = $\frac{(1.0)(.0100)(1.60-.15)(510)}{(20.0)}$ = 0.370 MEQ

Test 3 Run 3 MEQ = $\frac{(1.0)(.0100)(1.50-.15)(510)}{(20.0)}$ = 0.344 MEQ

3% Peroxide Catch

Test 1 Run 1 MEQ = $\frac{(1.0)(.0100)(8.55-.15)(500)}{(20.0)}$ = 2.10 MEQ

Test 1 Run 2 MEQ = $\frac{(1.0)(.0100)(6.60-.15)(500)}{(20.0)}$ = 1.61 MEQ

Test 1 Run 3 MEQ = $\frac{(1.0)(.0100)(7.30-.15)(500)}{(20.0)}$ = 1.79 MEQ

Total MEQ Per Run:

Test 3 Run 1 = 2.43 MEQ
Test 3 Run 2 = 1.98 MEQ
Test 3 Run 3 = 2.13 MEQ

Comments: _____

1 Form to be used in conjunction with combination method 5 and 6 train.

Interpoll Laboratories
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Chain of Custody
Sample Deposition Sheet

Job US STEEL MINTAC
Team Leader DVH
Date Submitted 4-3-92
Test No. 1

Source NO 4 SCRUBBER
Test Site STACK
Date of Test 3-31-92
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
3 + 1 BLANK	Probe Wash: ☒ Acetone ☐ D.I. Water	☒ As per EPA M-5 ☐ Other _____	
3 + 1 BLANK	Filter: ☒ 4" G.F. ☐ S.S. Thimble ☐ 2.5" G.F. ☐ 47 mm G.F.	☒ As per EPA M-5 ☐ As per EPA M-17 ☐ Other _____	Fluse combined SO_2
3 - 3 - + 1 BLANK EA	Impinger Catch: ☒ D.I. Water ☒ 3% H_2O_2 ☐ 4M5 Hg Only ☐ 4M5 Metals ☐ 1.0 N NaOH ☐ Other _____	☐ MN Protocol ☐ WI Protocol ☐ EPA M-6 or 8 ☐ Acid Gases ☐ Formaldehyde ☐ Metals ☐ Other _____	1+
3	Integrated Gas sample	☒ As per EPA M-3 ☐ As per EPA M-10 ☐ Other _____	
0	Oxides of Nitrogen (NO_x)	☐ As per EPA M-7A ☐ Other _____	Date _____ Time (HRS) _____
	☐ Fuel Sample ☐ Aggregate	☐ Attached fuel Form #S-0163RRR	
0	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☐ Other _____	
0	Audit Samples ☐ Sulfur Dioxide ☐ Oxides of Nit. ☐ Other _____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other _____	

Source Information

1) Type of Source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☐ Dryer ☐ Other _____
2) Fuel: ☐ Coal ☐ Wood ☐ Gas ☐ Oil ☐ RDF ☐ Other _____
3) Is sample combustible? ☒ No ☐ Yes
4) Does sample need special handling? ☒ No ☐ Yes If yes, explain _____

Interpoll Laboratories
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Chain of Custody
Sample Deposition Sheet

Job US STEEL MINTAC
Team Leader DVH
Date Submitted 4-3-92
Test No. 3

Source NO 5 SCRUBBER
Test Site STACK
Date of Test 4-2-92
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
3 + 1 BLANK	Probe Wash: ☒ Acetone ☐ D.I. Water	☒ As per EPA M-5 ☐ Other _____	
3 + 1 BLANK	Filter: ☒ 4" G.F. ☐ S.S. Thimble ☐ 2.5" G.F. ☐ 47 mm G.F.	☒ As per EPA M-5 ☐ As per EPA M-17 ☐ Other _____	
3 3 + 1 BLANK	Impinger Catch: ☒ D.I. Water ☒ 3% H_2O_2 ☐ 4M5 Hg Only ☐ 4M5 Metals ☐ 1.0 N NaOH ☐ Other _____	☒ MN Protocol ☐ WI Protocol ☐ EPA M-6 or 8 ☐ Acid Gases ☐ Formaldehyde ☐ Metals ☐ Other _____	Combined S_2 & Imp Catch
3	Integrated Gas sample	☒ As per EPA M-3 ☐ As per EPA M-10 ☐ Other _____	
0	Oxides of Nitrogen (NO_x)	☐ As per EPA M-7A ☐ Other _____	Date _____ Time (HRS) _____
0	☐ Fuel Sample ☐ Aggregate	☐ Attached fuel Form #S-0163RRR	
0	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☐ Other _____	
0	Audit Samples ☐ Sulfur Dioxide ☐ Oxides of Nit. ☐ Other _____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other _____	

Source Information

1) Type of Source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☐ Dryer ☒ Other ACC
2) Fuel: ☐ Coal ☐ Wood ☐ Gas ☐ Oil ☐ RDF ☐ Other _____
3) Is sample combustible? ☒ No ☐ Yes
4) Does sample need special handling? ☒ No ☐ Yes If yes, explain _____

S-278RRRR

APPENDIX E

PROCESS INFORMATION

Interpoll Stack Tests
March 31, 1992 to April 2, 1992

	Test 1			Test 2			Test 3		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Date	Mar. 31	Mar. 31	Mar. 31	Apr. 1	Apr. 1	Apr. 1	Apr. 2	Apr. 2	Apr. 2
Time									
Start	10:00	11:40	13:20	08:10	09:50	11:30	07:45	10:50	12:45
Stop	11:06	12:45	14:30	09:20	11:10	12:40	08:49	12:00	13:30
Line #	4	4	4	5	5	5	5	5	5
Green ball feed rate	508	509	507	418	413	413	496	503	500
Scrubber Data									
Water flow – gpm	3010	3009	3015	2975	2964	2970	3004	3009	3003
Delta pressure	8.53	7.73	8.50	5.88	5.90	5.87	8.11	8.68	8.71
Outlet tempurature	94.8	94.9	95.2	100.0	100.8	101.0	102.4	101.5	102.1
Waste Gas fan Data									
Motor current (amps)	392	376	390	365	364	368	387	412	415
Inlet damper % open	72.7	61.4	72	45.6	45.2	45.2	72.18	93.8	100
Outlet tempurature	106.1	105.9	106.4	114.0	115.1	114.1	118.4	118.0	119.4
Fuel Data									
PH mcf/hour	68.57	66.86	68.57	63.43	63.00	65.14	61.71	61.71	60.00
Kiln mcf/hour	72.22	66.41	60.57	130.56	131.10	128.78	162.60	166.96	178.42
Total Mcf/hour	140.79	133.27	129.14	193.99	194.10	193.92	224.31	228.67	238.42
Pounds of wood/hr	9120	9118	9108	0	0	0	0	0	0
MBTU/ton	503	503	486	584	595	595	565	580	615

APPENDIX F

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, 1987). 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 glass-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 °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.

3a P2(7)

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Condensible Organic Compounds Analysis

(State of Minnesota - MPCA Exhibit C)

Method II-8672-MN

Equipment: Separatory funnel - 500 cc with Teflon stopcock

Powder funnel - 75 mm ID with a 17 mm stem

Evaporating dish(es) - 200 cc or 250 cc beaker

Reagents: Diethyl ether - reagent grade

Chloroform - reagent grade

Sodium sulfate - (ACS) granular anhydrous

Toluene - (if 3% hydrogen peroxide is used to collect the samples)

Glass wool (Pyrex microfiber)

PREPARATION

1. Place 1 kg of granular anhydrous sodium sulfate in a shallow tray and heat to 200 ^{o}C for at least four hours. Store in a tightly sealed glass container.

2. Place a plug of clean glass wool in the stem of the powder funnel. The plug must be of sufficient size so that it is held snuggly in place by its own pressure. Add a one-inch layer of dry sodium sulfate.

SAMPLING

An all-glass impinger assembly is used in the back half of the EPA Method 5 sampling train when an organic wet catch is to be collected. The impinger assembly consists of a modified impinger, a Greenburg Smith impinger followed by another modified impinger. The third impinger should have a temperature measuring device at the outlet upstream of a final impinger or desiccant column to monitor the temperature of the outlet gas stream. Prior to the start of the test, each of the first two impingers should be charged with 100 g of Class I water. The Method 5 train should be operated as provided for in EPA Method 5. Ice should be added to the impinger bath to keep the temperature of the gas at the outlet at or less than 68 ^{o}F. After the post test leak check, the impinger train is removed and impinger contents poured into a tared all-glass sample bottle and closed with a Teflon-lined cap. The sample bottle is then weighed and the total condensate calculated by subtraction of the bottle tare weight and the weight of initial water added to the impingers (200 g). A label is affixed and the sample is returned to the laboratory for analysis. The sample should be stored at 4 ^{o}C if the analysis is not conducted within 48 hours.

ANALYSIS

I. Organics

Caution! Work in vented hood!!!

A. Organic Blank Determination

1. Pour 125 mL of ethyl ether and 125 mL of chloroform into a tared beaker.
2. Evaporate solvent in hood at 70 ^{o}F or less until no solvent remains.
3. Desiccate the sample in dish for two hours.
4. Weigh the sample to nearest 0.1 mg, record and report on Form LSC-036.

B. Organic Sample Determination

1. Test for peroxide in sample ether using KI strips. (If KI strip shows positive, contact your supervisor before proceeding.)
2. Transfer the sample solution quantitatively to a 500 mL separatory funnel. Use the first of three 25 mL chloroform aliquots to rinse the sample container.
3. Extract with three 25 mL portions of chloroform. (Shake and vent to release pressure about 4 to 5 times each.) Allow the phases to separate. (Bottom layer is chloroform.) Draw off the bottom layer, transferring the solvent with a funnel containing a plug of sodium sulfate into a tared beaker. (Do not draw off any of the aqueous layer.)

4. After the three chloroform extractions, use two 25 mL portions of chloroform to rinse the sodium sulfate, collecting the rinses in the same tared beaker as the extracts.

5. Next extract the sample three times with 25 mL aliquots of ethyl ether. (Shake and vent to release pressure about 4 to 5 times each.) Allow the phases to separate. (Top layer is ethyl ether.) Draw off the bottom layer (aqueous) into another separatory funnel taking less than 1 mL of the ethyl ether layer with. Decant the ethyl ether, passing it through sodium sulfate and collecting the ethyl ether in the same tared dish as the chloroform.

6. After the three ethyl ether extractions, take two 25 mL portions of ethyl ether and rinse the sodium sulfate collecting the rinses in the same tared beaker as the extracts.

7. Evaporate the solvents (chloroform and ethyl ether) in the tared beaker in the hood at 70 ^{o}F or less until no solvent remains. (Use no heat and have no sources of ignition in the hood when doing this procedure.) Do not evaporate so quickly as to allow evaporative cooling to lower the temperature of the container below the dew point of water, otherwise, water will be condensed out in the container.

8. Desiccate to constant weight (two hours). Record and report the final weight to the nearest 0.1 mg on Form LSC-036.

II. Inorganics

If inorganic residue information is required, the following procedure should be conducted:

A. Inorganic Blank Determination

1. Vent the remaining aqueous phase from the organic extraction in the hood to remove residual organic solvents (usually overnight).
2. Decant the impinger catch into a tared evaporating dish.
3. Evaporate all of the water in the sample in an oven at 100 ^{o}C. Take care not to boil to prevent bumping and loss of sample.
4. Cool the dried sample in the desiccator and desiccate until a constant weight is obtained.
5. Report the results to the nearest 0.1 mg on Form LSC-036.

B. Inorganic Sample Determination

Follow steps 1-5 in Section A above.

NOTES

1. For the organics determination, in the rare event that the impinger catch resulted from a Modified Method 6 determination (SO_2), whereby the solution contains dilute hydrogen peroxide ($\geq$ 3%), do not use ether as an extraction solvent. Substitute toluene for ethyl ether in Section I. (Ether in the presence of peroxide forms explosive hydroperoxide.)

2. In the organics determination, more than three extractions may be required to extract all of the organics. Additional extractions should be performed if the aqueous phase is still cloudy.

3. Special state requirements:

   Michigan - Total sample evaporated in tared evaporating dish on steam bath.

   Iowa - Organics and inorganics separately, as required.

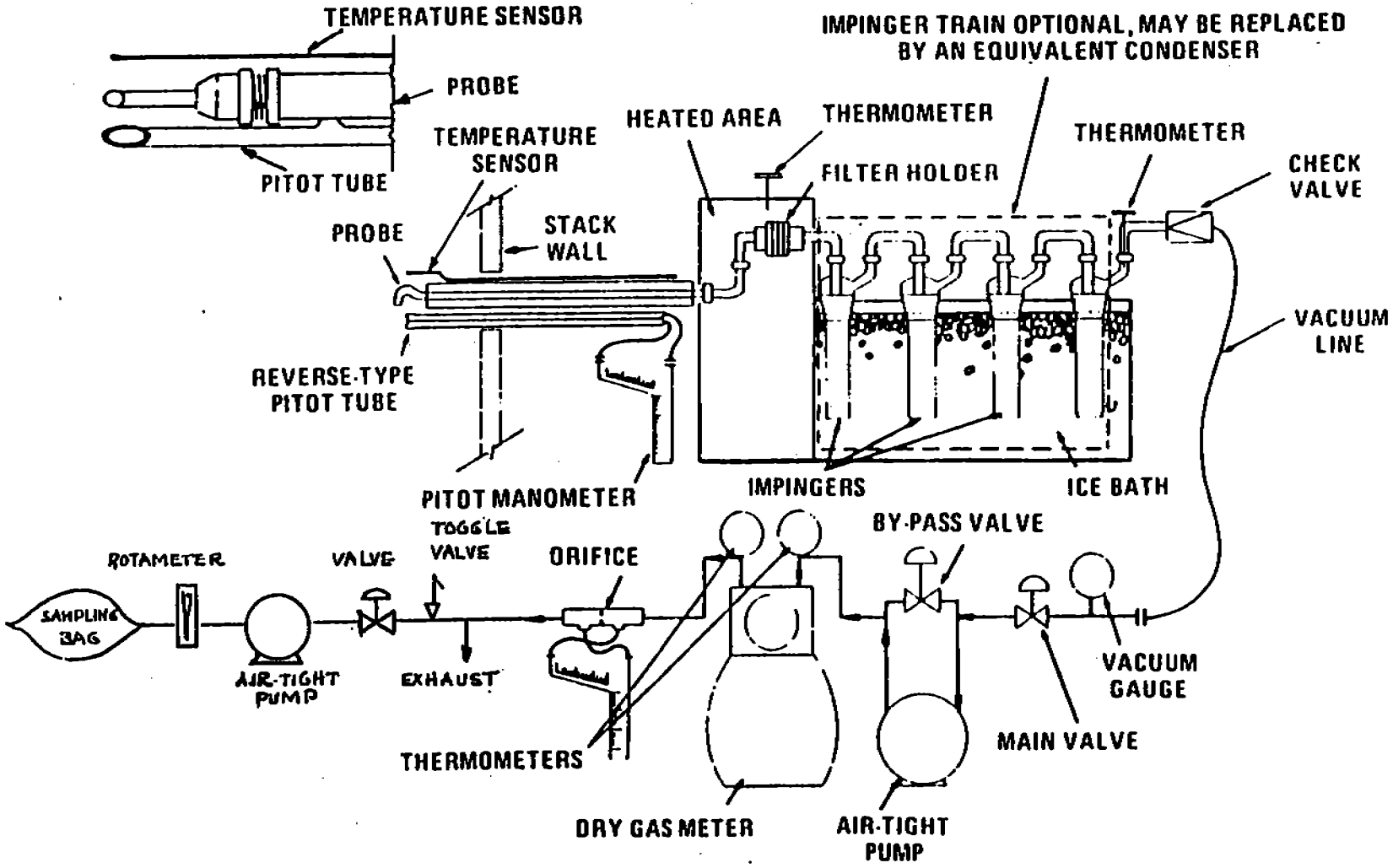
   Wisconsin - Use Method II-8672-WI.

   Rest of states - Organics only.

REFERENCES

Proposed Standards of Performance for New Stationary Sources, Federal Register 36(159) Part II, August 1, 1979.

Minnesota Pollution Control Agency, Exhibit C.



Particulate-sampling train.

Interpoll Laboratories, Inc.
(612)786-6020

Determination of Sulfur Dioxide From Stationary Source Samples

Interpoll Method Modified EPA 5-AIR
EPA Reference Methods 5 and 6

Version 1.0
July 17, 1991

Total Number of Revisions 0
Date of Last Revision July 17, 1991

1 APPLICATION

This method is applicable for the determination of sulfur dioxide emissions from stationary sources.

2 RANGE

The minimum detectable limit of the method has been determined to be 3.4 mg of SO_2/m^3. No upper limit has as of yet been established.

3 SAMPLE HANDLING AND PRESERVATION

No preservation requirements are necessary. If possible, keep samples cooled below 4 degrees celsius.

4 SUMMARY OF METHOD

A gas sample is extracted from the sampling point in the stack using a standard EPA method 5 sampling train equipped with 2 impingers containing deionized water which collect the condensible organics. For the collection of sulfur dioxide, the sampling train is modified by the addition of 2 impingers containing 3% peroxide. Each impinger solution is recovered separately in the field and returned to the laboratory for analysis.

5 INTERFERENCES

5.1 Cations and fluorides are interferents which should be removed by glass wool filters and an isopropanol bubbler, neither of which will affect the sulfur dioxide collection.

5.2 Free ammonia will interfere with the sulfur dioxide analysis by reacting with the sulfur dioxide to form particulate sulfite. This particulate consists of white particulate noticed in the probe and isopropanol bubbler. Alternative methods for this type of situation are required, however, they must first be approved by the EPA.

6 APPARATUS AND GLASSWARE

6.1 Sampling train (modified EPA method 5 set up).

6.2 Wash bottles, polyethylene, 100 mL. (2)

6.3 Storage bottles, polyethylene, 100 mL, to store impinger samples.

6.4 Pipettes, Volumetric type, 5 mL, 20 mL (one per sample), and 25 mL sizes.

6.5 Volumetric flasks, 100 mL (one per sample) and 1000 mL size.

6.6 Burettes, 5 and 50 mL sizes.

6.7 Erlenmeyer flasks, 250 mL (one for each sample, blank and standard).

6.8 Dropping bottle, 125 mL size.

6.9 Graduated cylinder, 100 mL size.

6.10 Spectrophotometer, capable of measuring absorbance at 352 nanometers.

7 REAGENTS

7.1 Water: deionized distilled to conform to ASTM Type III (D1193-77).

7.2 Isopropanol: (80%) mix 80 mL of isopropanol with 20 mL ASTM Type III water. Each lot of isopropanol must be checked prior to use as follows:

Shake 10 mL of isopropanol with 10 mL of freshly prepared 10% potassium iodide solution. Prepare a blank by similarly treating 10 mL of distilled water. After 1 minute, read the absorbance at 352 nm on the spectrophotometer. If absorbance exceeds 0.1, reject alcohol for use. Alcohol may be passed through activated alumina to remove peroxides, however, it may be more efficient to reject the lot and purchase a reagent grade isopropanol with low peroxides.

7.3 Hydrogen peroxide: (3%) Dilute 30% hydrogen peroxide 1:9 with ASTM Type III water. Prepare fresh daily.

7.4 Potassium iodide solution: (10%) Dissolve 10 grams KI in ASTM Type III water and dilute to 100 mL. Prepare as needed.

7.5 Isopropanol: (100%).

7.6 Thorin Indicator: Dissolve 0.2 grams in 100 mL ASTM Type III water.

7.7 Barium perchlorate solution: (0.010 N) Dissolve 1.95 grams of barium perchlorate trihydrate in 200 mL distilled water and dilute to 1 liter with isopropanol. Standardize as in Section 10.

7.8 Sulfuric Acid Standard: (0.010 N).

8 SAFETY

Normal, accepted stationary source testing safety practices should be followed during sampling. Good laboratory practics should be followed during the analysis. Caution should be excersized when working with hydrogen peroxide. There are no known carcinogens used in this method.

9 PROCEDURE

9.1 Follow EPA method 5 for sampling train set up, sampling procedures, and sample recovery.

9.2 Analysis of 3% Peroxide Catch Samples for Sulfate:

9.2.1 Note the level of fluid. Confirm whether any sample was lost during shipment. Record all necessary information on form S-421 (Figure 9-1).

9.2.2 Transfer contents of the bottle to a 100 mL volumetric flask and dilute to volume with ASTM Type III water.

9.2.3 Pipette a 20 mL aliquot of this solution into a 250 mL Erlenmeyer flask and add 80 mL of 100% isopropanol and approx. 2 drops of thorin indicator.

9.2.4 Titrate to a pink endpoint using 0.010 N barium perchlorate.

9.2.5 Repeat steps 9.5.3 and 9.5.4 and average the two results.

Figure 9-1. EPA Method 6 Sulfur Dioxide Titration Data Sheet

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EPA Method 6 Sulfur Dioxide
Titration Data Sheet

Job__________ Source__________
Team Leader__________ Test Site__________
Date Submitted__________ Date of Test__________
Test No.__________ No. of Runs Completed__________
Date of Analysis__________ Technician__________

Test/ Run	Sample Log Number	pH of Original Sample *	Final Vol. (V_{soln})	Dilution Factor (DF)	Aliquot Titrated (V_a)	No. of An.	Start Vol. Buret (ml)	Final Vol. Buret (ml)	Volume of Tit. (V_t) (ml)
Field Blank		□ pH<3.5 □ pH____	□ 500 ml □ 250 ml □ 100 ml □ ____ml	□ 1 DF □ 10 DF □ 25 DF □ 50 DF □ ____DF	□ 1 ml □ 5 ml □ 10 ml □ 20 ml □ ____ml	1			
						2			
						Avg			V_b
		□ pH<3.5 □ pH____	□ 500 ml □ 250 ml □ 100 ml □ ____ml	□ 1 DF □ 10 DF □ 25 DF □ 50 DF □ ____DF	□ 1 ml □ 5 ml □ 10 ml □ 20 ml □ ____ml	1			
						2			
						Avg			
		□ pH<3.5 □ pH____	□ 500 ml □ 250 ml □ 100 ml □ ____ml	□ 1 DF □ 10 DF □ 25 DF □ 50 DF □ ____DF	□ 1 ml □ 5 ml □ 10 ml □ 20 ml □ ____ml	1			
						2			
						Avg			
		□ pH<3.5 □ pH____	□ 500 ml □ 250 ml □ 100 ml □ ____ml	□ 1 DF □ 10 DF □ 25 DF □ 50 DF □ ____DF	□ 1 ml □ 5 ml □ 10 ml □ 20 ml □ ____ml	1			
						2			
						Avg			
		□ pH<3.5 □ pH____	□ 500 ml □ 250 ml □ 100 ml □ ____ml	□ 1 DF □ 10 DF □ 25 DF □ 50 DF □ ____DF	□ 1 ml □ 5 ml □ 10 ml □ 20 ml □ ____ml	1			
						2			
						Avg			
		□ pH<3.5 □ pH____	□ 500 ml □ 250 ml □ 100 ml □ ____ml	□ 1 DF □ 10 DF □ 25 DF □ 50 DF □ ____DF	□ 1 ml □ 5 ml □ 10 ml □ 20 ml □ ____ml	1			
						2			
						Avg			
		□ pH<3.5 □ pH____	□ 500 ml □ 250 ml □ 100 ml □ ____ml	□ 1 DF □ 10 DF □ 25 DF □ 50 DF □ ____DF	□ 1 ml □ 5 ml □ 10 ml □ 20 ml □ ____ml	1			
						2			
						Avg			
		□ pH<3.5 □ pH____	□ 500 ml □ 250 ml □ 100 ml □ ____ml	□ 1 DF □ 10 DF □ 25 DF □ 50 DF □ ____DF	□ 1 ml □ 5 ml □ 10 ml □ 20 ml □ ____ml	1			
						2			
						Avg			
		□ pH<3.5 □ pH____	□ 500 ml □ 250 ml □ 100 ml □ ____ml	□ 1 DF □ 10 DF □ 25 DF □ 50 DF □ ____DF	□ 1 ml □ 5 ml □ 10 ml □ 20 ml □ ____ml	1			
						2			
						Avg			
		□ pH<3.5 □ pH____	□ 500 ml □ 250 ml □ 100 ml □ ____ml	□ 1 DF □ 10 DF □ 25 DF □ 50 DF □ ____DF	□ 1 ml □ 5 ml □ 10 ml □ 20 ml □ ____ml	1			
						2			
						Avg			

Normality of Titrant (N): _______N

Vol. Titrant for Field blank (V_b): _______ml
Vol. Titrant for Method Blank: _______ml

□ Ion Exchange
□ EPA Audit(s)
Audit No.__________
Audit No.__________

** If pH >3.5 Adjust with conc. perchloric acid to pH~2.0*

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9.3 Analysis of DI Water Catch Samples for Sulfate:

9.3.1 Transfer the contents of the bottle to a 500 mL volumetric flask and bring up to volume with ASTM Type III water. Use form S-421 (Figure 9-1) to record all necessary information.

9.3.2 Pipette a 100 mL aliquot into a 250 mL Erlenmeyer flask, add 100 uL of 30% peroxide. Test solution with KI paper. If paper turns purple, the solution is KI positive. If the paper stays white, continue adding 100 ul increments of 30% peroxide until positive KI paper indication is achieved.

9.3.3 Titrate sample according to steps 9.5.4 and 9.5.5.

9.4 Analysis of DI Water Catch Samples for Condensible Organics:

Using the 400 mL of sample left after step 4.6.2, check this sample with KI paper for evidence of possible peroxide contamination. If the KI paper turns purple, check with your supervisor before proceeding. If the KI paper stays white in color, proceed with standard Minnesota protocol extraction (Interpoll Method II-8672-MN).

10 CALCULATION

10.1 For the calculation of sulfur dioxide, use the information recorded on form S-421 (Figure 9-1), fill out form S-421A (Figure 10-1) and perform the required calculations.

10.2 For the calculation of condensible organics, follow standard Minnesota protocol (Interpoll Method II-8672-MN).

Figure 10-1. EPA Method 6 Sulfur Dioxide Calculation Data Sheet.

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EPA Method 6 Sulfur Dioxide Calculation Data Sheet[1]

Job_____ Source_____
Team leader_____ Test Site_____
Date submitted_____ Date of Test_____
Test Number_____ No. of Runs Completed_____
Date of analysis_____ Technician_____

MEQ Calculation

$$MEQ = \frac{DF\ N\ (V_a - V_b)\ V_s}{V_a}$$

DF = Dilution Factor
N = Normality of Titrant
V_a = Volume of Titrant Sample (ml)
V_b = Volume of Titrant Blank (ml)
V_s = Final Volume of sample (ml)
V_a = Volume of Aliquot (ml)

Water Catch

Test___Run___ MEQ = (___)(___)(___ - ___)(___) / (___) = _____MEQ

Test___Run___ MEQ = (___)(___)(___ - ___)(___) / (___) = _____MEQ

Test___Run___ MEQ = (___)(___)(___ - ___)(___) / (___) = _____MEQ

3% Peroxide Catch

Test___Run___ MEQ = (___)(___)(___ - ___)(___) / (___) = _____MEQ

Test___Run___ MEQ = (___)(___)(___ - ___)(___) / (___) = _____MEQ

Test___Run___ MEQ = (___)(___)(___ - ___)(___) / (___) = _____MEQ

Total MEQ Per Run:

Test___Run___ = _____ MEQ

Test___Run___ = _____ MEQ

Test___Run___ = _____ MEQ

Comments:_____

1 Form to be used in conjunction with combination method 5 and 6 train.
S-421A

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11 QUALITY CONTROL PROCEDURES

11.1 One blank must be titrated with each series of samples.

11.2 An acetone reagent blank will be used as the probe wash field blank. Samples will be blank corrected using the acetone reagent blank results.

11.3 Replicate titrations must meet the limits set in Section 12 of this method.

11.4 EPA supplied audit samples will be analyzed at each field site. These audit samples will follow the same procedures as all other samples. The results of the audit samples must meet the requirements set in Section 12 of the method.

11.5 All leak checks outlined in Section 9 - procedure, are quality control checks.

11.6 All calibration steps required in EPA Method 5 should be followed for correct usage of the sampling train.

12 ACCURACY AND PRECISION

12.1 The precision control limit for replicate titrations is 1 percent or 0.2 mL whichever is larger.

12.2 The concentrations of the audit samples obtained from the EPA shall agree within 5 percent of the actual concentrations. If the 5 percent specification is not met, reanalyze the compliance samples and audit samples, and include initial and reanalysis values in the test report.

13 REFERENCES

13.1 CFR Title 40 Part 60 Appendix A: EPA Method 5 (Revised July 1990).

13.2 CFR Title 40 Part 60 Appendix A: EPA Method 6 (Revised July 1990).

APPENDIX G

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.

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, ^{o}F

T_{wb} = Wet bulb temperature of stack gas, ^{o}F

$T_{m(avg)}$ = Absolute average dry gas meter temperature, ^{o}R

$T_s(avg)$ = Absolute average stack temperature, ^{o}F

T_{std} = Standard absolute temperature, 528 ^{o}F (68 ^{o}F)

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.

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 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

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

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

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

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

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

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

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

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

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

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

$\overline{V}_s$ = Average actual stack gas velocity, FT/SEC

vp_{tdb} = 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

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

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

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

$$C_s = \frac{7.06 \times 10^{-5}\ MEQ}{V_{std}}$$

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

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

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

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

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

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, °R

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 °F 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

APPENDIX H

SAMPLING TRAIN CALIBRATION DATA

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job US STEEL Date 4-2-93

Operator GH Module No. 6

Instructions: Operate the control module at a flow rate equal to ^H@ for 10 minutes before attaching the umbilical. Record the following data:

Bar press 28.37 in. Hg. γ = 1.0007 ^H@ 1.78 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(557.80)	[redacted]	
2.5	559.74	40.9	37.8
5.0	561.64	43.6	39.6
7.5	563.56	46.0	40.9
10	565.48	47.2	41.5
[redacted]	V_m = 7.68	Avg(t_m) = 42.9	°F

Calculate Y_{en} as follows:

$$Y_{en} = \frac{1.786}{\gamma\ V_m}\left[\frac{(t_m + 460)}{P_b}\right]^{0.5}$$

$$Y_{en} = \frac{1.786}{(1.0007)(7.68)}\left[\frac{(42.9) + 460}{(28.37)}\right]^{0.5}$$

$$Y_{en} = .978$$

If Y_{en} is not within the range of 0.97 to 1.03, "the volume metering system should be investigated before beginning."

CFR Title 40, Part 60, Appendix A, Method 5, Section 4.4.1

S-432R

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: April 10, 1992

Meter Box No. : 6 (Rockwell Dry Test Meter Serial No. 64710)

Date of Last Calibration: March 16, 1992
Calibration Technician: D. Brennan
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.)
March 26, 1992	2-3525	974.26	1216.26	242.00	242.00
March 31, 1992	2-3526	1218.05	1400.35	182.30	424.30

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6020

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Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
March 26, 1992	2-3525	974.26	1216.26	242.00	242.00
March 31, 1992	2-3526	1218.05	1400.35	182.30	424.30
April 1, 1992	2-3527	1405.01	1555.31	150.30	574.60
April 2, 1992	2-3526	1557.80	1749.47	191.67	766.27

* Total volume through meter since last calibration.

Date 3/16/92

Bar. Press. 28.88 in. Hg

INTERPOLL LABORATORIES, INC.
METER CALIBRATION SHEET
EPA METHOD 6

Control Module No. 6
Serial No. DTM 64710
Wet Test Meter No. AL-20
Technician D. BRENNAN

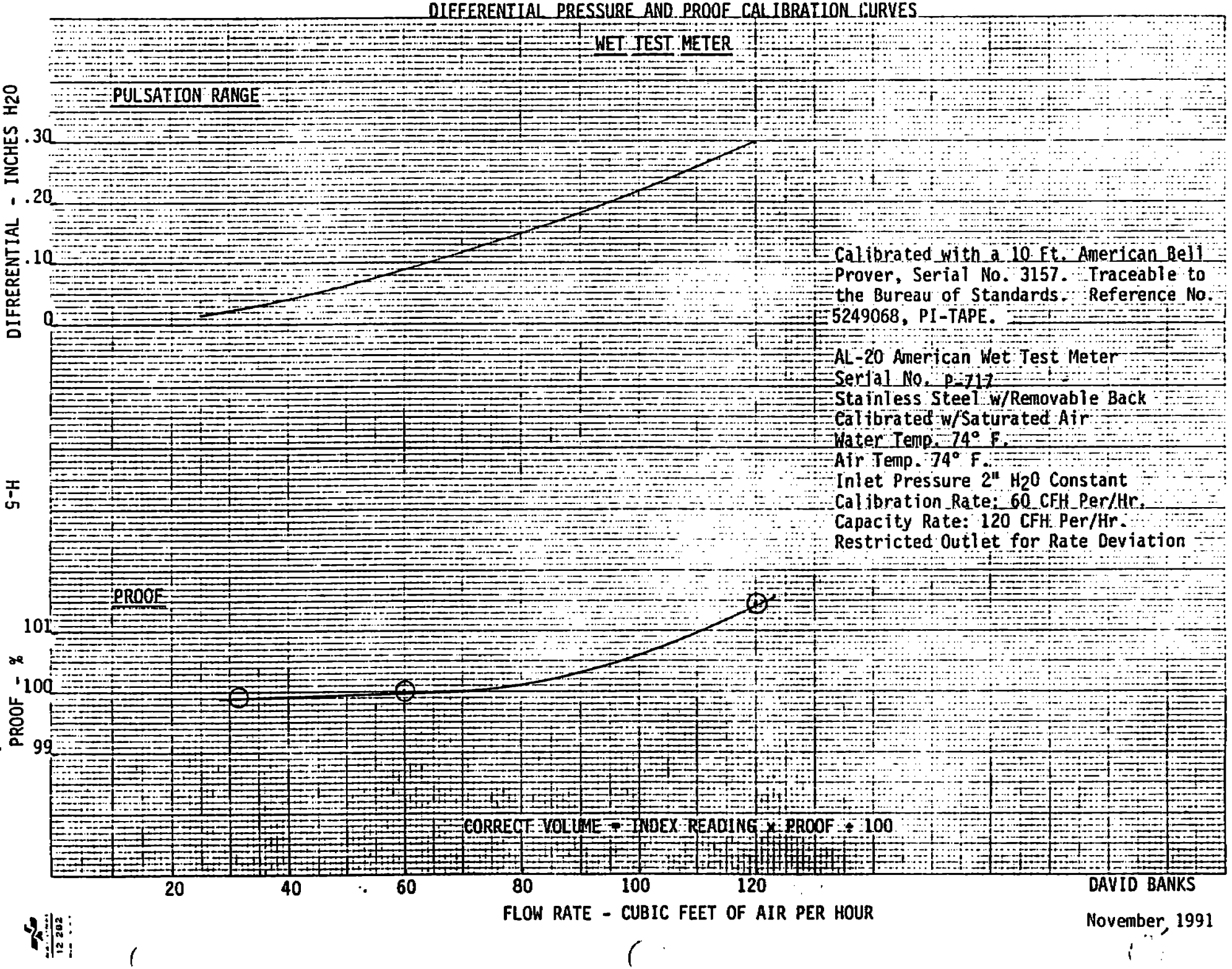
ΔH (in. WC)		Gas Volume Wet Test Meter (ft^3)	* Cal. Index θ (%)	* Diff. Wet Test Meter ΔP_w (in.WC)	Gas Volume Dry test meter (ft^3)		Gas temperatures			Time θ (min/sec)	Meter Coeff. Y	Orifice Const. ΔH@	C_f
							Wet Test	Dry Test					
nominal	actual				V_{d1}	V_{df}	t_w (°F)	t_{d1} (°F)	t_{do} (°F)				
0.5	.50	2	99.85	0.01	968.000	970.050	60.0	78	72	5.00	1.0009	1.74	
1.2	1.2	3	99.91	0.025	971.000	974.078	60.0	80	73	4.52	1.0015	1.75	
2.0	2.0	3	99.93	0.055	952.000	955.068	60.0	76	70	3.47	.9964	1.77	
3.3	3.3	5	100.00	0.09	956.000	961.113	59.5	81	72	4.59	1.0012	1.81	
4.7	4.7	6	100.02	0.12	962.000	967.103	59.5	83	74	4.13	1.0035	1.84	
		8	8	4	8	6	7	8	8	8	11/13	1.0007	1.782	

Positive leak check performed by D. BRENNAN
Meter was in tolerance ■
Meter was not in tolerance ☐; readjusted linkage
Meter was not in tolerance ☐; changed dry test meters

Approved by Daniel J. Dega Date 3/16/92

* Based on AL-20 wet test meter calibration in Nov. 1991 against Bell Prover (NBS Traceable) - Carl Poe Co.

DIFFERENTIAL PRESSURE AND PROOF CALIBRATION CURVES



Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 3-31-92 Nozzle Number 7-4
Technician: D. Van Hoever

The nozzle is rotated in 60 degree increments and the diameter at each point is measured to the nearest 0.001 inch. The observed readings and average are shown below.

Position	Diameter (inches)
1	.248
2	.247
3	.249
Average:	.247

Interpoll Laboratories, Inc.

Temperature Measurement Device Calibration Sheet

Unit under test:

Vendor Beckman Industrial

Model HD110 T — Serial Number 10507095 (POT #18)

Range -4 to 1999 °F °F — Thermocouple Type K

Date of Calibration 9/12/91 — Technician D.V.H

Method of Calibration:

☐ Comparison against ASTM mercury in glass thermometer using a thermostatted and insulated aluminum block designed to provide uniform temperature. The temperature is adjusted by adjusting the voltage on the block heater cartridge.

☒ Omega Model CL-300 Type K Thermocouple Simulator which provides 22 precise temperature equivalent millivolt signals. The CL-300 is cold junction compensated. Calibration accuracy is ± 0.1% of span (2100 °F) ± 1 degree (for negative temperatures add ± 2 degrees. The CL-300 simulates exactly the millivoltage of a Type K thermocouple at the indicated temperature.

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation Δt (°F)	Deviation (%)
0	0	0	0	0
100	100	96	4	.71
200	200	200	0	0
300	300	298	2	.39
400	400	395	5	.58
500	500	495	5	.32
600	600	598	2	.18
700	700	699	1	.08
800	800	804	4	.32
900	900	906	6	.44
1000	1000	1011	11	.75
1100	1100	1115	15	.96
1200	1200	1221	21	1.26
1300	1300	1322	22	1.25
1400	1400	1426	26	1.39
1500	1500	1524	24	1.22
1600	1600	1626	26	1.26
1700	1700	1721	21	.97
1800	1800	1819	19	.84
1900	1900	1912	12	.51
2000	—	—	—	—
2100	—	—	—	—
		Averages:		.68

OF = off scale response by unit under test (°F)

% dev = 100 Δt / (460 + t)

☒ Unit in tolerance

☐ Unit was not in tolerance; recalibrated - See new calibration sheet.

S-433

(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 23-4

Pitot tube dimensions:

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

Alignment:

4. α_1 <10° 1
5. α_2 <10° 0

6. B_1 <5° 2
7. B_2 < 5° 2

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

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .754 IN.
11. Pitot to probe sheath 3.00 IN.
12. Pitot to thermocouple (parallel to probe) 3.00 IN.
13. Pitot to thermocouple (perpendicular to probe) .760 IN.

☒ Meets all EPA design criteria thus C_p = 0.84

☐ Does not meet EPA design criteria - thus calibrate in wind tunnel
C_p = _____

Date of Inspection: 3-2-92

Inspected by: E Trankle

CFR Title 40 Part 60 Appendix A Method 2

DVH's personal

INTERPOLL LABORATORIES
(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 7/8/91
Technician Duane Van Hoever
Mercury Column Barometer No. 1
Aneroid Barometer No. Ultimeter serial # 8C1216

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjsted Mercury Barometer Read	Initial Aneriod Barometer Read	Difference (P_{ba}-P_{bm})
29.27	70	.11	29.16	29.17	-.01

Has this barometer shown any consistent problems with calibration? Yes/No. If yes, explain. No

Has problem been alleviated? Yes/No. How?

*Note

Aneroid barometers will be calibrated periodically against a mercury column barometer. The aneroid barometer to be calibrated should be placed in close proximity to the mercury barometer and left to equilibrate for 20-30 minutes before calibrating. Aneriod barometer will be calibrated to the adjusted mercury barometer readings.

S-312

TACON 23

Source category: Taconite ore processing
Plant name : USS Minnesota
Test date : March\April 1992
Process : Pelletizing lines

Date:
Location:
Ref. No.: 20

Basis for process rate :

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton
Pelletizing line 4 grate/kiln natural gas and wood-fired	Wet venturi scrubber	filt. PM	1	48.83	569.00	0.043	0.086
		filt. PM	2	43.99	570.00	0.039	0.077
		filt. PM	3	45.26	568.00	0.040	0.080
				AVERAGE		0.040	0.081
		SO2	1	81.90	569.00	0.072	0.14
		SO2	2	75.54	570.00	0.066	0.13
		SO2	3	79.77	568.00	0.070	0.14
				AVERAGE		0.069	0.14
		CO2	1	76698.6	569.00	67	135
		CO2	2	70018.3	570.00	61	123
		CO2	3	78206.5	568.00	69	138
				AVERAGE		66	132
Pelletizing line 5 grate/kiln natural gas-fired	Wet venturi scrubber	filt. PM	1	29.36	556.00	0.026	0.053
		filt. PM	2	31.89	563.00	0.028	0.057
		filt. PM	3	33.81	560.00	0.030	0.060
				AVERAGE		0.028	0.057
		SO2	1	78.27	556.00	0.070	0.14
		SO2	2	64.83	563.00	0.058	0.12
		SO2	3	69.07	560.00	0.062	0.12
				AVERAGE		0.063	0.13
		CO2	1	68542.2	556.00	62	123
		CO2	2	69965.8	563.00	62	124
		CO2	3	70177.9	560.00	63	125
				AVERAGE		62	124