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RESULTS OF THE JANUARY 1992 AIR TOXIC EMISSION STUDY ON THE NO. 2 BOILER AT THE NSP BLACK DOG PLANT

interpoll

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RESULTS OF THE JANUARY 1992 AIR TOXIC EMISSION STUDY ON THE NO. 2 BOILER AT THE NSP BLACK DOG PLANT

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Report Number 2-3496
May 4, 1992
DD/djd

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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 (^{0}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^{6}BTU	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/DSCM	milligrams 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
ug	micrograms
v/v	percent by volume
w/w	percent by weight
<	$\leq$ (when following a number)

Standard conditions are defined as 68 ^{0}F (20 ^{0}C) and 29.92 IN. of mercury pressure.

Jeff Cole, RTI, says this is a dry bottom boiler, according to the UDI/EEI database. Jeff has been working with the NSP data for five years and, therefore, I am taking his word on this.

Jj

1 INTRODUCTION

On January 31, 1992 Interpoll Laboratories personnel conducted an air toxics emission study on the No. 2 Boiler at the Northern States Power Company (NSP) Black Dog Plant located in Burnsville, Minnesota. On-site testing was performed by D. Van Hoever, E. Trowbridge, C. Mosser, J. Bergstrom and R. Aschenbach. Coordination between testing activities and plant operation was provided by Jim Paris of NSP.

The No. 2 Boiler is a 137 MW Foster-Wheeler Atmospheric Fluidized Bed Combustor (AFBC) boiler built in 1954 and converted to AFBC in 1986. It is equipped with 12 Detroit Stoker flipper feeders and has an economizer and air preheater. It has a steaming capacity of 1.039 KLB/HR of superheated steam. Particulate emissions are controlled by a primary (Research Cottrell 6-section) and secondary (Belco/GE 6-section) electrostatic precipitator. The boiler is also equipped with a Joy Mechanical Dust Collector. Cleaned flue gas from Units 1, 2, 3 and 4 is exhausted to the atmosphere by means of a steel liner which has an internal diameter of 22'-6" at the test port elevation (Units 1, 3 and 4 were off-line during these tests). At the time of these tests Unit 2 was firing 100% Western coal (blend of Antelope and Northern Antelope) and was operating on an inert bed.

An EPA Multi-Metal Modified Method 5 (4M5) sampling train was used to isokinetically collect solid and vapor phase trace metals at the Stack test site. The samples were collected and analyzed as per the EPA Draft Method "Methodology for the Determination of Metals Emissions in Exhaust Gases from Stationary Source Combustion Processes". The aerosol or solid phase trace metal samples were collected on Pallflex® Type 2500 QAT ultra pure filters. The vapor phase trace metals were collected in an all glass impinger train. The first and second impingers each contained 100 cc of a mixture of 5% HNO_3 and 10% H_2O_2. The third and fourth impingers contained 100 cc of a mixture of 4% $KMnO_4$ and 10% H_2SO_4. These impingers collect any elemental mercury which might penetrate the first two impingers.

The recovered four-part samples were returned to the laboratory where the probe rinse, filter and nitric acid impinger catch were combined, dissolved in acid (including the quartz filter) and analyzed by Inductively Coupled Argon Plasma Emission Spectrometry (ICP). In some cases, samples were reanalyzed by graphite furnace atomic absorption spectrometry for greater sensitivity. The permanganate mercury catch and an aliquot of the front half catch were each analyzed by cold vapor atomic absorption spectrometry (CV/AA). Two field-biased blanks were collected and recovered at each test site and analyzed for trace metals with the field samples. The probe rinse and filter catch were conditioned and analyzed gravimetrically prior to processing so that the total particulate weight could be determined.

The combined particulate and trace metal samplings performed at the ESP Inlet test site was performed using a modified EPA Method 17 sampling train designed to sample sites with high particulate loadings. The samples were collected using an out-stack stainless steel filter holder equipped with a special high efficiency stainless steel filter thimble. The sample gas passes through a pig tail stainless steel nozzle directly into the filter. After sampling is completed and the end-of-the run leak check performed, the sample train is turned on again at 0.75 cfm and the nozzle and filter holder tapped while sampling ambient air. This step carries any flyash deposited inside the nozzle into the filter holder. The filter thimble is then removed; returned to the laboratory; conditioned to remove free moisture and weighed which completes the gravimetric analysis. Samples for elemental analysis are obtained by bouncing the filter thimble on a hard surface which releases the entire filter cake from the mirror-like SS filter thimble walls. Aliquots of known weight are then taken for chemical analysis. No attempt is made to recover the thin layer of flyash remaining on the surface of the filter, since a more than adequate mass of flyash is recovered for chemical analysis and since this layer of flyash is in close contact with the stainless steel filter and might be contaminated to one degree or another with chromium or nickel stemming from decomposition of the stainless steel

filtration substrate.

The Inlet sampling trains also included an ice-bath cooled impinger train which contained four impingers (100 cc of acidified permanganate in each of the first two; the third impinger serves as a trap and the fourth contains desiccant). This impinger train collects the elemental mercury vapor which passes through the filter.

PM-10 determinations were performed at the Stack test site using an EPA M5 sampling train equipped with an eight-stage cascade impactor attached to the instack end of the probe. The gold-plated plates were coated with Apiezon H to minimize particle bounce off. Three determinations and one control were performed in accordance with PM-10 SIP Development Guideline USEPA - 450/2-86-001: Appendix C. Four separate impactor sets were used to collect the samples. The samples were returned to the laboratory, conditioned and weighed. The results were calculated in accordance with the impactor manufacturers recommendations using the provided 50% cut point calibration data.

Integrated flue gas samples were extracted simultaneously with each of the above-referenced sample trains from the sampling train exhaust ports using a specially designed gas sampling system as part of the overall project quality assurance . Integrated flue gas samples were collected in 44-liter Tedlar bags housed in a protective aluminum housing. 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.

The combined particulate and trace metal testing at the ESP Inlet was conducted from 10 test ports on the ESP Inlet Ducts. Each test run was 120 minutes in duration. Testing on the Stack was conducted from four test ports oriented at 90 degrees. These test ports are located approximately 9.8 stack diameters downstream of the breeching inlet and

7.2 diameters upstream of the stack exit. A 12-point traverse was used to extract representative trace metals samples. Each traverse point was sampled ten minutes for the combined particulate and trace metals runs to give a total sampling time of 120 minutes per run. A four-point traverse was used for PM-10 (cascade impactor) testing. Each traverse point was sampled 30 minutes to give a total sampling time of 120 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

2.1 Total Particulate Material

The results of the total particulate material mass rate determinations performed at the No. 2 Boiler ESP Inlet and Stack are presented in Tables 1 and 2. The average mass rates and removal efficiencies were as follows:

	Mass Rate (LB/HR)		Removal
Run No.	(Inlets)	(Stack)	Efficiency (%)
1	3155	22.3	99.29
2	4281	24.8	99.42
3	3089	25.2	99.18
Avg.	3508	24.1	99.30

In reviewing the particulate mass rate determinations, it should be noted that the sum of the dry standard volumetric flow rates measured at the ESP Inlet test site was 17 - 21% higher than those at the Stack test site. This is not unexpected. The Stack test site is aerodynamically ideal for gas velocity measurements inasmuch as the gas stream flow is undisturbed for more than eight stack diameters upstream ensuring that the flow lines are parallel to the stack walls. In the case of the Inlet measurements, the test sites are generally less than one diameter downstream of a flow disturbance and thus nonparallel flow is to be expected. The S-Type pitot tube used in this work, always over estimates the velocity pressure when the pitot tube is not facing directly into the flow (angle of attack <> 0).

Table 1. Summary of the Results of the January 31, 1992 Particulate Loading Determinations on the No. 2 Boiler ESP Inlet at the NSP Black Dog Plant Located in Burnsville, Minnesota.

ITEM	Run 1	Run 2	Run 3
Date of test	01-31-92	01-31-92	01-31-92
Time runs were done (HRS)	850/1101	1150/1424	1500/1708
Gross elect. generation (MW)	85.0	85.0	85.0
Percent opacity	12.0	12.0	12.0
Volumetric flow			
actual (ACFM)	555094	545244	546149
standard (DSCFM)	352635	344205	343215
Gas temperature (DEG-F)	267	267	267
Moisture content (%V/V)	8.35	8.89	9.30
Gas composition (%V/V,dry)			
carbon dioxide	12.00	11.90	12.40
oxygen	7.60	7.70	7.20
nitrogen	80.40	80.40	80.40
Isokinetic variation (%)	98.7	99.1	99.7
Particulate concentration			
actual (GR/ACF)	0.663	0.916	0.660
standard (GR/DSCF)	1.04	1.45	1.05
Part. emission rate (LB/HR)	3155	4281	3089
Emission factor (LB/MMBTU)	2.29	3.21	2.24

Note: Dry Catch Only

Table 2. Summary of the Results of the January 31, 1992 Particulate Emission Test on the No. 2 Boiler Stack at the NSP Black Dog Plant Located in Burnsville, Minnesota.

ITEM	Run 1	Run 2	Run 3
Date of test	01-31-92	01-31-92	01-31-92
Time runs were done (HRS)	850/1155	1150/1405	1500/1710
Gross elect. generation (MW)	85.0	85.0	85.0
Percent opacity	12.0	12.0	12.0
Volumetric flow			
actual (ACFM)	530518	526854	530187
standard (DSCFM)	354118	351097	354635
Gas temperature (DEG-F)	243	244	244
Moisture content (%V/V)	8.17	8.18	7.82
Gas composition (%V/V,dry)			
carbon dioxide	9.40	9.70	9.60
oxygen	10.40	10.20	10.20
nitrogen	80.20	80.10	80.20
Isokinetic variation (%)	99.0	99.8	99.4
Particulate concentration			
actual (GR/ACF)	.00489	.00549	.00554
standard (GR/DSCF)	.00733	.00824	.00829
Part. emission rate (LB/HR)	22.25	24.80	25.21
Emission factor (LB/MMBTU)	0.020	0.022	0.023

Note: Dry Catch Only

2.2 Elemental Analysis

The results of the elemental analyses performed on the flyash samples collected at the ESP Inlets and the Stack have been used together with the flue gas sample volumes to calculate exhaust gas concentrations of each of the 24 elements of interest (See Table 3). The elemental concentrations are presented for each of the three two-hour test runs at both the ESP Inlets and Outlet. Table 4 presents the same results except in LB/10^6BTU.

Elemental mass flow rates entering and leaving the ESP have been calculated from the individual element exhaust gas concentrations and the volumetric exhaust gas flow rates. These results are given in Table 5. Mass flow rates of elements entering the ESP were calculated using the volumetric flow rates at the inlet site. Removal efficiencies for each element were calculated where possible using the average mass rates at the ESP Inlets and Outlet. The results of these calculations are also presented in Table 5. Elemental removal efficiencies are in good agreement with the total particulate removal efficiencies. Elements that are very volatile and/or not collected efficiently by the electrostatic precipitators exhibit lower removal efficiencies.

The results of the elemental analyses performed on the flyash samples were also used to calculate flyash composition (See Table 6). In the case of major and minor elements, the results are reported as the corresponding mineral form expected to exist in the flyash as is custom in mineral ash analyses. This data shows that the analyses performed accounted for almost 100% of the total composition of the samples in the case of the Inlet samples and 68 - 69% in the case of the of the Stack samples. Silicon, a major component of flyash was not analyzed for in the case of the Stack samples nor was sulfur or carbon.

Table 3. Results of the January 1992 Trace Metal Determinations Performed at the No. 2 Boiler ESP Inlet and Stack at the NSP Black Dog Plant in Burnsville, Minnesota.

	Concentration (ug/Nm^3)					
	Run 1		Run 2		Run 3	
Element	Inlet	Stack	Inlet	Stack	Inlet	Stack
Aluminum	194000	804	266000	993	201000	1010
Antimony	3.58	<.46	4.66	<.46	5.28	<.46
Arsenic	36.8	.45	47.6	.47	32.7	.43
Barium	13400	41.3	18700	49.2	13700	52.6
Beryllium	7.15	<.023	11.6	<.023	6.91	<.023
Boron	1410	70.8	1730	77.7	1410	64.5
Cadmium	<5	3.08	<7	9.01	<5	4.38
Calcium	479000	3090	616000	3530	521000	3630
Chromium	115	4.37	159	8.60	117	2.94
Copper	427	10.6	516	13.7	381	8.64
Iron	106000	740	135000	800	101000	873
Potassium	7120	<55.2	8640	82.8	7210	68.6
Magnesium	83700	538	108000	626	81800	636
Manganese	237	4.04	348	4.74	247	6.81
Molybdenum	22.0	4.92	27.5	10.4	20.5	3.87
Sodium	38100	639	51600	757	41700	621
Nickel	147	28.7	187	36.3	144	7.64
Lead	63.7	37.8	62.0	242[1]	69.5	46.6
Selenium	15.4	.46	16.2	.23	14.4	.34
Strontium	8370	42.8	10700	50.1	8280	55.8
Vanadium	515	3.34	670	3.34	514	3.32
Zinc	261	93.3	329	70.8	226	35.5
Mercury	2.02	2.22	3.85	2.04	2.60	2.26
Silver	<4.79	<.46	<6.63	<.46	<4.81	<.46
Sulfur	115000	-	146000	-	113000	-
Silicon	272000	-	392000	-	286000	-
SO_2	-	118000	-	126000	-	116000

Note:

Sulfur could not be analyzed in the ESP Outlet flyash samples since the first two impingers in the 4M5 sampling train contain 10% H_2O_2 which retains SO_2. Thus the sulfur results reported for the Stack test site reflects the sum of the sulfur in the flyash as well as the sulfur in the SO_2 emissions.

Silicon was not analyzed in the ESP Outlet flyash samples since the EPA methodology requires dissolution of the filter which is pure SiO_2.

(1) This lead concentration is an artifact.

Table 4. Results of the January 1992 Trace Metal Determinations Performed at the No. 2 Boiler ESP Inlet and Stack at the NSP Black Dog Plant in Burnsville, Minnesota.

	Emission Factor (LB/10^6BTU)					
	Run 1		Run 2		Run 3	
Element	Inlet	Stack	Inlet	Stack	Inlet	Stack
Aluminum	$1.86X10^{-1}$	$9.76X10^{-4}$	$2.57X10^{-1}$	$1.18X10^{-3}$	$1.87X10^{-1}$	$1.20X10^{-3}$
Antimony	$3.42X10^{-6}$	$<5.57X10^{-7}$	$4.49X10^{-6}$	$<5.47X10^{-7}$	$4.90X10^{-6}$	$<5.44X10^{-7}$
Arsenic	$3.52X10^{-5}$	$5.41X10^{-7}$	$4.59X10^{-5}$	$5.53X10^{-7}$	$3.04X10^{-5}$	$5.06X10^{-7}$
Barium	$1.28X10^{-2}$	$5.01X10^{-5}$	$1.80X10^{-2}$	$5.86X10^{-5}$	$1.27X10^{-2}$	$6.26X10^{-5}$
Beryllium	$6.85X10^{-6}$	$<2.79X10^{-8}$	$1.11X10^{-5}$	$<2.74X10^{-8}$	$6.43X10^{-6}$	$<2.72X10^{-8}$
Boron	$1.35X10^{-3}$	$8.59X10^{-5}$	$1.67X10^{-3}$	$9.25X10^{-5}$	$1.31X10^{-3}$	$7.67X10^{-5}$
Calcium	$4.59X10^{-1}$	$3.75X10^{-3}$	$5.95X10^{-1}$	$4.20X10^{-3}$	$4.84X10^{-1}$	$4.32X10^{-3}$
Cadmium	$<4.59X10^{-6}$	$3.73X10^{-6}$	$<6.40X10^{-6}$	$1.07X10^{-5}$	$<4.47X10^{-6}$	$5.21X10^{-6}$
Chromium	$1.10X10^{-4}$	$5.30X10^{-6}$	$1.54X10^{-4}$	$1.02X10^{-5}$	$1.09X10^{-4}$	$3.49X10^{-6}$
Copper	$4.08X10^{-4}$	$1.29X10^{-5}$	$4.98X10^{-4}$	$1.63X10^{-5}$	$3.54X10^{-4}$	$1.03X10^{-5}$
Iron	$1.01X10^{-1}$	$8.98X10^{-4}$	$1.30X10^{-1}$	$9.52X10^{-4}$	$9.37X10^{-2}$	$1.04X10^{-3}$
Potassium	$6.82X10^{-3}$	$<6.59X10^{-5}$	$8.34X10^{-3}$	$9.85X10^{-5}$	$6.71X10^{-3}$	$8.16X10^{-5}$
Magnesium	$8.01X10^{-2}$	$6.52X10^{-4}$	$1.04X10^{-1}$	$7.44X10^{-4}$	$7.61X10^{-2}$	$7.57X10^{-4}$
Manganese	$2.27X10^{-4}$	$4.90X10^{-6}$	$3.36X10^{-4}$	$5.64X10^{-6}$	$2.30X10^{-4}$	$8.11X10^{-6}$
Molybdenum	$2.11X10^{-5}$	$5.97X10^{-7}$	$2.66X10^{-5}$	$1.24X10^{-5}$	$1.91X10^{-5}$	$4.61X10^{-6}$
Sodium	$3.64X10^{-2}$	$7.75X10^{-4}$	$4.98X10^{-2}$	$9.00X10^{-4}$	$3.88X10^{-2}$	$7.51X10^{-4}$
Nickel	$1.40X10^{-4}$	$3.48X10^{-5}$	$1.80X10^{-4}$	$4.32X10^{-5}$	$1.33X10^{-4}$	$9.09X10^{-6}$
Lead	$6.10X10^{-5}$	$4.59X10^{-5}$	$5.98X10^{-5}$	$2.87X10^{-4}$[1]	$6.46X10^{-5}$	$5.55X10^{-5}$
Selenium	$1.48X10^{-5}$	$5.57X10^{-7}$	$1.56X10^{-5}$	$2.74X10^{-7}$	$1.34X10^{-5}$	$4.03X10^{-7}$
Strontium	$8.01X10^{-3}$	$5.18X10^{-5}$	$1.03X10^{-2}$	$5.97X10^{-5}$	$7.70X10^{-3}$	$6.64X10^{-5}$
Vanadium	$4.93X10^{-4}$	$4.05X10^{-6}$	$6.46X10^{-4}$	$3.97X10^{-6}$	$4.78X10^{-4}$	$3.95X10^{-6}$
Zinc	$2.49X10^{-4}$	$1.13X10^{-4}$	$3.17X10^{-4}$	$8.43X10^{-5}$	$2.10X10^{-4}$	$4.34X10^{-5}$
Mercury	$1.94X10^{-6}$	$2.69X10^{-6}$	$3.72X10^{-6}$	$2.42X10^{-6}$	$2.42X10^{-6}$	$2.69X10^{-6}$
Silver	$<4.59X10^{-6}$	$<5.57X10^{-7}$	$<6.40X10^{-6}$	$<5.47X10^{-7}$	$<4.47X10^{-6}$	$<5.44X10^{-7}$
Sulfur	$1.10X10^{-1}$	-	$1.41X10^{-1}$	-	$1.05X10^{-1}$	-
Silicon	$2.61X10^{-1}$	-	$3.78X10^{-1}$	-	$2.66X10^{-1}$	-
SO_2	-	$1.43X10^{-1}$	-	$1.50X10^{-1}$	-	$1.38X10^{-1}$

Note:

Sulfur could not be analyzed in the ESP Outlet flyash samples since the first two impingers in the 4M5 sampling train contain 10% H_2O_2 which retains SO_2. Thus the sulfur results reported for the Stack test site reflects the sum of the sulfur in the flyash as well as the sulfur in the SO_2 emissions.

Silicon was not analyzed in the ESP Outlet flyash samples since the EPA methodology requires dissolution of the filter which is pure SiO_2.

[1] This lead emission factor is an artifact.

Table 5. Results of the January 1992 **Trace Metal Determinations** performed at the No. 2 Boiler ESP Inlet and Stack at the NSP Black Dog Plant in Burnsville, Minnesota.

	Mass Flow (LB/HR)						
	Run 1		Run 2		Run 3		Avg. Removal
Element	Inlet	Stack	Inlet	Stack	Inlet	Stack	Eff. (%w/w)
Aluminum	256	1.05	339	1.29	255	1.33	99.57
Antimony	0.00473	<0.0006	0.00593	<0.0006	0.00670	<0.0006	89.63
Arsenic	0.0486	0.000584	0.0606	0.000603	0.0415	0.000559	98.84
Barium	17.7	0.0541	23.8	0.0639	17.4	0.0691	99.68
Beryllium	0.00946	<0.00003	0.0147	<0.00003	0.00877	<0.00003	99.73
Boron	1.86	0.0927	2.20	0.101	1.78	0.0847	95.24
Cadmium	<0.006	0.00403	<0.008	0.0117	<0.006	0.00575	NA
Calcium	634	4.05	785	4.59	661	4.76	99.35
Chromium	0.151	0.00573	0.203	0.0112	0.148	0.00386	95.87
Copper	0.564	0.0139	0.657	0.0177	0.483	0.0113	97.48
Iron	140	0.969	171	1.04	128	1.15	99.28
Potassium	9.47	<0.07	11.0	0.107	9.15	0.0901	99.58
Magnesium	111	0.704	137	0.812	104	0.835	99.33
Manganese	0.313	0.00529	0.443	0.00615	0.314	0.00895	98.09
Molybdenum	0.0291	0.0064	0.0351	0.0135	0.0261	0.0051	72.26
Sodium	50.3	0.837	65.7	0.983	53.0	0.829	98.43
Nickel	0.194	0.0376	0.238	0.0471	0.182	0.0100	84.57
Lead	0.0842	0.0496	0.0789	0.314[1]	0.0882	0.0613	35.67
Selenium	0.0204	0.000602	0.0206	0.000299	0.0183	0.000445	97.73
Strontium	11.1	0.0560	13.6	0.0651	10.5	0.0733	99.45
Vanadium	0.681	0.00437	0.853	0.00434	0.653	0.00436	99.40
Zinc	0.345	0.122	0.418	0.0920	0.287	0.0479	75.02
Mercury	0.00268	0.00290	0.00490	0.00265	0.00330	0.00297	21.72
Silver	<0.006	<0.0006	<0.008	<0.0006	<0.006	<0.0006	NA
Sulfur	152	-	152	-	152	-	
Silicon	360	-	499	-	363	-	
SO_2	-	362	-	356	-	334	

Note:

Sulfur could not be analyzed in the ESP Outlet flyash samples since the first two impingers in the 4M5 sampling train contain 10% H_2O_2 which retains SO_2. Thus the sulfur results reported for the Stack test site reflects the sum of the sulfur in the flyash as well as the sulfur in the SO_2 emissions.

Silicon was not analyzed in the ESP Outlet flyash samples since the EPA methodology requires dissolution of the filter which is pure SiO_2.

(1) This lead emission rate is an artifact, and as such has been excluded in the removal efficiency calculations.

NA - Not Applicable, not detected values at inlet make removal efficiency meaningless.

Table 6. Summary of the Flyash Composition Calculations Based on the Flyash Sample Analytical Results from the January 1992 Trace Metals Emission Test on the No. 2 Boiler at the NSP Black Dog Plant in Burnsville, Minnesota.

	Fly Ash Compsition (% w/w)					
	Run 1		Run 2		Run 3	
Element	Inlet	Stack	Inlet	Stack	Inlet	Stack
Al_2O_3	15.34	11.00	15.14	11.81	15.80	11.91
As_2O_3	0.00	0.00	0.00	0.00	0.00	0.00
B_2O_3	0.19	1.65	0.17	1.58	0.19	1.30
BaO	0.63	0.33	0.52	0.35	0.64	0.37
BeO	0.00	0.00	0.00	0.00	0.00	0.00
CaO	27.98	31.34	26.03	31.10	30.36	31.66
CdO	0.00	0.03	0.00	0.06	0.00	0.03
Cr_2O_3	0.01	0.05	0.01	0.08	0.01	0.03
CuO	0.02	0.10	0.02	0.11	0.02	0.07
Fe_2O_3	6.32	7.66	5.80	7.20	6.00	7.79
K_2O	0.36	<0.48	0.31	0.63	0.36	0.52
MgO	5.80	6.46	5.37	6.53	5.64	6.58
Mn_3O_4	0.01	0.04	0.01	0.04	0.01	0.06
MoO_3	0.00	0.05	0.00	0.10	0.00	0.04
Na_2O	2.14	6.24	2.09	6.42	2.35	5.31
NiO	0.01	0.26	0.01	0.29	0.01	0.06
PbO	0.00	0.30	0.00	1.64	0.00	.31
SO_3	11.99	-	10.99	-	11.74	-
SeO_2	0.00	0.00	0.00	0.00	0.00	0.00
SiO_2	24.38	-	25.24	-	25.45	-
Sb_2O_3	0.00	0.00	0.00	0.00	0.00	0.00
SrO	0.41	0.37	0.38	0.37	0.41	0.41
V_2O_5	0.04	0.04	0.04	0.04	0.04	0.04
ZnO	0.01	0.84	0.01	0.55	0.01	0.28
HgO	0.00	0.01	0.00	0.01	0.00	0.01
Ag_2O	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	98.01	68.31	94.56	69.97	101.34	67.91

Sulfur could not be analyzed in the ESP Outlet flyash samples since the first two impingers in the 4M5 sampling train contain 10% H_2O_2 which retains So_2. Thus the sulfur results reported for the Stack test site reflects the sum of the sulfur in the flyash as well as the sulfur in the SO_2 emissions.

Silicon was not analyzed in the ESP Outlet flyash samples since the EPA methodology requires dissolution of the filter which is pure SiO_2.

2.3 PM-10

The results of the PM-10 Constant Sampling Rate (CSP) determinations are summarized in Table 7. The total particulate emission rate averaged 15.2 LB/HR using the CSR PM-10 sampling train. The size distribution results obtained from the in situ aerodynamic size classifications (See Section 3.3) indicate that about 86.8% by weight of the flyash particles have diameters less than 10 microns. The PM-10 emission rate averaged 13.2 LB/HR.

Table 7. Summary of the PM-10 Measurements Performed at the No. 2 Boiler Stack at the NSP Black Dog Plant in Burnsville, Minnesota.

	Run 1	Run 2	Run 3	Avg.
Total mass rate (LB/HR)	15.5	14.0	16.2	15.2
% ≤ 10 um	95.0	86.5	79.0	86.8
PM-10 mass rate (LB/HR)	14.7	12.1	12.8	13.2

2.4 BTEX

The results of the benzene, toluene, ethyl benzene and xylene (BTEX) determinations are presented in Table 8. No BTEX was detected in the exhaust gases from the No. 2 Boiler.

Table 8. Summary of the Results of the January 31, 1992 BTEX Determinations on the Unit 2 Stack at the NSP Black Dog Plant in Burnsville, Minnesota.

Test/Run		Concentration (ppm,d)	Emission Rate (LB/HR)
3/1	Benzene	<0.02	<0.1
	Toluene	<0.02	<0.1
	Ethyl Benzene	<0.02	<0.1
	Xylene	<0.02	<0.1
3/2	Benzene	<0.02	<0.1
	Toluene	<0.02	<0.1
	Ethyl Benzene	<0.02	<0.1
	Xylene	<0.02	<0.1
3/3	Benzene	<0.02	<0.1
	Toluene	<0.02	<0.1
	Ethyl Benzene	<0.02	<0.1
	Xylene	<0.02	<0.1

No discussion of how these were sampled/measured

2.5 Conclusions

No difficulties incurred in the field or in the laboratory analysis of the flue gas samples which could not be solved. Based on these facts plus a complete review of all of the data, 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.

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 PM-10 results and the trace metals sampling data. 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. Emission rates have been calculated using the product of the concentration times flow method.

3.1 Results of Orsat and Moisture Analyses

Test No. 1
No. 2 Boiler ESP Inlet

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

	Run 1	Run 2	Run 3
Date of run	01-31-92	01-31-92	01-31-92
Dry basis (orsat)			
carbon dioxide.....	12.00	11.90	12.40
oxygen.....	7.60	7.70	7.20
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	80.40	80.40	80.40
Wet basis (orsat)			
carbon dioxide.....	11.00	10.84	11.25
oxygen.....	6.97	7.02	6.53
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	73.68	73.26	72.92
water vapor.....	8.35	8.89	9.30
Dry molecular weight.....	30.22	30.21	30.27
Wet molecular weight.....	29.20	29.13	29.13
Specific gravity.....	1.009	1.006	1.006
Water mass flow.....(LB/HR)	90143	94151	98736
FO	1.108	1.109	1.105

Test No. 1
Unit No. 2 Stack

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

	Run 1	Run 2	Run 3
Date of run	01-31-92	01-31-92	01-31-92
Dry basis (orsat)			
carbon dioxide.....	9.40	9.70	9.60
oxygen.....	10.40	10.20	10.20
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	80.20	80.10	80.20
Wet basis (orsat)			
carbon dioxide.....	8.63	8.91	8.85
oxygen.....	9.55	9.37	9.40
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	73.65	73.55	73.93
water vapor.....	8.17	8.18	7.82
Dry molecular weight.....	29.92	29.96	29.94
Wet molecular weight.....	28.95	28.98	29.01
Specific gravity.....	1.000	1.001	1.002
Water mass flow.....(LB/HR)	88407	87693	84427
FO	1.117	1.103	1.115

Test No. 2
Unit No. 2 Stack - Control (Run 0)
(Particle Sizing)

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

Date of run	01-31-92

Dry basis (orsat)

carbon dioxide.....	0.00
oxygen.....	0.00
carbon monoxide.....	0.00
nitrogen.....	100.00

Wet basis (orsat)

carbon dioxide.....	0.00
oxygen.....	0.00
carbon monoxide.....	0.00
nitrogen.....	91.57
water vapor.....	8.43
Dry molecular weight.....	28.00
Wet molecular weight.....	27.16
Specific gravity.....	0.938
Water mass flow.....(LB/HR)	0.00

FO	0.000

Test No. 2
Unit No. 2 Stack
(Particle Sizing)

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

	Run 1	Run 2	Run 3
Date of run	01-31-92	01-31-92	01-31-92
Dry basis (orsat)			
carbon dioxide.....	9.50	9.60	9.60
oxygen.....	10.40	10.20	10.30
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	80.10	80.20	80.10
Wet basis (orsat)			
carbon dioxide.....	8.70	8.83	8.83
oxygen.....	9.52	9.38	9.47
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	73.32	73.73	73.65
water vapor.....	8.47	8.07	8.05
Dry molecular weight.....	29.94	29.94	29.95
Wet molecular weight.....	28.93	28.98	28.99
Specific gravity.....	0.999	1.001	1.001
Water mass flow.....(LB/HR)	0.00	0.00	0.00
FO	1.105	1.115	1.104

3.2 Results of Particulate Determinations

Test No. 1
No. 2 Boiler ESP Inlet

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

	Run 1	Run 2	Run 3
Date of run	01-31-92	01-31-92	01-31-92
Time run start/end.....(HRS)	850/1101	1150/1424	1500/1708
Static pressure.....(IN.WC)	-10.20	-10.20	-10.20
Cross sectional area (SQ.FT)	132.25	132.25	132.25
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	167.0	175.0	200.0
desiccant.....(GRAMS)	41.0	43.0	30.0
total.....(GRAMS)	208.0	218.0	230.0
Total particulate material..			
.....collected(grams)	7.2804	9.9118	7.1961
Gas meter coefficient.....	0.9959	0.9959	0.9959
Barometric pressure..(IN.HG)	29.31	29.31	29.31
Avg. orif.pres.drop..(IN.WC)	2.72	2.64	2.67
Avg. gas meter temp..(DEF-F)	88.7	93.2	96.4
Volume through gas meter....			
at meter conditions...(CF)	113.90	112.50	113.50
standard conditions.(DSCF)	107.61	105.41	105.74
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.....(IN)	.250	.250	.250
Avg.stack gas temp ..(DEG-F)	267	267	267
Volumetric flow rate.....			
actual.....(ACFM)	555094	545244	546149
dry standard.....(DSCFM)	352635	344205	343215
Isokinetic variation.....(%)	98.7	99.1	99.7
Particulate concentration...			
actual.....(GR/ACF)	0.66288	0.91560	0.65964
dry standard.....(GR/DSCF)	1.04388	1.45095	1.05009
Particle mass rate...(LB/HR)	3155.192	4280.756	3089.180
F-factor .....(DSCF/MMBTU)	9780	9780	9780
Emission factor...(LB/MMBTU)	2.292	3.210	2.238

Test No. 1
Unit No. 2 Stack

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

	Run 1	Run 2	Run 3
Date of run	01-31-92	01-31-92	01-31-92
Time run start/end.....(HRS)	850/1155	1150/1405	1500/1710
Static pressure.....(IN.WC)	-1.10	-1.10	-1.10
Cross sectional area (SQ.FT)	397.61	397.61	397.61
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	125.0	122.0	120.0
desiccant.....(GRAMS)	20.0	23.0	19.0
total.....(GRAMS)	145.0	145.0	139.0
Total particulate material..			
.....collected(grams)	0.0365	0.0410	0.0415
Gas meter coefficient.....	1.0083	1.0083	1.0083
Barometric pressure..(IN.HG)	29.04	29.04	29.04
Avg. orif.pres.drop..(IN.WC)	1.37	1.36	1.39
Avg. gas meter temp..(DEF-F)	59.8	59.8	60.7
Volume through gas meter....			
at meter conditions...(CF)	77.04	77.00	77.57
standard conditions.(DSCF)	76.82	76.78	77.22
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.....(IN)	.365	.365	.365
Avg.stack gas temp ..(DEG-F)	243	244	244
Volumetric flow rate.....			
actual.....(ACFM)	530518	526854	530187
dry standard.....(DSCFM)	354118	351097	354635
Isokinetic variation.....(%)	99.0	99.8	99.4
Particulate concentration...			
actual.....(GR/ACF)	0.00489	0.00549	0.00554
dry standard.....(GR/DSCF)	0.00733	0.00824	0.00829
Particle mass rate...(LB/HR)	22.254	24.796	25.207
F-factor .....(DSCF/MMBTU)	9780	9780	9780
Emission factor...(LB/MMBTU)	0.020	0.022	0.023

3.3 Results of PM-10 Determinations

Test No. 2
Unit No. 2 Stack - Control (Run 0)
(Particle Sizing)

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

Date of run	01-31-92
Time run start/end.....(HRS)	856/ 956
Static pressure.....(IN.WC)	-1.10
Cross sectional area (SQ.FT)	397.61
Pitot tube coefficient.....	.840
Water in sample gas	
condenser.....(ML)	0.0
impingers.....(GRAMS)	26.0
desiccant.....(GRAMS)	12.0
total.....(GRAMS)	38.0
Total particulate material..	
.....collected(grams)	0.0000
Gas meter coefficient.....	0.9993
Barometric pressure..(IN.HG	29.04
Avg. orif.pres.drop..(IN.WC)	0.35
Avg. gas meter temp..(DEF-F)	57.9
Volume through gas meter....	
at meter conditions...(CF)	19.67
standard conditions.(DSCF)	19.46
Total sampling time....(MIN)	60.00
Nozzle diameter.....(IN)	.263
Avg.stack gas temp ..(DEG-F)	240
Volumetric flow rate.....	
actual.....(ACFM)	536121
dry standard.....(DSCFM)	358325
Isokinetic variation.....(%)	95.5

Test No. 2
Unit No. 2 Stack
(Particle Sizing)

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

	Run 1	Run 2	Run 3
Date of run	01-31-92	01-31-92	01-31-92
Time run start/end.....(HRS)	1028/1128	1250/1455	1515/1720
Static pressure.....(IN.WC)	-1.10	-1.10	-1.10
Cross sectional area (SQ.FT)	397.61	397.61	397.61
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	56.0	0.0	54.0
impingers.....(GRAMS)	0.0	56.0	0.0
desiccant.....(GRAMS)	24.0	20.0	19.0
total.....(GRAMS)	80.0	76.0	73.0
Total particulate material..			
.....collected(grams)	0.0132	0.0119	0.0139
Gas meter coefficient.....	0.9993	0.9993	0.9993
Barometric pressure..(IN.HG)	29.04	29.04	29.04
Avg. orif.pres.drop..(IN.WC)	0.39	0.39	0.36
Avg. gas meter temp..(DEF-F)	62.0	63.8	63.8
Volume through gas meter....			
at meter conditions...(CF)	41.48	41.75	40.16
standard conditions.(DSCF)	40.71	40.84	39.28
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.....(IN)	.263	.263	.263
Avg.stack gas temp ..(DEG-F)	243	244	244
Volumetric flow rate.....			
actual.....(ACFM)	543723	543556	520285
dry standard.....(DSCFM)	361715	362725	347370
Isokinetic variation.....(%)	98.9	98.9	99.4
Particulate concentration...			
actual.....(GR/ACF)	0.00333	0.00301	0.00364
dry standard.....(GR/DSCF)	0.00501	0.00451	0.00546
Particle mass rate...(LB/HR)	15.534	14.026	16.246

Results of the Particle Size Distribution Determination

Sample Identification: No. 2 Boiler Stack - January 31, 1992
Cascade Impactor Sampling

Assigned Density: 1.00 g/cc

Stage	Run 1		Run 2		Run 3	
	um	% ≥	um	% ≥	um	% ≥
Preimpactor	12.0	3.63	12.0	12.73	12.0	21.02
1	7.6	8.47	7.6	15.58	7.6	22.39
2	4.6	13.62	4.6	15.75	4.6	23.54
3	3.0	25.34	3.0	27.05	3.0	33.04
4	1.85	37.37	1.85	41.37	1.85	45.50
5	1.20	58.85	1.20	66.08	1.20	64.72
6	0.74	83.51	0.74	87.77	0.74	87.04
7	0.43	95.69	0.43	94.72	0.43	98.49

um — Aerodynamic equivalent diameter in microns
% ≥ — Relative cumulative frequency - percent by mass of aerosol with diameters greater than stated size

4 RESULTS OF FUEL ANALYSES

INTERPOLL LABORATORIES INC.
Fuel Laboratory
(612) 786-6020

03-10-1992

Client: NSP/BLACKDOG

Laboratory Log Number: 5282-73-1202

Sample Identification: COAL NO. 2 COMPOSITE 1/31/92
(Blend of Antelope & Northern Antelope)

Ultimate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			27.22
Ash		7.95	5.79
Carbon	74.27	68.36	49.75
Hydrogen	5.09	4.69	3.41
Nitrogen	1.15	1.06	0.77
Oxygen (calculated)	19.06	17.55	12.77
Sulfur	0.43	0.39	0.29
Heating Value, BTU/LB.	12767	11752	8553

Respectfully submitted,

Jeannie F. O'Neil,
Manager
Inorganic Chemistry Group

9696

INTERPOLL LABORATORIES, INC.
(612)786-6020

NSP/Black Dog
Laboratory Log No. 5282

Results of Trace Metals Analysis

Test: 1
Source: Units 2 Coal Composite
Test Type: Coal (Blend of Antelope & Northern Antelope)

Trace Metal	Method	Concentration in Sample (ug/g)
(Log No.)		(5282-73)
Silver	EPA 6010	< 0.03
Aluminum	EPA 6010	5300
Arsenic	EPA 7060	0.85
Boron	EPA 6010	29.3
Barium	EPA 6010	47.0
Beryllium	EPA 7091	0.27
Calcium	EPA 6010	10100
Cadmium	EPA 6010	< 0.13
Chromium	EPA 6010	3.11
Copper	EPA 6010	14.6
Iron	EPA 6010	2620
Mercury	EPA 7470	< 0.0023
Potassium	EPA 6010	243
Lithium	SM 317A	1.22
Magnesium	EPA 6010	1750
Manganese	EPA 6010	5.27
Molybdenum	EPA 6010	0.50
Sodium	EPA 6010	1160
Nickel	EPA 6010	4.59
Lead	EPA 6010	2.34
Antimony	EPA 7041	0.07
Selenium	EPA 7740	0.28
Strontium	SM 326A	172
Titanium	EPA 6010	413
Vanadium	EPA 6010	15.6
Zinc	EPA 6010	8.74

Results are reported on an as received basis with a moisture content of 27.22% and an ash content of 5.79%.

APPENDIX A

VOLUMETRIC FLOW RATE DETERMINATIONS

Test No. 1
No. 2 Boiler ESP Inlet

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

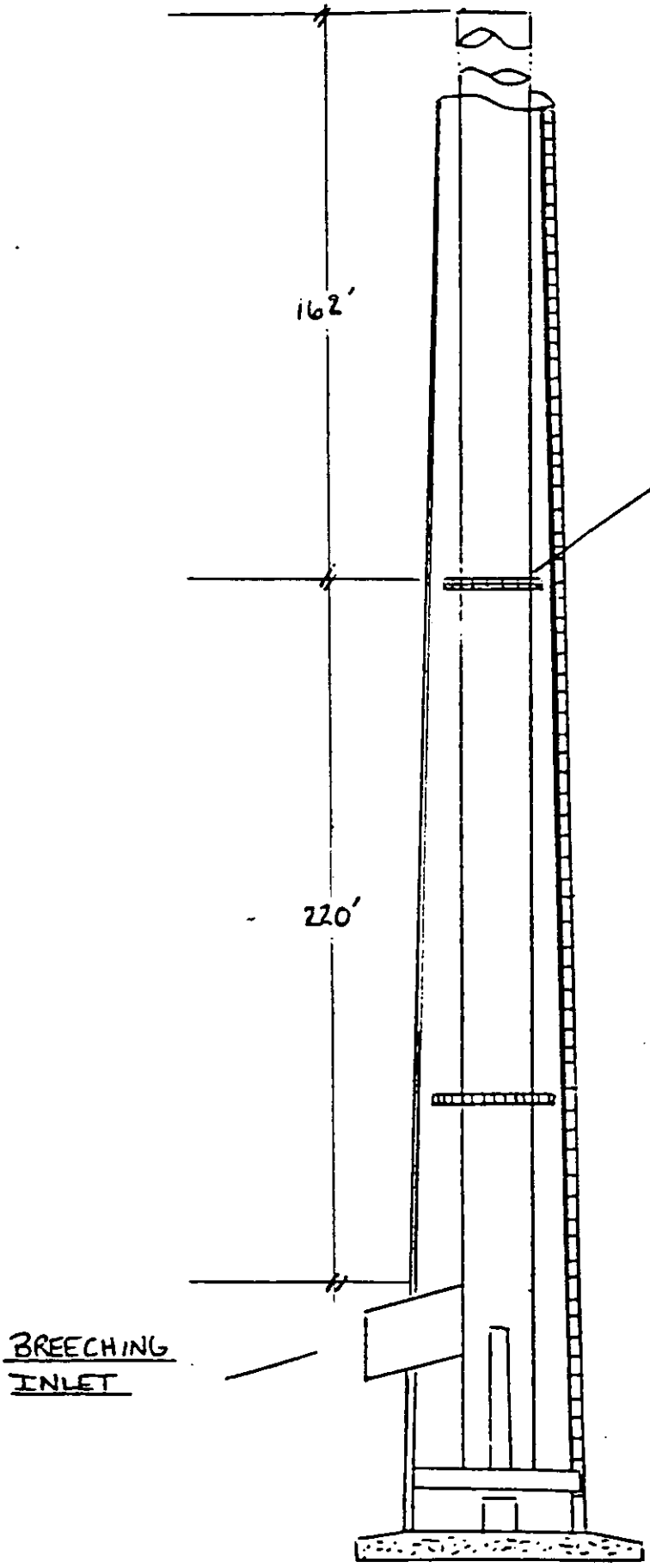
Date of Determination.....	01-31-92
Time of Determination.....(HRS)	810
Barometric pressure.....(IN.HG)	29.31
Pitot tube coefficient.....	.84
Number of sampling ports.....	3
Total number of points.....	30
Shape of duct.....	Rectangular
Duct width.....(IN)	69
Duct length.....(IN)	276
Duct area.....(SQ.FT)	132.25
Direction of flow.....	UP
Static pressure.....(IN.WC)	-10.2
Avg. gas temp.....(DEG-F)	264
Moisture content.....(% V/V)	8.35
Avg. linear velocity.....(FT/SEC)	68.7
Gas density.....(LB/ACF)	.05283
Molecular weight.....(LB/LBMOLE)	30.22
Mass flow of gas.....(LB/HR)	1726786
Volumetric flow rate.....	
actual.....(ACFM)	544796
dry standard.....(DSCFM)	347799

APPENDIX B

LOCATION OF TEST PORTS

NORTHERN STATES POWER

BLACK DOG STATION - UNITS 1-4



NOT TO SCALE

1/91 DHD

APPENDIX C

FIELD DATA SHEETS

TABLE OF CONTENTS

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job KISP Beech Dog

Source No 2 Boiler ESP Inlet

Test 1 Run (1-3) Date 1-31-92

Stack dimen. 69 X 276 IN.

Dry bulb ____ °F Wet bulb ____ °F

Manometer: ☒ Reg. ☐ Exp. ☐ Elec.

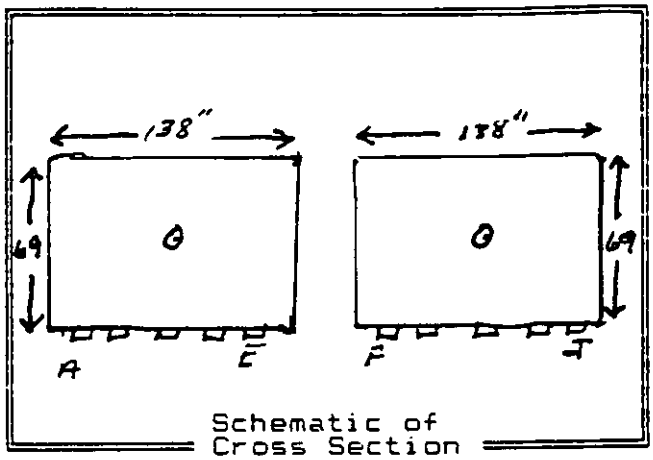
Barometric pressure 29.31 in Hg

Static pressure - 10.2 in WC

Operators E.TROWBRIDGE - C.MOSSER

Pitot No. 24Y-8 Cp .84

Particulate/Hg



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: 5 3/4 in.		Time start: 0810 hrs			
A	1			11.5	17.25	1.00		280	
	2			34.5	40.25	1.10			
	3			57.5	63.25	1.00			
B	1					1.00		283	
	2					1.10			
	3					1.30			
C	1					.80		282	
	2					1.15			
	3					1.40			
D	1					.95		283	
	2					1.00			
	3					1.15			
E	1					1.00		284	
	2					1.05			
	3					1.10			
F	1					.70		245	
	2					.90			
	3					1.00			
G	1	I-1				1.00	1.10	245	247
	2	2				1.10	1.05		
	3	3				1.10	1.25		
H	1	I-1				1.10	.90	245	242
	2	2				1.20	1.05		
	3	3				1.30	.90		

Temp. meas. tool & S/N: PDT-12

Time end: 0830 hrs

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

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP Blackdog Date 1-31-92 Test 1 Run (1-3)
Source ESP Inlet No. of traverse points 30
Method ____ Filter holder: In stack S.S. Filter type: S.S.

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: SS No. 23

Recovery solvent(s)
☐ acetone
☒ other(s) M.C.

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

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		100	
Impinger No. 2	267	100	167
Impinger No. 3		0	
Condenser			
Desiccant	1464	1423	41
Total			208

Integrated Gas Sampling Data:

Bag Pump No. B7 Box No. 4 Bag No. 1
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 0852 (HRS) Time end: 1100 (HRS)
Sampling rate: 200 cc/min Operator: ET
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 NSP Blackdog
Source No.2 Boiler ESP Inlet
Date 1-31-9[illegible] Test 1 Run 1

Operators E. Trowbridge - C. Mossor
Meter Box No. 6 ^H@ 1.50 IN WC
Gasmeter coeff. .9257

Pitot No. 24V-8 Cp .840
Bar. Press. 29.31 inHg H2O x
Nozzle No. 1-4 Nozzle Dia .250 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 (%v/v)
	0850	85.90											
A-3	4	89.40	.98	2.42	9.50	10.0	283	252	IN-STACK	42	85	84	5.3
2	8	93.38	1.20	2.89	3.41	11.0	285				86	84	5.3
1	12	97.26	1.05	2.54	5.24	10.0	283	255		44	88	84	6.2
B 3	16	101.10	1.30	3.12		12.0	290				89	84	6.1
2	20	104.80	1.10	2.67	4.89	12.5	283	250		45	90	85	5.7
1	24	108.45	1.00	2.44	8.49	12.0	281				90	85	5.9
C 3	28	112.70	1.45	3.51	2.79	14.0	285	252		45	91	86	5.8
2	32	116.80	1.20	2.91	6.73	14.2	285				91	86	5.7
1	36	120.20	.90	2.19	0.14	11.0	283	253		47	92	87	6.5
D 3	40	124.10	1.20	2.91	4.08	14.5	287				93	88	6.3
2	44	127.80	1.00	2.44		12.0	286	256		49	93	88	6.0
1	48	131.30	.98	2.39	1.26	12.0	285				94	88	6.4
E 3	52	135.06	1.10	2.68	5.04	12.8	285	255		50	95	89	6.4
2	56	138.80	1.10	2.68	8.83	13.0	287				95	89	6.6
1	60	142.50	1.00	2.44	2.44	13.0	288	254		51	95	90	6.6
F 3	64	146.40	1.20	2.93	6.39	14.0	290				92	88	8.0
2	68	150.45	1.20	3.00	0.39	14.2	265	251		50	90	87	7.8
1	72	153.53	.70	1.80	3.49	10.0	245				90	87	8.2
G 3	76	157.42	1.10	2.82	7.36	13.0	245	253		50	90	87	8.0
2	80	161.30	1.10	2.82	1.23	13.0	246				90	87	8.1
1	84	164.98	1.00	2.56	4.92	13.0	248	255		51	90	87	8.0
H 3	88	169.10	1.30	3.33	9.12	14.5	245				90	87	7.8
2	92	173.10	1.20	3.06	3.15	14.6	249	252		52	90	87	7.8
1	96	177.00	1.10	2.82	7.02	13.5	246				90	87	7.9
I 3	100	181.18	1.30	3.32	1.22	15.0	248	254		52	90	87	7.2
	θ =	Vm =		^H =							Avg. =		

(CONTINUED)

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP/BLACKDOG
Source No 2 Boiler ESP Inlet
Date 1-31-82 Test 1 Run 1

Operators PAGE 2
Meter Box No. ____ ΔH@ ____ IN WC
Cosmeter coeff. ____

Pitot No. ____ Cp ____
Bar. Press. ____ InHg H2O ____ %
Nozzle No. ____ Nozzle Dia ____ 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 (%v/v)
		181.18											
I 2	104	185.00	1.10	2.81	5.08	14.7	249	250	IN-STACK	52	90	87	6.8
1	108	188.62	1.05	2.68	8.85	14.5	248				90	87	7.2
J 3	112	192.40	.90	2.31	2.35	13.0	247	255		54	90	87	7.1
2	116	196.25	1.10	2.85	6.24	14.9	239				90	87	6.6
1	120	199.80	.90	2.34	9.77	13.5	237	252		54	90	87	6.8
	(1101)												
	θ = 120	Vm = 113.90		ΔH = 2.72							Avg. = 88.7		

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP/BLACKDOG Date 1-31-92 Test 1 Run 2
Source NO2 BOILER ESP INLET No. of traverse points 30
Method SS-4M5 Filter holder: SS INVERTED Filter type: SS

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: SS NO, 26

Recovery solvent(s)
☐ acetone
☒ other(s) D.I.C

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

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		100	
Impinger No. 2	375	100	175
Impinger No. 3		0	
Condenser			
Desiccant	1391	1348	43
Total			218

Integrated Gas Sampling Data:

Bag Pump No. 57 Box No. 4 Bag No. 2
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 1151 (HRS) Time end: 1423 (HRS)
Sampling rate: 200 cc/min Operator: ET
S/N of O_2 Analyzer used to monitor train outlet: 12

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CF-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job: NSP/BLACK DOG
Source: No 2 Boiler ESP-INLET
Date: 12-21-92 Test 1 Run 2

Operators: ET-CM
Meter Box No. 6 ΔH@ 1.80 IN WC
Computer coeff. 1.9959

Pitot No. 24Y-8 Cp .840
Bar. Press. 29.37 inHg H2O ? x
Nozzle No. 1-4 Nozzle Dia .250 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.	Cond/In	Cond/Out	Oxygen (%v/v)
		1150	200.20											
J	3	4	203.70	.90	2.29	3.68	10.0	253	256	IN-STACK	45	85	84	7.2
	2	8	207.50	1.10	2.77	7.51	12.0	253				88	84	6.6
	1	12	210.96	.88	2.23	0.94	10.5	252	254		46	90	86	6.8
I	3	16	215.18	1.30	3.30	5.12	12.2	251				90	86	7.3
	2	20	219.01	1.10	2.79	8.97	12.5	253	257		48	90	86	7.1
	1	24	222.74	1.00	2.54	2.64	12.0	252				93	88	7.4
H	3	28	226.82	1.30	3.33	6.85	14.0	249	255		48	93	88	7.4
	2	32	230.98	1.20	3.07	0.90	13.5	249				94	88	7.3
	1	36	234.63	1.00	2.57	4.60	13.0	247	257		50	95	88	8.0
G	3	40	238.40	1.10	2.84	8.49		245				95	88	7.5
	2	44	241.90	.80	2.07	1.82	11.5	245	254		50	96	90	7.6
	1	48	244.99	.70	1.81	4.94	9.8	245				97	91	7.9
F	3	52	249.05	1.20	3.10	9.02	14.0	246	256		51	98	92	8.2
	2	56	252.90	1.10	2.86	2.94	13.5	245				99	92	8.1
	1	60	256.12	.70	1.82	6.07	14.0	245	252		51	99	92	8.2
E	3	64	259.92	1.10	2.72	9.90	13.0	282				99	93	6.6
	2	68	263.75	1.10	2.69	5.70	13.0	290	256		53	99	93	6.8
	1	72	267.39	1.00	2.45	7.33		290				99	93	4.9
D	3	76	271.40	1.20	2.95	1.32	14.0	287	255		52	96	93	6.5
	2	80	274.99	1.00	2.44	4.94	13.0	289				98	93	6.2
	1	84	278.55	1.00	2.45	8.57	13.0	288	250		54	98	93	6.5
C	3	88	282.65	1.35	3.30	2.18	15.0	289				99	94	5.7
	2	92	286.70	1.20	2.95	6.77	14.0	287	254		55	99	94	5.8
	1	96	290.20	.90	2.22	0.23	13.0	286				99	94	6.2
B	3	100	294.20	1.20	2.96	4.22	14.1	295	254		54	99	94	5.8
		θ =	Vm =		ΔH =							Avg. =		

(CONTINUED)

C-6

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job: NSP - BLACKDOG
Source: No 2 Boiler - ESP INLET
Date: 1-31-92 Test: 1 Run: 2

Operators: PAGE 2
Meter Box No. ____ KMF ____ IN WC
Converter coeff. ____

Pitot No. ____ Cp
Bar. Press. ____ inHg H2O ____ %
Nozzle No. ____ Nozzle Dia ____ 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 (%v/v)
			294.20											
B	2	104	298.00	1.10	2.71	8.04	14.5	285	254	IN-STACK	54	94	94	6.0
	1	108	301.70	1.00	2.47	1.69	14.0	283				98	94	5.7
A	3	112	305.30	.95	2.35	5.25	12.0	283	250		55	96	93	7.1
	2	116	309.10	1.10	2.71	2.06	14.0	284				96	93	7.8
	1	120	312.70	1.00	2.46	2.69		285	251		55	97	93	8.1
		(1424)												
		θ = 120	Vm = 112.70		ΔH = 2.64							Avg. = 93.2		

S-0037R

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP/BLACK DOG Date 1-31-92 Test 1 Run 3
Source NO 2 BOILER ESP INLET No. of traverse points 30
Method 5S-4M5 Filter holder: INVERTED Filter type: SS

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: SS NO. 30

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

No. of probe wash bottles:
Sample recovered by:

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		100	
Impinger No. 2	400	100	200
Impinger No. 3		0	
Condenser			
Desiccant	1385	1355	30
Total			230

Integrated Gas Sampling Data:

Bag Pump No. 57 Box No. 4 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 1501 (HRS) Time end: 1707 (HRS)
Sampling rate: 200 cc/min Operator: ET
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 NSP/BLACK DOG
Source NO2 Roller ESP INLET
Date 2-21-93 Test 1 Run 3

Operators ET-CM
Meter Box No. 6 ΔH 1.80 IN WC
Coeff: .9959

Pitot No. 24V-8 Cp .846
Bar. Press. 29.31 inHg H2O X
Nozzle No. 4 Nozzle Dia .250 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.	Cyc/In	Cyc/Out	Oxygen (xv/v)
	1500	313.30											
A 3	4	316.80	.90	2.21	6.74	8.5	284	252	IN-STACK	50	92	90	5.5
2	8	320.52	1.10	2.68	0.52	9.0	285				96	91	5.3
1	12	324.18	1.00	2.46	4.16	8.9	283	254		52	97	91	5.1
E 3	16	328.10	1.20	2.94	8.13	10.5	286				97	91	5.7
2	20	331.90	1.10	2.69	1.93	10.5	287	256		53	97	92	5.4
1	24	335.60	1.00	2.45	5.55	10.0	287				97	92	5.7
C 3	28	339.62	1.30	3.18	9.68	12.0	287	255		54	96	92	5.6
2	32	343.64	1.20	2.93	3.65	12.0	289				97	92	5.5
1	36	347.24	.92	2.26	7.13	9.0	287	257		55	97	92	6.1
D 3	40	351.14	1.20	2.93	1.10	12.0	288				97	92	5.9
2	44	354.98	1.10	2.69	4.90	11.0	289	255		56	97	92	5.9
1	48	358.185	1.00	2.47	8.55	10.0	287				99	93	6.4
E 3	52	362.40	1.10	2.70	2.36	11.0	288	258		55	99	94	6.5
2	56	365.70	.80	1.96	5.61	8.5	290				100	94	6.3
1	60	368.80	.75	1.85	8.77	8.0	288	254		55	101	94	6.5
F 3	64	372.90	1.20	3.11	2.87	12.0	249				102	94	8.0
2	68	376.70	1.00	2.60	6.62	11.0	248	255		54	102	94	7.9
1	72	379.95	.80	2.08	9.98	9.0	248				102	94	8.0
G 3	76	383.99	1.10	2.87	3.92	11.5	245	253		56	102	94	7.5
2	80	387.70	1.00	2.61	7.67	11.0	245				102	94	7.4
1	84	391.50	1.00	2.62	1.44	11.0	243	252		55	102	95	7.7
H 3	88	395.71	1.30	3.39	5.71	13.5	246				102	95	6.6
2	92	399.80	1.20	3.11	9.81	13.0	251	254		56	102	95	7.0
1	96	403.76	1.10	2.85	3.74	12	250				102	95	7.0
I 3	100	408.00	1.30	3.36	8.01	13.5	248	252		56	102	95	6.8
	Q =	Vm =		ΔH =							Avg. =		

(Continued)

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Page 2

Job NSP / BLACKDOG
Source No 2 Boiler ESP INLET
Date 1-31-92 Test 1 Run 2

Operators ______
Meter Box No. ______
Gamma/Calib. coeff. ______ IN WC

Pitot No. ______ Cp ______
Bar. Press. ______ inHg H2O ______ x
Nozzle No. ______ Nozzle Dia ______ IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Del. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
		408.00											
I 2	104	411.98	1.10	2.85	1.94		250	252	IN STACK	56	102	95	6.9
1	108	415.70	1.00	2.60	5.68	11.0	248				101	95	6.7
J 3	112	419.40	1.00	2.60	4.43	11.0	250	255		56	101	95	6.7
2	116	423.20	1.00	2.61	3.19	11.0	247				101	95	6.7
1	120	426.80	.90	2.35	4.75	10.5	247	252		57	101	95	6.8
	(1908)												
	θ = 120	Vm = 18.50		^H = 2.6							Avg. = 96.4		

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INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job NSP / Black Dog

Source Unit No. 2 Stack

Test 1 Runs 1-3 Date 1-31-92

Stack dimen. 270 IN.

Dry bulb ____ °F Wet bulb ____ °F

Manometer: ☒ Reg. ☐ Exp. ☐ Elec.

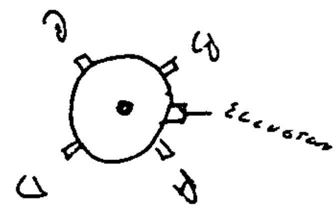
Barometric pressure 29.04 in Hg

Static pressure -1.1 in WC

Operators DVH + S. Bergstrom

Pitot No. 1115-8' glass Cp .84

4005



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: 6 in.		Time start: hrs	
A	1	.044	11.88	17.88		
	2	.146	39.42	45.42		
	3	.296	79.92	85.92		
B	1					
	2					
	3					
C	1					
	2					
	3					
D	1					
	2					
	3					
Temp. meas. tool & S/N:					Time end: hrs	

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

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP / Block Dot Date 1-31-92 Test 1 Run 1
Source UNIT #2 No. of traverse points 12
Method 4M5 Filter holder: TEFLON Filter type: 3.52 Pallflex

Sample Train Leak Check:

Pretest: 0.02 cfm at 15 in. Hg. (vac)
Postest: .02 cfm at 11 in. Hg. (vac)

Particulate Catch Data:

No.s of filters used: 1

Recovery solvent(s)
☐ acetone
☒ other(s) 4M5

No. of probe wash bottles: 6 2
Sample recovered by: DVH

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	495	487	8.0
Impinger No. 2	592	475	117.0
Impinger No. 3			
Condenser			
Desiccant	1355	1335	20.0
Total			145

Integrated Gas Sampling Data:

Bag Pump No. B-16 Box No. 7 Bag No. 1

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

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

Time start: 0850 (HRS) Time end: 1155 (HRS)

Sampling rate: 200 cc/min Operator: DVH + D.B.

S/N of O_2 Analyzer used to monitor train outlet: 7

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

4MS-8

Job: USP / BLACK DOG
Source: UNIT 22 STACK
Date: 1-31-92 Test 1 Run 1

Operators: DJH + J.B.
Meter Box No.: 7 ΔH@ 1.86 IN WC
Calibr coeff.: 1.0073

Pitot No.: 8' GLASS Cp .84
Bar. Press.: 29.01 inHg H2O 9 %
Nozzle No.: GLASS Nozzle Dia .365 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgs. Vol. (cf)	VAC. inHg	Stack (°F)	Probe (°F)	Oven (°F)	Impg. (°F)	Con/In (°F)	Con/Out (°F)	Oxygen (v/v)
	(0850)	289.31											
C-1	5	292.72	.125	1.50	292.8	9.0	243	259	261	36	54	52	10.0
1	10	295.96	.120	1.41	295.92	8.5	241	260	259	36	57	52	9.8
2	15	299.18	.120	1.42	299.17	8.0	243	258	259	36	60	53	9.5
2	20	302.33	.115	1.36	302.37	8.0	241	256	257	36	62	54	9.6
3	25	305.44	.105	1.25	305.43	8.0	241	256	258	35	63	54	10.1
3	30	308.451	.100	1.19	308.43	7.5	242	257	258	35	63	55	10.0
B 1	35	311.75	.125	1.49	311.78	8.5	243	255	259	35	63	55	10.0
1	40	315.02	.120	1.43	315.06	8.5	241	256	260	35	63	55	10.0
2	45	318.40	.125	1.49	318.41	8.5	243	255	257	35	64	56	10.0
2	50	321.73	.125	1.49	321.76	8.5	241	253	259	34	64	56	10.1
3	55	324.87	.110	1.32	324.91	8.0	243	255	261	34	64	56	10.1
3	60	328.063	.110	1.32	328.06	8.0	242	254	256	34	65	56	10.1
A-1	65	331.37	.120	1.44	331.35	8.5	242	251	255	34	64	56	10.0
1	70	334.68	.120	1.43	334.64	8.5	244	252	256	33	65	57	10.2
2	75	337.86	.115	1.38	337.87	8.0	243	253	256	33	65	57	10.4
2	80	341.16	.120	1.44	341.16	8.5	243	250	255	33	65	57	10.1
3	85	344.21	.100	1.20	344.17	7.5	242	251	257	33	65	57	10.0
3	90	346.99	.085	1.02	346.95	7.0	242	251	256	33	65	58	10.2
D-1	95	350.34	.125	1.50	350.31	8.5	241	250	255	33	66	58	10.4
1	100	353.65	.120	1.44	353.61	8.5	244	253	259	33	66	58	10.1
2	105	356.87	.120	1.44	356.91	8.5	243	252	254	33	66	58	10.2
2	110	360.19	.120	1.44	360.21	8.5	243	252	255	33	66	58	10.1
3	115	363.21	.100	1.20	363.23	7.5	242	252	253	33	66	58	10.1
3	120	366.346	.105	1.26	366.32	8.0	242	250	251	33	66	58	10.1
	(1155)												
	θ = 120	Vm = 77.036		ΔH 1.37							Avg. = 59.8		

S-0037R

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP / Plastic Dock Date 1-31-92 Test 1 Run 2
Source UNIT NO. 2 No. of traverse points 12
Method YMS Filter holder: TEFLON Filter type: 3.52" Pallflex

Sample Train Leak Check:

Pretest: 0.02 cfm at 15 in. Hg. (vac)
Postest: .000 cfm at 13 in. Hg. (vac)

Particulate Catch Data:

No.s of filters used: 1

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

No. of probe wash bottles: 2
Sample recovered by: D.B.

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	493	490	3.0
Impinger No. 2	606	487	119.0
Impinger No. 3			
Condenser			
Desiccant	1340	1317	23
Total			145.0

Integrated Gas Sampling Data:

Bag Pump No. B-16 Box No. 7 Bag No. 2
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: .00 cc/min at 15 in. Hg.
Time start: 1150 (HRS) Time end: 1405 (HRS)
Sampling rate: 200 cc/min Operator: D. BRENNAN
S/N of O_2 Analyzer used to monitor train outlet: 7

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job: NSP / Black Dog
Source: Unit No. 2
Date: 1-31-92 Test 1 Run 2

Operators: D.B. & S.B.
Meter Box No. 7 ΔH@ 1.86 IN WC
Gasmeter coeff. 1.033

Pitot No. 4ms 8' (Glass) Cp .84
Bar. Press. 28.61 inHg H2O 8.5 %
Nozzle No. Glass Nozzle Dia .365 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgs. Vol. (cf)	VAC. inHg	Stack (°F)	Probe (°F)	Oven (°F)	Impg. (°F)	Gas/In (°F)	Gas/Out (°F)	Oxygen (%v/v)
	(1150)	368.160											
D-1	5	371.40	.120	1.45	371.46	18.0	243	242	246	46	56	53	10.0
1	10	374.62	.115	1.37	374.65	19.5	244	242	245	46	56	53	10.1
2	15	377.732	.110	1.31	377.78	19.5	244	240	245	46	57	53	10.0
2	20	381.05	.110	1.31	381.11	7.0	244	244	246	44	59	53	10.1
3	25	384.12	.105	1.25	384.17	6.0	245	245	246	44	61	54	10.1
3	30	387.234	.105	1.26	387.[illegible]	6.0	245	243	245	44	62	54	10.1
A-1	35	390.59	.125	1.50	390.60	8.5	244	240	248	43	63	55	10.0
1	40	393.94	.125	1.50	393.92	8.5	245	242	250	43	64	56	10.1
2	45	397.23	.120	1.44	397.26	8.0	245	241	249	43	65	56	10.1
2	50	400.59	.125	1.51	400.63	8.5	244	243	250	43	66	57	10.0
3	55	403.68	.100	1.21	403.65	8.0	244	245	253	42	65	57	10.1
3	60	406.840	.110	1.33	406.87	8.0	244	246	251	42	65	57	10.1
B-1	65	410.15	.120	1.45	410.[illegible]	8.0	245	245	252	42	64	57	10.0
1	70	413.46	.125	1.51	413.49	8.5	245	247	255	42	65	57	10.0
2	75	416.74	.115	1.39	416.73	9.0	244	248	254	42	65	57	10.0
2	80	419.93	.110	1.33	419.90	8.0	244	246	253	42	65	58	10.1
3	85	422.90	.100	1.21	422.92	7.5	244	248	251	41	66	58	10.1
3	90	425.966	.100	1.21	425.96	7.5	244	249	253	41	66	58	10.0
C-1	95	429.22	.120	1.45	429.26	8.0	245	252	255	41	64	58	10.2
1	100	432.47	.115	1.39	432.49	8.0	244	250	253	41	65	58	10.1
2	105	435.75	.120	1.45	435.80	8.5	244	251	254	41	66	58	10.1
2	110	439.08	.120	1.45	439.12	8.5	244	253	253	41	66	58	10.0
3	115	442.12	.100	1.21	442.14	7.5	243	249	251	41	66	58	10.1
3	120	445.163	.095	1.15	445.10	7.5	243	250	253	41	66	58	10.0
	(1405)												
	θ = 120	Vm =		ΔH 1.36							Avg. = 59.8		

* Stop test due to wet filter ... leaks, pass ... @ 15" ...

S-0037R

C-15

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP1 BULK C06 Date 1-31-92 Test 1 Run 3
Source UNIT NO. 2 No. of traverse points 12
Method 4M5 Filter holder: TEFLON Filter type: 3.52" PELLFLEX

Sample Train Leak Check:

Pretest: ☐ 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: .00 cfm at 13 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 1

Recovery solvent(s)
☐ acetone
☒ other(s) 4M5

No. of probe wash bottles:
Sample recovered by:

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	492	490	2.0
Impinger No. 2	607	489	118.0
Impinger No. 3			
Condenser			
Desiccant	1310	1291	19.0
Total			139.0

Integrated Gas Sampling Data:

Bag Pump No. B-16 Box No. 7 Bag No. 3

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

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

Time start: 1500 (HRS) Time end: 1710 (HRS)

Sampling rate: 200 cc/min Operator: D. BRENNAN

S/N of O_2 Analyzer used to monitor train outlet: 7

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job: NSP / Black Dog
Source: Unit No. 2
Date: 1-31-92 Test: 1 Run: 3

Operators: D. Brennan + J. Bergstrom
Meter Box No: 7 ΔH@ 1.86 IN WC
Calendar coeff.: 1.0083

Pitot No. YMS 8' (Glass) Cp: .84
Bar. Press.: 29.01 inHg H2O 7.5 X
Nozzle No.: Glass Nozzle Dia: .365 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dot. Vol. (cf)	VAC. inHg	Stack (°F)	Probe (°F)	Oven (°F)	Impg. (°F)	Cas/In (°F)	Cas/Out (°F)	Oxygen (xv/v)
	(1500)	445.80											
C-1	5	449.18	.125	1.52	449.17	9.5	243	253	261	40	53	51	10.5
1	10	452.45	.120	1.43	452.43	8.0	245	255	260	40	56	52	10.2
2	15	455.66	.115	1.38	455.63	8.0	245	254	257	40	59	53	10.2
2	20	458.87	.115	1.38	458.84	8.0	245	255	258	39	61	54	10.3
3	25	461.90	.100	1.21	461.85	7.0	244	255	255	39	62	55	10.3
3	30	464.858	.100	1.21	464.84	7.0	244	253	256	39	63	56	10.2
B-1	35	468.20	.125	1.51	468.23	8.0	245	251	255	39	63	56	10.3
1	40	471.49	.120	1.45	471.53	8.0	245	252	255	39	64	56	10.3
2	45	474.77	.115	1.39	474.77	8.0	244	254	257	38	65	57	10.3
2	50	477.96	.110	1.34	477.95	7.5	244	254	258	38	65	57	10.3
3	55	480.95	.095	1.15	480.90	7.0	243	254	256	38	66	58	10.3
3	60	483.88	.100	1.22	483.94	7.0	243	255	257	38	66	58	10.2
A-1	65	487.24	.130	1.58	487.34	8	244	257	260	39	66	58	10.3
1	70	490.65	.120	1.46	490.72	8	244	256	256	39	67	58	10.3
2	75	494.00	.120	1.46	494.04	8.5	245	257	250	38	67	59	10.2
2	80	497.30	.120	1.46	497.36	8.5	245	258	255	38	67	59	10.3
3	85	500.49	.100	1.22	500.40	8	244	257	256	39	67	59	10.3
3	90	503.52	.100	1.22	503.44	7	244	256	258	39	67	59	10.3
D-1	95	507.00	.140	1.70	507.03	9	245	257	258	40	67	59	10.3
1	100	510.54	.130	1.58	510.49	9	245	256	255	40	67	59	10.4
2	105	513.82	.120	1.46	513.82	7.5	244	256	256	40	67	59	10.3
2	110	517.32	.130	1.58	517.28	9	244	255	254	38	67	59	10.3
3	115	520.39	.100	1.22	520.32	7.5	244	256	254	38	67	59	10.3
3	120	523.373	.100	1.22	523.36	7.5	244	257	256	38	67	60	10.3
	(1710)												
	θ = 120	Vm = 77.893		ΔH = 1.39							Avg. = 60.7		

S-0037R

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PM-10 TRAVERSE POINT SELECTION DATA SHEET

Job NSP Blackdog
Source Unit #2 Stack
Test 2 Run 1
Date 1-31-92
Operator

Pitot Tube No. 23-6
Barometric pres. 29.04 in.Hg.
Duct shape: [X] Round [ ] Rectang.
Duct dimensions 270.00 in.
Length of port 5.25 in.

PM-10 Guidelines require that the velocity at each of the four selected traverse points be within +/- 20%. Record the velocity pressure of the traverse points and perform the indicated calculations. The values in the last column must fall within range of 80 - 120.

Traverse Point	Gas Temp. (deg-F)	Velocity Pressure ΔP (in. WC)	$\sqrt{\Delta P}$	$\frac{100\sqrt{\Delta P}}{(\sqrt{\Delta P})_{avg}}$
A 1		.12	.3464	103.34
B 1		.12	.3464	103.34
C 1		.11	.3317	98.95
D 1		.10	.3162	94.33
Averages			.3352	

The average velocity pressure to be used for the sizing run may now be calculated from the following expression:

$$\Delta P = (\sqrt{\Delta P}_{avg})^2 = .11 \text{ in. WC}$$

Traverse points on round ducts: .15 D and .85 D
Distance from the duct wall: _____ _____ in.
Distance from the end of port: _____ _____ in.

CF-016

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP BLACKDOG Date 1-31-92 Test 2 Run D
Source Unit #2 STACK No. of traverse points 4
Method 201 Filter holder: S.S. Filter type: G.F.

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: 6.0 cfm at 5 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	26	0	26
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1248	1236	12
Total			38

Integrated Gas Sampling Data:

Bag Pump No. B3 Box No. 28 Bag No. 1
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0.0 cc/min at 17 in. Hg.
Time start: 0856 (HRS) Time end: 0856 (HRS)
Sampling rate: 200 cc/min Operator: BA
S/N of O_2 Analyzer used to monitor train outlet: 4

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Black Dog
Source Unit #2 Stack
Date 1-31-93 Test 2 Run 0

Operators DOH + BA
Meter Box No. 8 ΔH@ 1.58 IN WC
Gas meter coeff. .9993

Pitot No. 23-6 Cp .84
Bar. Press. 29.04 inHg H2O 9 %
Nozzle No. ____ Nozzle Dia .263 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 (%v/v)
	0856	136.95											
D 1	5	138.30	.11	.23	8.56	1	237	242	254	40	51	51	10.3
1	10	140.03	.11	.35	0.19	1	238				55	52	10.5
1	15	141.75	.11	.35	1.82	1.5	237				58	53	10.6
C 1	20	143.46	.11	.35	3.46	1.5	240	247	259	39	60	54	10.6
1	25	145.12	.11	.35	5.10	1.5	241				61	55	10.6
1	30	146.78	.11	.35	6.74	1.5	243				62	55	10.8
B 1	35	148.39	.11	.35	8.38	1.5	240	250	260	37	63	56	10.8
1	40	150.04	.11	.35	0.03	1.5	241				63	56	10.9
1	45	151.70	.11	.35	1.68	1.5	242				64	57	10.9
A 1	50	153.34	.11	.35	3.33	1.5	242	248	258	36	64	57	11.0
1	55	154.98	.11	.35	4.98	1.5	240				64	58	11.0
1	60	156.625	.11	.35	6.64	1.5	241				64	58	10.8
	0956												
	θ = 60	Vm = 19.675		ΔH = .35							Avg. = 57.9		

S-0027R

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PM-10 TRAVERSE POINT SELECTION DATA SHEET

Job NSP BLACKDOG
Source Unit No. 2 Stack
Test 2 Run 1
Date 1-31-92
Operator

Pitot Tube No. 23-6
Barometric pres. 29.04 in.Hg.
Duct shape: ☒ Round ☐ Rectang.
Duct dimensions 270 in.
Length of port 5.75 in.

PM-10 Guidelines require that the velocity at each of the four selected traverse points be within +/- 20%. Record the velocity pressure of the traverse points and perform the indicated calculations. The values in the last column must fall within range of 80 - 120.

Traverse Point	Gas Temp. (deg-F)	Velocity Pressure ΔP (in. WC)	$\sqrt{\Delta P}$	$\frac{100\sqrt{\Delta P}}{(\sqrt{\Delta P})_{Avg}}$
A-1	244	.12	.3461	101.08
B-1	243	.12	.3461	101.08
C-1	243	.12	.3464	101.08
D-1	243	.11	.3316	96.76
Averages	243		.3427	

The average velocity pressure to be used for the sizing run may now be calculated from the following expression:

$$\Delta P = (\sqrt{\Delta P}_{Avg})^2 = .12 \text{ in. WC}$$

Traverse points on round ducts: .15 D and .85 D
Distance from the duct wall: _____ in. _____ in.
Distance from the end of port: _____ in. _____ in.

CF-016

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job USP Blackdoc
Source Unit #2 Stack
Method 201 Filter holder: SS

Date 1-31-92 Test 2 Run 1
No. of traverse points 4
Filter type: G.F

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: 0.0 cfm at 6 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			
Impinger No. 2			
Impinger No. 3			
Condenser	56	0	56
Desiccant	1306	1282	24
Total			80

Integrated Gas Sampling Data:

Bag Pump No. B3 Box No. 28 Bag No. 2

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

Pretest leak check: 0.0 cc/min at 17. in. Hg.

Time start: 1028 (HRS) Time end: 1128 (HRS)

Sampling rate: 200 cc/min Operator: BA

S/N of O_2 Analyzer used to monitor train outlet: 4

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP BLACKDOG
Source Unit No 2 STACK
Date 1-31-92 Test 2 Run 1

Operators DJH BA
Meter Box No. 8 ΔH@ 1.88 IN WC
Calibrator coeff. .9983

Pitot No. 23-6 Cp .84
Bar. Press. 29.04 inHg H2O 1 x
Nozzle No. ____ Nozzle Dia .263 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)
	(1028)	156.90											
A - 1	5	158.60	.12	.38	8.61	1	243	245	255	37	60	57	10.9
2	10	160.34	.12	.38	0.37	1	243				63	58	10.7
3	15	162.09	.12	.39	2.05	1	242				64	58	10.6
4	20	163.82	.12	.39	3.77	1	244	249	258	36	64	58	10.6
5	25	165.53	.12	.39	5.49	1	244				65	58	10.6
1	30	167.24	.12	.39	7.22	1	243				65	59	10.6
B - 2	35	168.99	.12	.39	8.95	1	243	250	260	35	65	59	10.6
2	40	170.72	.12	.39	0.67	1	242				65	59	10.6
1	45	172.43	.12	.39	122.40	1	242	251	263	35	65	59	10.4
1	50	174.16	.12	.39	124.13	1	243				65	59	10.5
1	55	175.90	.12	.39	125.86	1	242	250	262	35	65	59	10.6
1	60	177.63	.12	.39	2.59	1	243				65	59	10.6
C - 1	65	179.36	.12	.39	9.31	1	242				65	59	10.6
1	70	181.03	.12	.39	1.04	1	244	248	260	35	65	59	10.6
1	75	182.78	.12	.39	2.80	1	244				65	59	10.6
1	80	184.52	.12	.39	4.50	1	242				66	59	10.6
1	85	186.27	.12	.39	6.22	1	244	246	257	35	66	59	10.6
1	90	187.99	.12	.39	7.95	1	244				66	60	10.6
D - 1	95	189.70	.12	.39	9.68	1	243				66	60	10.5
1	100	191.41	.12	.39	1.41	1	244	248	260	36	66	60	10.6
1	105	193.13	.12	.39	3.14	1	242				66	60	10.6
1	110	194.84	.12	.39	4.87	1	243				66	60	10.6
1	115	196.61	.12	.39	6.60	1	244	250	259	35	66	60	10.6
1	120	198.375	.12	.39	8.33	1	245				66	60	10.6
	1138												
	θ = 120	Vm = 41.475		√H x .39							Avg. = 620		

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PM-10 TRAVERSE POINT SELECTION DATA SHEET

Job NSP Blaydon
Source Unit No 2 Stack
Test 2 Run 2
Date 1-31-92
Operator

Pitot Tube No. 23-6
Barometric pres. 29.04 in.Hg.
Duct shape: ☒ Round ☐ Rectang.
Duct dimensions 270 in.
Length of port 5.75 in.

PM-10 Guidelines require that the velocity at each of the four selected traverse points be within +/- 20%. Record the velocity pressure of the traverse points and perform the indicated calculations. The values in the last column must fall within range of 80 - 120.

Traverse Point	Gas Temp. (deg-F)	Velocity Pressure ΔP (in. WC)	$\sqrt{\Delta P}$	$\frac{100\sqrt{\Delta P}}{(\sqrt{\Delta P})_{Avg}}$
A 1	244	.12	.3464	101.07
B 1	244	.11	.3316	96.76
C 1	244	.12	.3464	101.07
D 1	244	.12	.3464	101.07
Averages			.3427	

The average velocity pressure to be used for the sizing run may now be calculated from the following expression:

$$\Delta P = (\sqrt{\Delta P}_{Avg})^2 = .12 \text{ in. WC}$$

Traverse points on round ducts: .15 D and .85 D
Distance from the duct wall: _____ _____ in.
Distance from the end of port: _____ _____ in.

CF-016

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP Blackdog Date 1-31-92 Test 2 Run 2
Source Unit No 2 Stack No. of traverse points 4
Method 201 Filter holder: S.S. Filter type: G.F.

Sample Train Leak Check:

Pretest: 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: 0.0 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: Recovery solvent(s)

☐ acetone
☐ other(s)

No. of probe wash bottles:
Sample recovered by:

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	56	0	56
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1277	1257	20
Total			76

Integrated Gas Sampling Data:

Bag Pump No. B3 Box No. 28 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0.0 cc/min at 17 in. Hg.
Time start: 1250 (HRS) Time end: 1455 (HRS)
Sampling rate: 200 cc/min Operator: BA
S/N of O_2 Analyzer used to monitor train outlet: 4

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Blackdog
Source Unit No 2 Stack
Date 1-31-92 Test 2 Run 2

Operators DUH - 3A
Meter Box No. 8 ΔH@ 1.83 IN WC
Calibrator coeff. .9993

Pitot No. 2B-6 Cp .84
Bar. Press. 29.04 inHg H2O 8.5 %
Nozzle No. ____ Nozzle Dia .213 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Del. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1250	198.60											
D - 1	5	200.41	.12	.39	0.53	1	244	245	255	36	62	58	10.6
1	10	202.12	.12	.39	2.06	1	242				65	59	10.6
1	15	203.72	.12	.39	3.79	1	243				66	59	10.6
1	20	205.47	.12	.39	5.53	1	245	247	258	36	66	60	10.5
1	25	207.22	.12	.39	7.26	1	244				67	60	10.6
C - 1	30	209.01	.12	.39	9.00	1	245				67	60	10.6
1	35	210.78	.12	.39	0.74	1	244	250	259	35	67	60	10.6
1	40	212.50	.12	.39	2.48	1	244				67	60	10.6
1	45	214.24	.12	.39	4.22	1	245				67	60	10.6
1	50	216.00	.12	.39	5.95	1	245	251	260	35	67	60	10.6
1	55	217.74	.12	.39	7.69	1	243				68	61	10.6
B - 1	60	219.42	.12	.39	9.44	1	244				68	61	10.5
1	65	221.12	.12	.39	1.18	1	244	247	256	36	68	61	10.6
1	70	222.89	.12	.39	2.92	1	243				68	61	10.6
1	75	224.65	.12	.39	4.66	1	245				68	61	10.6
1	80	226.42	.12	.39	6.40	1	244	250	259	35	68	61	10.6
1	85	228.17	.12	.39	8.15	1	243				68	61	10.6
A - 1	90	229.91	.12	.39	9.89	1	243				68	61	10.7
1	95	231.64	.12	.39	1.63	1	245	247	257	35	68	61	10.6
1	100	233.37	.12	.39	3.37	1	244				68	61	10.6
1	105	235.10	.12	.39	5.11	1	244				68	61	10.6
1	110	236.83	.12	.39	6.86	1	245	246	255	36	68	61	10.6
1	115	238.58	.12	.39	8.60	1	244				68	61	10.5
1	120	240.347	.12	.39	0.34	1	244	249	257	36	68	61	10.6
	(1455)												
	θ = 120	Vm = 41.747		ΔH = .39							Avg. 63.8		

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PM-10 TRAVERSE POINT SELECTION DATA SHEET

Job NSP Blackdog
Source Unit No. 2 Stack
Test 2 Run 3
Date 1-31-92
Operator

Pitot Tube No. 23-6
Barometric pres. 29.04 in.Hg.
Duct shape: ☒ Round ☐ Rectang.
Duct dimensions 270 in.
Length of port 5.75 in.

PM-10 Guidelines require that the velocity at each of the four selected traverse points be within +/- 20%. Record the velocity pressure of the traverse points and perform the indicated calculations. The values in the last column must fall within range of 80 - 120.

Traverse Point	Gas Temp. (deg-F)	Velocity Pressure ΔP (in. WC)	$\sqrt{\Delta P}$	$\frac{100\sqrt{\Delta P}}{(\sqrt{\Delta P})_{avg}}$
A - 1	245	.11	.3464	102.18
B - 1	245	.12	.3316	97.82
C - 1	245	.11	.3464	102.18
D - 1	245	.12	.3316	97.82
Averages			.339	

The average velocity pressure to be used for the sizing run may now be calculated from the following expression:

$$\Delta P = (\sqrt{\Delta P}_{avg})^2 = .11 \text{ in. WC}$$

Traverse points on round ducts: .15 D and .85 D
Distance from the duct wall: 40.5 _____ in.
Distance from the end of port: 46.25 _____ in.

CF-016

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP Blackdog Date 1-31-92 Test 2 Run 3
Source Unit No 2 Stack No. of traverse points 4
Method 201 Filter holder: SS Filter type: GF

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: 0.0 cfm at 5 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			
Impinger No. 2			
Impinger No. 3			
Condenser	54	0	54
Desiccant	1260	1241	19
Total			73

Integrated Gas Sampling Data:

Bag Pump No. B3 Box No. 2 Bag No. 1
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0.0 cc/min at 17 in. Hg.
Time start: 1515 (HRS) Time end: 1520 (HRS)
Sampling rate: 200 cc/min Operator: BA
S/N of O_2 Analyzer used to monitor train outlet: 4

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job: NSP Black Dog
Source: Unit No. 2 Stack
Date: 1-31-92 Test 2 Run 3

Operators: DLH + BP
Meter Box No. 8 ΔH@ 1.88 IN WC
Cocamator coeff. .9953

Pitot No. 236 Cp .84
Bar. Press. 29.04 inHg H2O 8.25 %
Nozzle No. ____ Nozzle Dia .263 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 (%v/v)
	1515	240.70											
A - 1	5	242.42	.11	.36	2.36	1	244	247	253	36	62	59	11.2
1	10	244.07	.11	.36	4.02	1	244				66	60	11.1
1	15	245.71	.11	.36	5.69	1	243	245	256	36	66	60	10.8
1	20	247.37	.11	.36	7.36	1	244				67	61	10.5
1	25	249.03	.11	.36	9.03	1	245	245	259	35	68	61	10.3
1	30	250.67	.11	.36	0.70	1	244				68	61	10.3
D - 1	35	252.37	.11	.36	2.37	1	243	250	260	35	68	61	10.2
1	40	254.05	.11	.36	4.04	1	245				69	61	10.3
1	45	255.74	.11	.36	5.71	1	244	248	257	36	69	62	10.2
1	50	257.42	.11	.36	7.39	1	244				69	62	10.2
1	55	259.08	.11	.36	9.07	1	243	248	255	35	69	62	10.1
1	60	260.74	.11	.36	0.74	1	244				69	62	10.2
C - 1	65	262.40	.11	.36	2.42	1	244	250	256	35	69	62	10.2
1	70	264.06	.11	.36	4.09	1	244				69	62	10.2
1	75	265.75	.11	.36	5.77	1	243	249	258	35	69	62	10.2
1	80	267.44	.11	.36	7.44	1	243				69	62	10.2
1	85	269.13	.11	.36	9.12	1	244	247	260	34	69	62	10.2
1	90	270.81	.11	.36	0.79	1	245				69	62	10.2
B - 1	95	272.52	.11	.36	2.47	1	244	247	258	35	69	62	10.1
1	100	274.16	.11	.36	4.14	1	244				69	62	10.2
1	105	275.83	.11	.36	5.82	1	243	245	258	36	69	62	10.2
1	110	277.50	.11	.36	7.49	1	244				69	62	10.1
1	115	279.16	.11	.36	9.17	1	243	247	260	35	69	62	10.2
1	120	280.855	.11	.36	0.84	1	244				69	62	10.2
	(1720)												
	θ = 120	Vm = 40.155		ΔH = .36							Avg. = 63.8		

S-0037R

Interpoll Laboratories
(612)786-6020

Field Data Sheet For BTEX

Job NSP Black Dog
Test Location Unit 2 Stack

Date 1-31-92
Operator(s) Jeff Bergstrom
Test 3 Run 1
Console No. 15
Bar. Pressure 24.04 In. Hg.

Y .9946

☑ Pretest Leak Check
(0 cc/min at 14 IN.HG. VAC)

☑ Post Test Leak Check
(0 cc/min at 14 IN.HG. VAC)

Sampling Time (min.)	Sample Volume (CF)	Flow Rate (cc/min)	Meter Temp	Vacuum (in. Hg.)	Wet Bulb	Dry Bulb	Moisture
(0850)	977.631	///////	///////	///////	///////	///////	///////
5	977.833	1000	62	1.5			
10	978.036	1000	63	1.5			
15	978.250	1000	64	1.5			
20	978.439	1000	65	1.5			
25	978.643	1000	66	1.5			
30	978.849		67	1.5			
35	979.047	1000	68	1.5			
40	979256	1000	69	1.5			
45	979.455	1000	70	1.5			
50	979.661	1000	70	1.5			
55	979.860	1000	71	1.5			
100	980.065	1000	71	1.5			

(0950) V_m = 2.434 CF i_m = 67.16 °F

V_{STD} = 2.35

C-30

S-290BL-R

Interpoll Laboratories
(612)786-6020

Field Data Sheet For BTEX

Job NSP / Black Dog
Test Location Unit 2 Stack

Date 1-31-92
Operator(s) J. Bergstrom
Test 3 Run 2
Console No. 15
Bar. Pressure 29.04 in. Hg.

Y .9946

☑ Pretest Leak Check
(0 cc/min at 14 IN.HG. VAC)

☑ Post Test Leak Check
(0 cc/min at 14 IN.HG. VAC)

Sampling Time (min.)	Sample Volume (CF)	Flow Rate (cc/min)	Meter Temp	Vacuum (in. Hg.)	Wet Bulb	Dry Bulb	Moisture
(1005)	981.2075	///////	///////	///////	///////	///////	///////
5	980.281	1000	72	1.5			
10	980.484	1000	72	1.5			
15	980.692	1000	72	1.5			
20	980.898	1000	72	1.5			
25	981.102	1000	72	1.5			
30	981.307	1000	73	1.5			
35	981.507	1000	73	1.5			
40	981.713	1000	73	1.5			
45	981.917	1000	73	1.5			
50	982.122	1000	74	1.5			
55	982.312	1000	74	1.5			
60	982.503	1000	74	1.5			

(1105) V_m = 2.428 CF t_m = 72.83 °F

V_{STD} = 2.32

C-31

S-290BL-R

Interpoll Laboratories
(612)786-6020

Field Data Sheet For BTEX

Job NSP / Black Dog
Test Location Unit 2 Stack

Date 1-31-92
Operator(s) J. Bergstrom
Test 3 Run 3
Console No. 15
Bar. Pressure 29.04 in. Hg.

Y .9946

☑ Pretest Leak Check
(0 cc/min at 14 IN.HG. VAC)

☑ Post Test Leak Check
(0 cc/min at 14 IN.HG. VAC)

Sampling Time (min.)	Sample Volume (CF)	Flow Rate (cc/min)	Meter Temp	Vacuum (in. Hg.)	Wet Bulb	Dry Bulb	Moisture
(1135)	982.510	////////	////////	////////	////////	////////	////////
5	982.710	1000	70	1.5			
10	982.914	1000	70	1.5			
15	983.156	1000	70	1.5			
20	983.323	1000	70	1.5			
25	983.528	1000	70	1.5			
30	983.732	1000	70	1.5			
35	983.936	1000	71	1.5			
40	984.143	1000	71	1.5			
45	984.349	1000	72	1.5			
50	984.546	1000	72	2.5			
55	984.751	1000	73	2.5			
60	984.965	1000	73	2.5			

V_m = 2.455 CF t_m = 71 °F

V_{STD} = 2.36

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S-2908L-R

APPENDIX D

INTERPOLL LABS ANALYTICAL DATA

TABLE OF CONTENTS

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job NSP / Blackdog
Team Leader ET
Date Submitted 1-31-92
Test No. 1
Date of Analysis 2-3-92

Source #2 Boiler
Test Site ESP Inlet
Date of Test 1-31-92
No. of Runs Completed 2
Technician R. [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
1/1	5282-17	1	0.00	12.00	19.60	12.00	7.60	1.11
		2	0.00	12.00	19.60	12.00	7.60	1.11
	☑ B ☐ F	Avg				12.00	7.60	
1/2	-18	1	0.00	11.90	19.60	11.90	7.70	1.11
		2	0.00	11.90	19.60	11.90	7.70	1.11
	☑ B ☐ F	Avg				11.90	7.70	
1/3	-19	1	0.00	12.40	19.60	12.40	7.20	1.10
		2	0.00	12.40	19.60	12.40	7.20	1.10
	☑ B ☐ F	Avg				12.40	7.20	
		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

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job: NSP/Blackdog
Team Leader: DVM
Date Submitted: 1-31-92
Test No.: 1
Date of Analysis: 2-3-92

Source: Unit #2
Test Site: Stack
Date of Test: 1-31-92
No. of Runs Completed: 3
Technician: R. Collins

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	5282-49	1	0.00	9.40	19.80	9.40	10.40	1.12
		2	0.00	9.40	19.80	9.40	10.40	1.12
	[x] B [ ] F	Avg				9.40	10.40	
1/2	-50	1	0.00	9.70	19.90	9.70	10.20	1.10
		2	0.00	9.70	19.90	9.70	10.20	1.10
	[x] B [ ] F	Avg				9.70	10.20	
1/3	-51	1	0.00	9.60	19.80	9.60	10.20	1.11
		2	0.00	9.60	19.80	9.60	10.20	1.11
	[x] B [ ] F	Avg				9.60	10.20	
		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						

- [x] Ambient Air QA Check
- [x] 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
D-2 Wood/Wood Bark	1.000-1.130

LSC-04-BR

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job NSP/Blackdog
Team Leader DB
Date Submitted 1-31-92
Test No. 2
Date of Analysis 2-1-92

Source Unit #2
Test Site Stack
Date of Test 1-31-92
No. of Runs Completed 2
Technician R. Cdim

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
2/1	5282-65	1	0.00	9.50	19.90	9.50	10.4	1.11
		2	0.00	9.50	19.90	9.50	10.4	1.11
	☑ B ☐ F	Avg				9.50	10.4	
2/2	-66	1	0.00	9.60	19.80	9.60	10.20	1.11
		2	0.00	9.60	19.80	9.60	10.20	1.11
	☑ B ☐ F	Avg				9.60	10.20	
2/3	-67	1	0.00	9.60	19.90	9.60	10.30	1.10
		2	0.00	9.60	19.90	9.60	10.30	1.10
	☑ B ☐ F	Avg				9.60	10.30	
		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 $F_o = \frac{20.9 - O_2}{CO_2}$

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	[illegible]

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

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job NSP Black Dog
Team Leader ET
Date Submitted 1-31-92
Test No. 1
Date of Analysis 2-3-92
Transport Leakage ☐ None ☐ _____ ml

Source #2 Boiler
Test Site ESP Inlet
Date of Test 1/31/92
No. of Runs Completed 3
Technician C. Helgeson
Solvent Methylene Chloride

0	Test 1 Run 0 Field Blank Log Number 5282-01 Vol. of Solvent 130 ml *Solvent Residue 3.0 ug/ml	Dish No. 5 Dish Tare Wt. 50.6866 g Dish+Sample Wt. 50.6870 g Sample Wt. 0.0004 g
1	Test 1 Run 1 Vol. of Solvent 30 ml Log Number -05 Comments	Dish No. 52 Dish Tare Wt. 49.8082 g Dish+Sample Wt. 49.8700 g Sample Wt. 0.0618 g
2	Test 1 Run 2 Vol. of Solvent 20 ml Log Number -09 Comments	Dish No. 105 Dish Tare Wt. 47.8622 g Dish+Sample Wt. 47.8851 g Sample Wt. 0.0229 g
3	Test 1 Run 3 Vol. of Solvent 55 ml Log Number -13 Comments	Dish No. 203 Dish Tare Wt. 46.8713 g Dish+Sample Wt. 46.8831 g Sample Wt. 0.0118 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 3.0 ug/ml = [(Sample Wt. 0.0004 g)(10^6)]/Vol. of Sol. 130 ml
EPA-M5 Acetone Residue Blank Spec. ≤ 7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0617	0.0238 D-4	0.0118		

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job NSP Black Dog
Team Leader DVH
Date Submitted 1-31-92
Test No. 1
Date of Analysis 2-3-92

Source Unit 2
Test Site ESP Inlet
Date of Test 1/30/92
No. of Runs Completed 3
Technician C. Helgesen

0	Test 1 Run 0 Field Blank Log Number 5282-02 Comments	Filter No. 20 Filter Type SS Thimble Filter Tare Wt. 39.9305 g Filter+Sample Wt. 39.9306 g Sample Wt. 0.0001 g
1	Test 1 Run 1 Log Number -06 Comments	Filter No. 23 Filter Type SS Thimble Filter Tare Wt. 41.1540 g Filter+Sample Wt. 48.3727 g Sample Wt. 7.2187 g
2	Test 1 Run 2 Log Number -10 Comments	Filter No. 26 Filter Type SS Thimble Filter Tare Wt. 41.1095 g Filter+Sample Wt 50.9985 g Sample Wt. 9.8890 g
3	Test 1 Run 3 Log Number -14 Comments	Filter No. 30 Filter Type SS Filter Filter Tare Wt. 43.4588 g Filter+Sample Wt. 50.6433 g Sample Wt. 7.1845 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
	7.2187	9.8890	7.1845		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	7.2804	9.9118	7.1961		

LSC-02PR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job NSP Black Dog
Team Leader DU IT
Date Submitted 1-31-92
Test No. /
Date of Analysis 2-3-92
Transport Leakage ☐ None ☐ _____ ml

Source #2 Boiler
Test Site Stack
Date of Test 1-30-92
No. of Runs Completed 3
Technician C. Helgeson
Solvent Methylene Chloride

0	Test 1 Run 0-1 Field Blank Log Number 5282-20 Vol. of Solvent 150 ml *Solvent Residue ___ ug/ml	Dish No. 12 Dish Tare Wt. 50.5713 g Dish+Sample Wt. 50.5792 g Sample Wt. 0.0079 g
1	Test 1 Run 1 Vol. of Solvent 160 ml Log Number -32 Comments	Dish No. 15 Dish Tare Wt. 50.2347 g Dish+Sample Wt. 50.2466 g Sample Wt. 0.0119 g
2	Test 1 Run 2 Vol. of Solvent 155 ml Log Number -38 Comments	Dish No. 17 Dish Tare Wt. 50.5881 g Dish+Sample Wt. 50.6097 g Sample Wt. 0.0216 g
3	Test 1 Run 3 Vol. of Solvent 160 ml Log Number -45 Comments	Dish No. 18 Dish Tare Wt. 50.1956 g Dish+Sample Wt. 50.2186 g Sample Wt. 0.0230 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)(10^6)]/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
	0.0211	0.0216 D-6	0.0230		

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job NSP Black Dog
Team Leader Dvid
Date Submitted 1-31-92
Test No. 1
Date of Analysis 2-3-92
Transport Leakage [X] None [ ] _____ ml

Source #2 Boiler
Test Site Stack
Date of Test 1-30-92
No. of Runs Completed 3
Technician C. Helgeson
Solvent Methylene Chloride

0	Test 1 Run 0-2 Field Blank Log Number 5282-26 Vol. of Solvent 95 ml *Solvent Residue _____ ug/ml	Dish No. O Dish Tare Wt. 50.5013 g Dish+Sample Wt. 50.5063 g Sample Wt. 0.0050 g
1	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
2	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
3	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ 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)(10^6)]/Vol. of Sol. _____ ml
EPA-MS Acetone Residue Blank Spec. < 7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job NSP Black Dog
Team Leader DJH
Date Submitted 1-31-92
Test No. 1
Date of Analysis 2-3-92

Source #2 Boiler
Test Site Stack
Date of Test 1-30-92
No. of Runs Completed 3
Technician C. Helgoson

0
Test 1 Run 0-1
Field Blank
Log Number 5282-22
Comments
Filter No. 7023
Filter Type 3.52" 4MS
Filter Tare Wt. .4325 g
Filter+Sample Wt. .4325 g
Sample Wt. 0.0000 g

1
Test 1 Run 1
Log Number -34
Comments
Filter No. 7021
Filter Type 3.52" 4MS
Filter Tare Wt. .4268 g
Filter+Sample Wt. .4422 g
Sample Wt. 0.0154 g

2
Test 1 Run 2
Log Number -40
Comments 1 of 2
Filter No. 7020
Filter Type 3.52" 4MS
Filter Tare Wt. .4212 g
Filter+Sample Wt. .4217 g
Sample Wt. 0.0005 g

3
Test 1 Run 3
Log Number -47
Comments
Filter No. 7018
Filter Type 3.55" 4MS
Filter Tare Wt. .4220 g
Filter+Sample Wt. .4405 g
Sample Wt. 0.0185 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
	0.0154	0.0005	0.0185		

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EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job: NSP Black Dog
Team Leader:
Date Submitted:
Test No.:
Date of Analysis:

Source: #2 Boiler
Test Site: Stack
Date of Test: 1-30-92
No. of Runs Completed: 3
Technician: C. Helgeson

0
Test 1 Run 0-2
Field Blank
Log Number 5282-28
Comments:
Filter No. 7022
Filter Type 3.52" 4MS
Filter Tare Wt. .4411 g
Filter+Sample Wt. .4411 g
Sample Wt. 0.0000 g

1
Test ____ Run ____
Log Number:
Comments:
Filter No.:
Filter Type:
Filter Tare Wt. ____ g
Filter+Sample Wt. ____ g
Sample Wt. ____ g

2
Test 1 Run 2
Log Number 5282-411
Comments 2 of 2
Filter No. 7019
Filter Type 3.52" 4MS
Filter Tare Wt. .4473 g
Filter+Sample Wt. .4662 g
Sample Wt. 0.0189 g

3
Test ____ Run ____
Log Number:
Comments:
Filter No.:
Filter Type:
Filter Tare Wt. ____ g
Filter+Sample Wt. ____ g
Sample Wt. ____ 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
		0.0189			

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0365	0.0410	0.0415		

LSC-02PR

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Cascade Impactor Laboratory Data Sheet

Job NSP / Black Dog — Date of test 1-31-92

Source Unit 2 — Test 2 — Run 0

Analyst TM — Impactor No. 0 — Substrate used Apiezon H covered gold plated collection foil

Stage No.	Weight (g)					Cum. Weight (g)	% W/W	Part Dia. (um)
	Tare	Final	Uncorr. Mass	Control	Corr. Mass			
Preimpact.	49.62618	49.62649	0.00031	NA	NA	NA	NA	NA
1	2.16770	2.16797	0.00027					
2	2.05500	2.05514	0.00014					
3	1.93809	1.93814	0.00005					
4	1.86311	1.86318	0.00007					
5	2.01468	2.01467	-0.00001					
6	2.09852	2.09863	0.00011					
7	2.07224	2.07247	0.00023					
Filter	71.65310	71.65326	0.00016					

Sampling rate data:

V_{std} = 19.46 DSCF — P_b = 29.04 in. Hg

t_m = 240 °F — P_g = -1.10 in. WC

θ = 60 min. — MC = 8.43 % v/v

$$q_a = \frac{5.67\ V_{std}\ (t_m + 460)}{\theta\ (P_b + P_g/13.6)\ (100 - MC)}$$

$$q_a = \frac{5.67 \times (19.46) \times (240 + 460)}{(60) \times (29.04 + -1.10 / 13.6) \times (100 - 8.43)} = 0.485 \text{ acfm}$$

0.527 @ 300 °F

Rev. 1 CF-028

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Cascade Impactor Laboratory Data Sheet

Job NSP / Black Dog — Date of test 1-31-92

Source unit 2 — Test 2 — Run 1

Analyst TM — Impactor No. 1 — Substrate used Apiezon H covered gold plated collection foils

Stage No.	Weight (g)					Cum. Weight (g)	% W/W	Part Dia. (um)
	Tare	Final	Uncorr. Mass	Control	Corr. Mass			
Preimpact.	53.98664	53.98743	0.00079	−0.00031	0.00048	0.00048	3.63	12.0
1	2.02356	2.02447	0.00091	−0.00027	0.00064	0.00112	8.47	7.6
2	1.99141	1.99223	0.00082	−0.00014	0.00068	0.00180	13.62	4.6
3	2.09968	2.10128	0.00160	−0.00005	0.00155	0.00335	25.34	3.0
4	1.99048	1.99214	0.00166	−0.00007	0.00159	0.00494	37.37	1.85
5	1.99763	2.00056	0.00293	+0.00001	0.00294	0.00788	59.35	1.20
6	2.07096	2.07423	0.00327	−0.00011	0.00316	0.01104	83.51	0.74
7	2.34764	2.34948	0.00184	−0.00023	0.00161	0.01265	95.69	0.43
Filter	67.79389	67.79462	0.00073	−0.00016	0.00057	0.01322		

0.01455

Sampling rate data:

V_{mcd} = 40.71 DSCF — P_b = 29.04 in. Hg

t_m = 243 °F — P_g = −1.10 in. WC

θ = 120 min. — MC = 8.47 % v/v

$$q_m = \frac{5.67\ V_{mcd}\ (t_m + 460)}{\theta\ (P_b + P_g/13.6)\ (100 - MC)}$$

$$q_a = \frac{5.67 \times (40.71) \times (243 + 460)}{(120) \times (29.04 + -1.10 / 13.6) \times (100 - 8.47)} = \frac{0.510 \text{ acfm}}{0.551 \text{ @ } 300°F}$$

Rev. 1 CF-028

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Cascade Impactor Laboratory Data Sheet

Job NSP / Black Dog — Date of test 1-31-92

Source unit 2 — Test 2 Run 2

Analyst TM — Impactor No. 2 — Substrate used Apiezon H covered gold plated collection foils

Stage No.	Weight (g)					Cum. Weight (g)	% W/W	Part Dia. (um)
	Tare	Final	Uncorr. Mass	Control	Corr. Mass			
Preimpact.	44.53088	44.53271	0.00183	-0.00031	0.00152	0.00152	12.73	12.0
1	2.16690	2.16751	0.00061	-0.00027	0.00034	0.00186	15.58	7.6
2	2.12670	2.12686	0.00016	-0.00014	0.00002	0.00188	15.75	4.6
3	2.08149	2.08289	0.00140	-0.00005	0.00135	0.00323	27.05	3.0
4	1.92224	1.92402	0.00178	-0.00007	0.00171	0.00494	41.37	1.85
5	1.98520	1.98814	0.00294	+0.00001	0.00295	0.00789	66.08	1.20
6	2.02512	2.02782	0.00270	-0.00011	0.00259	0.01048	87.77	0.74
7	2.03265	2.03421	0.00106	-0.00023	0.00083	0.01131	94.72	0.43
Filter	66.03315	66.03394	0.00079	-0.00016	0.00063	0.01194		

Sampling rate data:

V_{std} = 40.84 DSCF — P_b = 29.04 in. Hg

t_m = 244 °F — P_g = -1.10 in. WC

θ = 120 min. — MC = 8.07 % v/v

$$q_a = \frac{5.67\ V_{std}\ (t_m + 460)}{\theta\ (P_b + P_g/13.6)\ (100 - MC)}$$

$$q_a = \frac{5.67 \times (40.84) \times (244 + 460)}{(120) \times (29.04 + -1.10 / 13.6) \times (100 - 8.07)} = \frac{0.510}{0.551} \text{ acfm @ } 300°F$$

Rev. 1 CF-028

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Cascade Impactor Laboratory Data Sheet

ob NSP / Black Dog — Date of test 1-31-92

Source unit 2 — Test 2 Run 3

nalyst _____ Impactor No. 3 — Substrate used Apiezon H covered gold plated collection foils

Stage No.	Weight (g)					Cum. Weight (g)	% W/W	Part Dia. (um)
	Tare	Final	Uncorr. Mass	Control	Corr. Mass			
Preimpact.	47.61940	47.62263	0.00323	-0.00031	0.00292	0.00292	21.02	12.0
1	1.90936	1.90982	0.00046	-0.00027	0.00019	0.00311	22.39	7.6
2	1.96106	1.96136	0.00030	-0.00014	0.00016	0.00327	23.54	4.6
3	2.01144	2.01281	0.00137	-0.00005	0.00132	0.00459	33.04	3.0
4	1.92949	1.93129	0.00180	-0.00007	0.00173	0.00632	45.50	1.85
5	1.99181	1.99447	0.00266	+0.00001	0.00267	0.00899	64.72	1.20
6	2.01926	2.02247	0.00321	-0.00011	0.00310	0.01209	87.04	0.74
7	2.05502	2.05684	0.00182	-0.00023	0.00159	0.01368	98.49	0.43
Filter	65.50596	65.50633	0.00037	-0.00016	0.00021	0.01389		

Sampling rate data:

V_{acd} = 39.28 DSCF — P_b = 29.04 in. Hg

t_m = 244 °F — P_g = -1.10 in. WC

θ = 120 min. — MC = 8.05 % v/v

$$q_a = \frac{5.67\ V_{acd}\ (t_m + 460)}{\theta\ (P_b + P_g/13.6)\ (100 - MC)}$$

$$q_a = \frac{5.67 \times (39.28) \times (244 + 460)}{(120) \times (29.04 + -1.10 / 13.6) \times (100 - 8.05)} = \frac{0.491 \text{ acfm}}{0.530 \text{ @ } 300°F}$$

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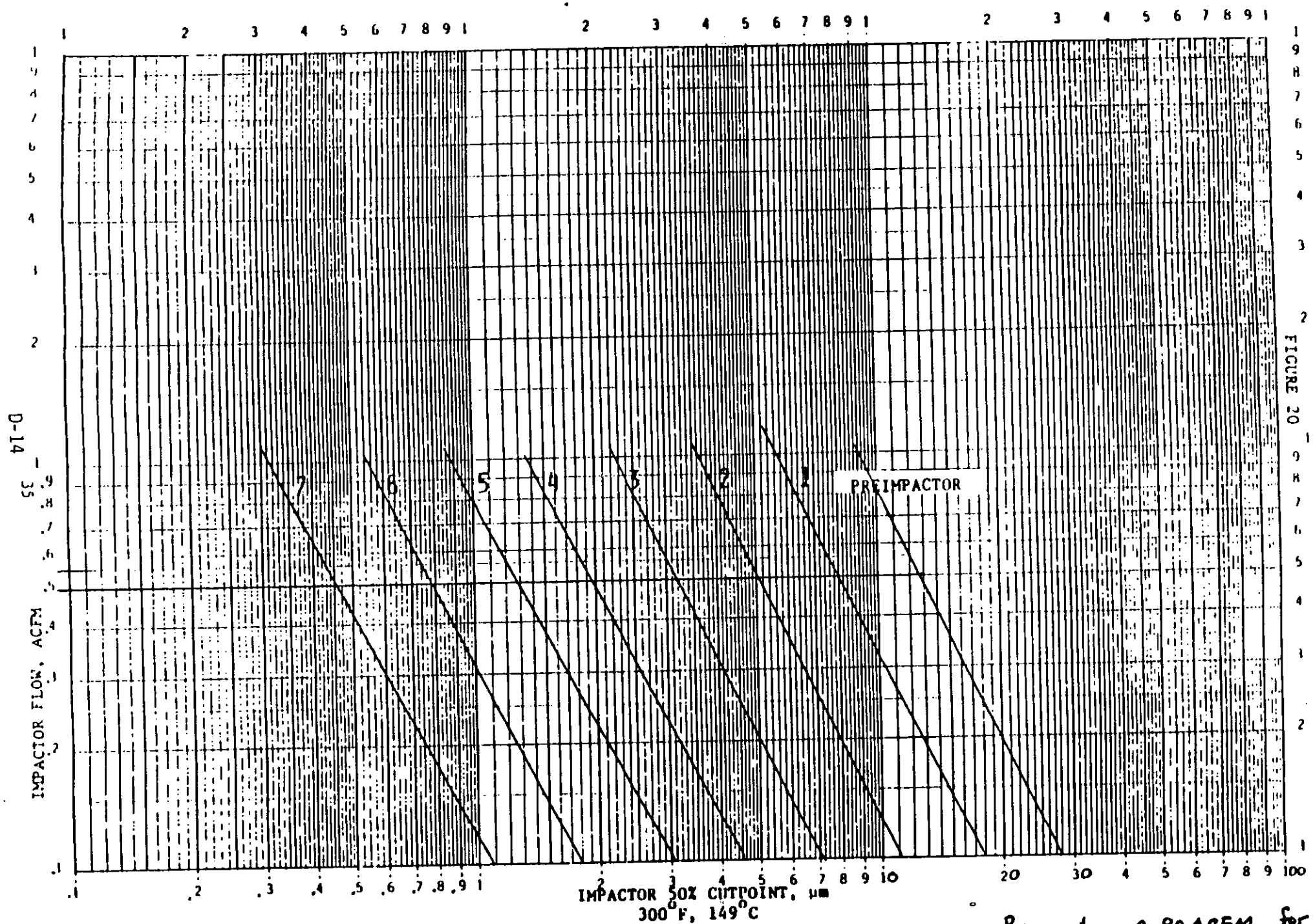

FIGURE 20

D-14

Preimpactor 0.80 ACFM for
@ 300°F 10 μm 50% cut po

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NSP/Black Dog
Laboratory Log No. 5282

Results of Trace Metals Analysis

Test: 1
Source: Unit 2 ESP Inlet
Test Type: Particulate

Trace Metal	Method	Total Mass of Elements in Sample (ug) Run 1	Run 2	Run 3
(Log No.)		(5282-06)	(5282-10)	(5282-14)
Wt. (g)	EPA 5	7.28	9.91	7.20
Silver	EPA 6010	< 14.6	< 19.8	< 14.4
Aluminum	EPA 6010	591000	794000	602000
Arsenic	EPA 7060	112	142	97.9
Boron	EPA 6010	4290	5160	4210
Barium	EPA 6010	40800	55800	41000
Beryllium	EPA 6010	21.8	34.5	20.7
Calcium	EPA 6010	1460000	1840000	1560000
Cadmium	EPA 6010	< 14.6	< 19.8	< 14.4
Chromium	EPA 6010	349	475	350
Copper	EPA 6010	1300	1540	1140
Iron	EPA 6010	322000	402000	302000
Mercury (F)	EPA 7470	< 0.29	< 0.40	< 0.29
Mercury (B)	EPA 7470	6.17	11.5	7.78
Potassium	EPA 6010	21700	25800	21600
Lithium	SM 317A	277	466	237
Magnesium	EPA 6010	255000	321000	245000
Manganese	EPA 6010	721	1040	741
Molybdenum	EPA 6010	67.0	82.3	61.5
Sodium	EPA 6010	116000	154000	125000
Nickel	EPA 6010	447	558	430
Lead	EPA 6010	194	185	208
Antimony	EPA 7041	10.9	13.9	15.8
Selenium	EPA 7740	47.0	48.4	43.1
Strontium	SM 326A	25500	31900	24800
Titanium	EPA 6010	54800	72200	55000
Vanadium	EPA 6010	1570	2000	1540
Zinc	EPA 6010	794	981	676

INTERPOLL LABORATORIES, INC.
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Results of Trace Metals Analysis

Facility: NSP/Black Dog
Test: 1
Source: Unit #2, Stack
Test Type: 4M5

Element	Method	Total Mass of Elements in Sample (ug) Field Blank 1	Field Blank 2	Run 1	Run 2	Run 3
(Log No.)		(5282-53)	(5282-54)	(5282-55)	(5282-56)	(5282-57)
(Wt. (g))	EPA 5	0.0079	0.0050	0.0365	0.0410	0.0415
Ag	EPA 6010	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
Al	EPA 6010	126.00	117.00	1750.00	2160.00	2210.00
As	EPA 7060	< 0.05	0.09	0.97	1.01	0.93
B	EPA 6010	15.00	15.20	154.00	169.00	141.00
Ba	EPA 6010	4.13	3.00	89.80	107.00	115.00
Be	EPA 7091	< 0.005	< 0.005	< 0.05	< 0.05	< 0.05
C	ASTM D3178	ND	ND	ND	ND	ND
Ca	EPA 6010	188.00	214.00	6730.00	7680.00	7930.00
Cd	EPA 6010	< 3.00	< 3.00	6.69	19.60	9.57
Co	EPA 6010	ND	ND	ND	ND	ND
Cr	EPA 6010	< 3.00	< 3.00	9.51	18.70	6.42
Cu	EPA 6010	3.86	18.90	23.10	29.70	18.90
Fe	EPA 6010	64.70	50.10	1610.00	1740.00	1910.00
Hg (F)	EPA 7470	0.20	0.10	3.62	2.89	3.32
Hg (B)	EPA 7470	0.20	0.14	1.20	1.54	1.62
K	EPA 6010	< 120.00	< 120.00	< 120.00	180.00	150.00
Li	SM 317A	ND	ND	ND	ND	ND
Mg	EPA 6010	27.20	29.40	1170.00	1360.00	1390.00
Mn	EPA 6010	< 3.00	< 3.00	8.79	10.30	14.90
Mo	EPA 6010	11.30	8.47	10.70	22.60	8.47
Na	EPA 6010	746.00	799.00	1390.00	1645.00	1380.00
Ni	EPA 6010	< 3.00	< 3.00	62.40	78.90	16.70
P	EPA 6010	ND	ND	ND	ND	ND
Pb	EPA 6010	< 9.00	< 9.00	82.30	525.00	102.00
S	EPA 6010	746.00	799.00	300000.00	298000.00	278000.00
Sb	EPA 7041	< 0.25	< 0.25	< 1.00	< 1.00	< 1.00
Se	EPA 7740	0.41	0.09	1.00	0.50	0.74
Si	EPA 6010	ND	ND	ND	ND	ND
Sn	EPA 6010	ND	ND	ND	ND	ND
Sr	SM 326A	< 5.00	< 5.00	93.00	109.00	122.00
Ti	EPA 6010	3.30	3.40	189.00	218.00	238.00
Tl	EPA 6010	ND	ND	ND	ND	ND
V	EPA 6010	< 3.00	< 3.00	7.26	7.26	7.26
Zn	EPA 6010	14.90	10.50	203.00	154.00	79.80

Critical results have been QA'ed

Interpoll Laboratories
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EPA Method 18/NIOSH Sampling Data Reporting Sheet

Job/Project NSP / Black Dog
Source unit No. 2
Test Site Stack

Date of Sampling 1-31-92
Analyst KDS
Date of Analysis 2-4-92
Method of Analysis ~~Modified~~ NIOSH-1501

Sample Log Number	Test/Run	Sampling Media	Sample Tube Size	Analytes:	Mass Front Section (Total ug)	Mass Back Section (Total ug)
5282-69	Test 3 Run 0	☑ C\C Coal ☐ P\C Coal ☐ S. Gel ☐ XAD-2	☐ 100/50 ☐ 300/150 ☐ 400/200 ☑ 800/200 ☐ 1060/240 ☐ 1800/200	Benzene Toluene Ethylbenzene Xylene	<5.0	<1.5

Comments: _____

Sample Log Number	Test/Run	Sampling Media	Sample Tube Size	Analytes:	Mass Front Section (Total ug)	Mass Back Section (Total ug)
5282-70	Test 3 Run 1	☑ C\C Coal ☐ P\C Coal ☐ S. Gel ☐ XAD-2	☐ 100/50 ☐ 300/150 ☐ 400/200 ☑ 800/200 ☐ 1060/240 ☐ 1800/200	Benzene Toluene Ethylbenzene Xylene	<5.0	<1.5

Comments: _____

Detection Limits:

Analytes:	Mass Front Section (Total ug)	Mass Back Section (Total ug)
Benzene	5.0	1.5
Toluene	5.0	1.5
E-Benzene	5.0	1.5
Xylenes	5.0	1.5

C\C Coal = Coconut Charcoal
P\C Coal = Petroleum Charcoal
S. Gel = Silica Gel

Tube Schematics:

Single Tube ☑

Two Tubes "Piggy-back" ☐

Tube No. 1 Tube No. 2

LOA-17

EPA Method 18/NIOSH Sampling Data Reporting Sheet

Job/Project NSP / Black Dog
Source Unit No. 2
Test Site Stack

Date of Sampling 1-31-92
Analyst KDS
Date of Analysis 2-9-92
Method of Analysis NIOSH-1501

Sample Log Number	Test/Run	Sampling Media	Sample Tube Size	Analytes:	Mass Front Section (Total ug)	Mass Back Section (Total ug)
5282-71	Test 3 Run 2	☑ C\C Coal ☐ P\C Coal ☐ S. Gel ☐ XAD-2	☐ 100/50 ☐ 300/150 ☐ 400/200 ☑ 800/200 ☐ 1060/240 ☐ 1800/200	Benzene	<5.0	<1.5
				Toluene	↓	↓
				Ethylbenzene	↓	↓
				Xylene	↓	↓

Comments:

Sample Log Number	Test/Run	Sampling Media	Sample Tube Size	Analytes:	Mass Front Section (Total ug)	Mass Back Section (Total ug)
5282-72	Test 3 Run 3	☑ C\C Coal ☐ P\C Coal ☐ S. Gel ☐ XAD-2	☐ 100/50 ☐ 300/150 ☐ 400/200 ☑ 800/200 ☐ 1060/240 ☐ 1800/200	Benzene	<5.0	<1.5
				Toluene	↓	↓
				Ethylbenzene	↓	↓
				Xylene	↓	↓

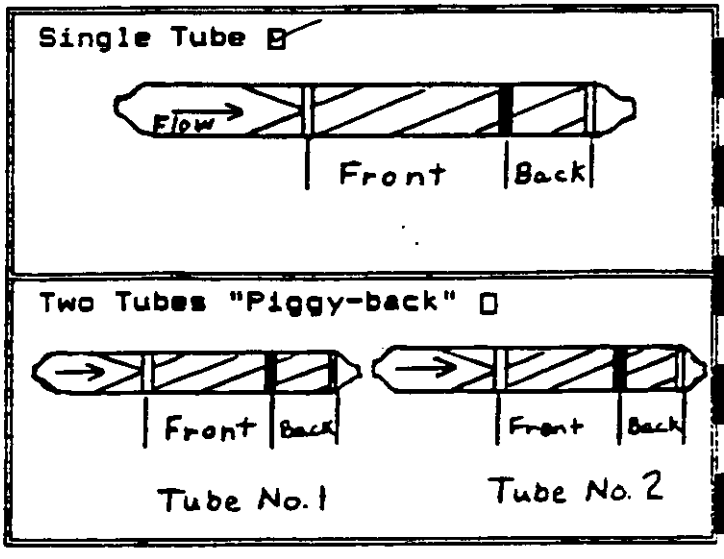
Comments:

Detection Limits:

Analytes:	Mass Front Section (Total ug)	Mass Back Section (Total ug)
Benzene	5.0	1.5
Toluene	5.0	1.5
E-Benzene	5.0	1.5
Xylenes	5.0	1.5

C\C Coal = Coconut Charcoal
P\C Coal = Petroleum Charcoal
S. Gel = Silica Gel

Tube Schematics:



LOA-13

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job USP / BLACKDOG
Team Leader E. TROWBRIDGE
Date Submitted 1-31-92
Test No. 1

Source UNIT #2
Test Site ESP INLET
Date of Test 1-31-92
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
4	Probe Wash: ☐ Acetone ☐ ~~D.I. Water~~ MeCl	☒ As per EPA M-5 ☐ Other Mercury	
4	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 Hg	
4 4	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 Acid Wash Probe	
3	Integrated Gas sample	☒ As per EPA M-3 ☐ As per EPA M-10 ☐ Other	
	Oxides of Nitrogen (NO_x)	☐ As per EPA M-7A ☐ Other	Date Time (HRS)
	☐ Fuel Sample ☐ Aggregate	☐ Attached fuel Form #S-0163RRR	
	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☐ Other	
	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

S-278RRRR

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Chain of Custody
Sample Deposition Sheet

Job NSP / Black Dog
Team Leader DVH
Date Submitted 1-31-92
Test No. 1

Source UNIT NO. 2
Test Site STACK
Date of Test 1-31-92
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
5 6	Probe Wash: ~~Acetone~~ METH CL ~~D.I. Water~~ 1NHNO3	~~As~~ per EPA M-5 Other METHCL	
6	Filter: 4" G.F. S.S. Thimble 2.5" G.F. 47 mm G.F. ~~3.5~~ 3.52"	As per EPA M-5 As per EPA M-17 Other METALS	
10 5	Impinger Catch: D.I. Water 3% H_2O_2 ~~4~~M5 Hg Only ~~4~~M5 Metals 1.0 N NaOH Other	MN Protocol WI Protocol EPA M-6 or 8 Acid Gases Formaldehyde ~~Metals~~ ~~Other~~ Hg (5 impinger acid wash Bottles)	
3	Integrated Gas sample	As per EPA M-3 As per EPA M-10 Other	
	Oxides of Nitrogen (NO_x)	As per EPA M-7A Other	Date Time(HRS)
3	~~Fuel Sample~~ Aggregate	Attached fuel Form #S-0163RRR	
	Particle Size	X-Ray Sedigraph Bahco Method Other	
	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 BITUMINOUS COAL
3) Is sample combustible? ■ No ☐ Yes
4) Does sample need special handling? ■ No ☐ Yes If yes, explain

S-278RRRR

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job NSP BLACK DOG
Team Leader DVM
Date Submitted
Test No. 2

Source Unit #2
Test Site Stack
Date of Test 1-31-92
No. of Runs Completed 3 + BLANK

No. of Samples	Type of Sample	Analysis Required	Comments
5	Probe Wash: ☒ ~~Acetone~~ ACET 2 ☐ D.I. Water	☐ As per EPA M-5 ☒ Other 201	
	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	
	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	
4	Integrated Gas sample	☒ As per EPA M-3 ☐ As per EPA M-10 ☐ Other	
	Oxides of Nitrogen (NO_x)	☐ As per EPA M-7A ☐ Other	Date Time (HRS)
	☐ Fuel Sample ☐ Aggregate	☐ Attached fuel Form #S-0163RRR	
4	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☒ Other PM 10	
	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

S-278RRRR

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job NSP / Black Dog
Team Leader D Van Hoover
Date Submitted 1-31-92
Test No. 3

Source Unit No. 2 Boiler
Test Site Stack
Date of Test 1-31-92
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
	Probe Wash: ☐Acetone ☐D.I. Water	☐As per EPA M-5 ☐Other _____	
	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 _____	
	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 _____	
	Integrated Gas sample	☐As per EPA M-3 ☐As per EPA M-10 ☐Other _____	
	Oxides of Nitrogen (NO_x)	☐As per EPA M-7A ☐Other _____	Date _____ Time(HRS) _____
	☐ Fuel Sample ☐ Aggregate	☐Attached fuel Form #S-0163RRR	
	Particle Size	☐X-Ray Sedigraph ☐Bahco Method ☐Other _____	
4	Audit Samples ☐Sulfur Dioxide ☐Oxides of Nit. ☑Other BTEX	☐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 _____

S-278RRRR

APPENDIX E

BOILER OPERATIONAL DATA

1-31-92

0850 START RUN 1

SOOT BLOWING ON AIR HEATERS. LAST AH [illegible] DONE AT 0847 HRS.

1101 RUN 1 END.

1150 START RUN 2

Soot Blowing on Air Heaters, SH/ECON 11.31 AM

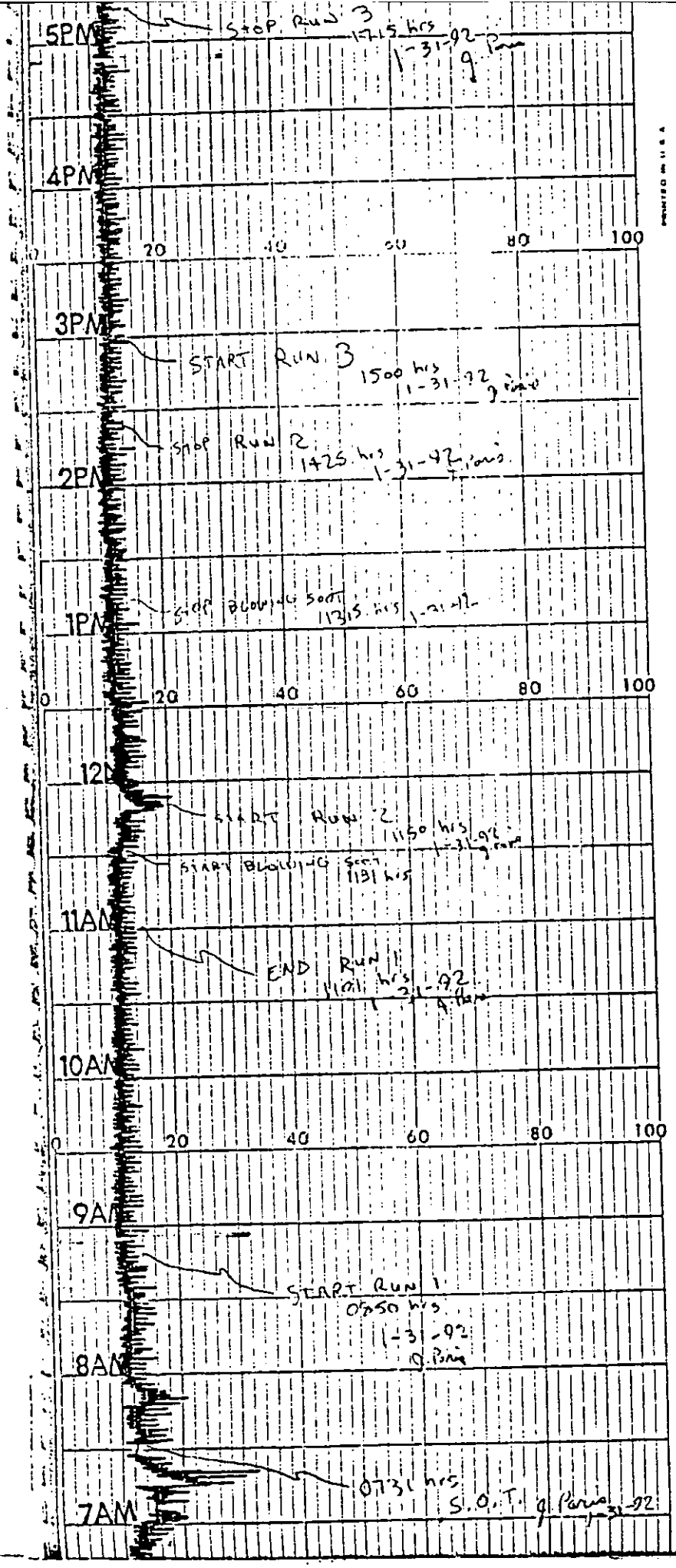
Soot Blowing done at 1315 HRS

1425 Run 2 END

1500 START RUN 3

[illegible] SOOT BLOWING THIS RUN

1715 STOP RUN 3



OPACITY
STRIP CHART

NO. 560104

1512-1521-1514

BLACKDOG STEAM PLANT

GENERATED LOAD RECORD
UNIT #2

ON LINE @ MN

DATE JAN 31 1992

OFF LINE @ _____

#2 "MAIN GENERATOR"			
TIME	MEGAWATTS	MEGAVARS REC------DEL	
0100	85		.18
0200	85		18
0300	85		17.4
0400	85		21.5
0500			
0600			
0700			
0800	85		36
0900	85		36
1000	85		36
1100	85		43
1200	85		43
1300	85		44
1400	85		43
1500	85		40.6
1600	85		38.7
1700	85		40.2
1800	85		48.3
1900			
2000			
2100			
2200			
2300			
2400			

EQUIPMENT	RUN TIME	
	IN	OUT
AIR PRE-HEATER		
21 ID FAN	MN	
22 ID FAN	MN	
21 FD FAN	MN	
22 FD FAN	MN	
21 B.C.P.		
22 B.C.P.	MN	
23 B.C.P.	MN	
24 B.C.P.	MN	
21 B.F.P.	MN	
22 B.F.P.	MN	
23 B.F.P.		
21 C.W.P.	MN	
22 C.W.P.		
21 H.W.P.	MN	
22 H.W.P.	MN	
21 H.D.P.	MN	

TIME	"SOOT BLOWERS"
1300	ALL ELEMENTS
0730	ALL
1130	ALL
1720	ALL

```
2 HOURLY                        UNIT 2 HOURLY LOG                              8:04:18      1/31/92

2FWP  2086.8  PSIG    2 AVG. FEEDWATER PRESS          76.9   MEG W    2 INT. NET MEGAWATTS
                                                      13.7   KVOLTS   2 AVG. GENERATOR AB PHASE
2MWH    85.1  MEG W   2 INT. GROSS MEGAWATTS          38.2   M-VARS   2 AVG. GENERATOR VARS
                                                    3678.9   AMPS     2 AVG. GENERATOR B PHASE
2FFH   708.6  K #/HR  2 INT. FEEDWATER FLOW
                                                       6.7   AMPS     2 AVG. EXCITER CURRENT
2FWT   437.1  DEG F   2 AVG. FEEDWTR TO ECON TEMP
                                                       8.2   MEG W    21 INT. X+Y STATION AUX MEGAWATTS
2MSP   853.2  PSIG    2 AVG. FINAL STEAM PRESS        -0.2   MEG W    1+2 RSA TO 2 INT. MEGAWATTS
                                                       8.0   MEG W    2 TOTAL STATION USE AUX + RSA INT
2MST   994.2  DEG F   2 AVG. FINAL STEAM TEMP       1175.3   AMPS     21 BUS AVG. A PHASE CURRENT
                                                    1271.3   AMPS     22 BUS AVG. A PHASE CURRENT
2ATT   298.8  DEG F   2 AVG. ATTEMP INLET FW TEMP      4.4   AMPS     1 RSA TO 22 A PHASE AVG. CURRENT
                                                       3.1   AMPS     2 RSA TO 21 A PHASE AVG. CURRENT
2AFH     3.2  K #/HR  2 INT. TOTAL ATTEMP FLOW
                                                       7.3   INCHES   2 AVG. CONDENSOR DIFF/PRESS
2BPH    29.4  INCHES  AVG. PLANT BAROMETRIC PRESS

2CVP    28.0  INCHES  2 AVG. CONDENSER VACUUM       107.4/ 106.9      2 AVG. N/S NOX PPM
                                                     17.6/  44.8      2 AVG. N/S CO PPM
2CWP                                                117.9/ 128.3      2 AVG. N/ S DEWPOINT
                                                      8.4/  11.1      2 AVG. N/S H2O %
2CIT    40.7  DEG F   21 AVG. CIRC WATER INLET TEMP   7.5/   6.6      2 AVG. N/S O2 %
  OR    39.0  DEG F   22 AVG. CIRC WATER INLET TEMP 0.435/ 0.407      2 AVG. N/S SO2 #/MBTU

2COT    59.2  DEG F   2 AVG. CIRC WATER OUTLET TEMP    0.0   SCFH     2 INT. TOTAL BURNER FUEL GAS FLOW
                                                       0.1   GPM      2 INT. TOTAL BURNER FUEL OIL FLOW
2HWT    76.4  DEG F   2 AVG. HOTWELL OUTLET TEMP
                                                                RAMSEY COAL SCALE VALUES
        1.00  HOURS   2 INT. GEN. ON-LINE % HOUR    @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
                                                      52.7   #/CUFT   21CELL DENSITY
       985.2  DEG F   2 AVG. THROTTLE STEAM TEMP      55.4   #/CUFT   22CELL DENSITY
       675.9  K #/HR  2 INT. FINAL STEAM FLOW         57.7   #/CUFT   23CELL DENSITY
         0.0  K #/HR  2 INT. TURB BYPASS STEAM FLOW   51.7   #/CUFT   24CELL DENSITY
         3.2  K #/HR  2 INT. A NORMAL SPRAY FLOW
         0.0  K #/HR  2 INT. B NORMAL SPRAY FLOW      11.9   TPH      21CELL SCALE   11263 .1 TON TOTAL
         3.2  K #/HR  2 INT. A+B SPRAY FLOW           13.7   TPH      22CELL SCALE   19587 .1 TON TOTAL
         0.0  K #/HR  2 INT. EMERGENCY SPRAY FLOW     13.7   TPH      23CELL SCALE   19895 .1 TON TOTAL
      1471.9  PSIG    2 AVG. DRUM PRESSURE            10.8   TPH      24CELL SCALE    9762 .1 TON TOTAL
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2 HOURLY — UNIT 2 HOURLY LOG — 9:04:19 — 1/31/92

Tag	Value	Units	Description
2FWP	2092.7	PSIG	2 AVG. FEEDWATER PRESS
2MWH	85.1	MEG W	2 INT. GROSS MEGAWATTS
2FFH	693.3	K #/HR	2 INT. FEEDWATER FLOW
2FWT	437.9	DEG F	2 AVG. FEEDWTR TO ECON TEMP
2MSP	851.7	PSIG	2 AVG. FINAL STEAM PRESS
2MST	998.0	DEG F	2 AVG. FINAL STEAM TEMP
2ATT	303.1	DEG F	2 AVG. ATTEMP INLET FW TEMP
2AFH	3.4	K #/HR	2 INT. TOTAL ATTEMP FLOW
2BPH	29.5	INCHES	AVG. PLANT BAROMETRIC PRESS
2CVP	28.0	INCHES	2 AVG. CONDENSER VACUUM
2CWP			
2CIT	40.7	DEG F	21 AVG. CIRC WATER INLET TEMP
OR	39.0	DEG F	22 AVG. CIRC WATER INLET TEMP
2COT	59.2	DEG F	2 AVG. CIRC WATER OUTLET TEMP
2HWT	76.4	DEG F	2 AVG. HOTWELL OUTLET TEMP
	1.00	HOURS	2 INT. GEN. ON-LINE % HOUR
	989.3	DEG F	2 AVG. THROTTLE STEAM TEMP
	675.1	K #/HR	2 INT. FINAL STEAM FLOW
	0.0	K #/HR	2 INT. TURB BYPASS STEAM FLOW
	3.4	K #/HR	2 INT. A NORMAL SPRAY FLOW
	0.0	K #/HR	2 INT. B NORMAL SPRAY FLOW
	3.4	K #/HR	2 INT. A+B SPRAY FLOW
	0.0	K #/HR	2 INT. EMERGENCY SPRAY FLOW
	1471.9	PSIG	2 AVG. DRUM PRESSURE

Value	Units	Description
76.9	MEG W	2 INT. NET MEGAWATTS
13.7	KVOLTS	2 AVG. GENERATOR AB PHASE
36.7	M-VARS	2 AVG. GENERATOR VARS
3849.1	AMPS	2 AVG. GENERATOR B PHASE
6.6	AMPS	2 AVG. EXCITER CURRENT
8.2	MEG W	21 INT. X+Y STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA TO 2 INT. MEGAWATTS
8.0	MEG W	2 TOTAL STATION USE AUX + RSA INT
1172.6	AMPS	21 BUS AVG. A PHASE CURRENT
1283.9	AMPS	22 BUS AVG. A PHASE CURRENT
4.4	AMPS	1 RSA TO 22 A PHASE AVG. CURRENT
3.1	AMPS	2 RSA TO 21 A PHASE AVG. CURRENT
7.2	INCHES	2 AVG. CONDENSOR DIFF/PRESS
114.7/	112.8	2 AVG. N/S NOX PPM
18.5/	45.5	2 AVG. N/S CO PPM
116.5/	124.5	2 AVG. N/ S DEWPOINT
8.2/	10.0	2 AVG. N/S H20 %
7.6/	6.6	2 AVG. N/S O2 %
0.406/	0.390	2 AVG. N/S SO2 #/MBTU
0.0	SCFH	2 INT. TOTAL BURNER FUEL GAS FLOW
0.1	GPM	2 INT. TOTAL BURNER FUEL OIL FLOW

RAMSEY COAL SCALE VALUES

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Value	Units	Description	Total		
50.7	#/CUFT	21CELL DENSITY			
55.6	#/CUFT	22CELL DENSITY			
57.3	#/CUFT	23CELL DENSITY			
52.1	#/CUFT	24CELL DENSITY			
11.7	TPH	21CELL SCALE	11381	.1	TON TOTAL
13.5	TPH	22CELL SCALE	19724	.1	TON TOTAL
13.4	TPH	23CELL SCALE	20028	.1	TON TOTAL
10.7	TPH	24CELL SCALE	9869	.1	TON TOTAL

2FWP	2091.8	PSIG	2 AVG. FEEDWATER PRESS
2MWH	85.0	MEG W	2 INT. GROSS MEGAWATTS
2FFH	696.8	K #/HR	2 INT. FEEDWATER FLOW
2FWT	437.9	DEG F	2 AVG. FEEDWTR TO ECON TEMP
2MSP	851.4	PSIG	2 AVG. FINAL STEAM PRESS
2MST	996.5	DEG F	2 AVG. FINAL STEAM TEMP
2ATT	303.5	DEG F	2 AVG. ATTEMP INLET FW TEMP
2AFH	3.4	K #/HR	2 INT. TOTAL ATTEMP FLOW
2BPH	29.5	INCHES	AVG. PLANT BAROMETRIC PRESS
2CVP	28.0	INCHES	2 AVG. CONDENSER VACUUM
2CWP			
2CIT	40.6	DEG F	21 AVG. CIRC WATER INLET TEMP
OR	39.0	DEG F	22 AVG. CIRC WATER INLET TEMP
2COT	59.0	DEG F	2 AVG. CIRC WATER OUTLET TEMP
2HWT	76.4	DEG F	2 AVG. HOTWELL OUTLET TEMP
	1.00	HOURS	2 INT. GEN. ON-LINE % HOUR
	987.9	DEG F	2 AVG. THROTTLE STEAM TEMP
	673.8	K #/HR	2 INT. FINAL STEAM FLOW
	0.0	K #/HR	2 INT. TURB BYPASS STEAM FLOW
	3.3	K #/HR	2 INT. A NORMAL SPRAY FLOW
	0.0	K #/HR	2 INT. B NORMAL SPRAY FLOW
	3.4	K #/HR	2 INT. A+B SPRAY FLOW
	0.0	K #/HR	2 INT. EMERGENCY SPRAY FLOW
	1471.9	PSIG	2 AVG. DRUM PRESSURE

77.0	MEG W	2 INT. NET MEGAWATTS
13.7	KVOLTS	2 AVG. GENERATOR AB PHASE
35.9	M-VARS	2 AVG. GENERATOR VARS
3834.8	AMPS	2 AVG. GENERATOR B PHASE
6.6	AMPS	2 AVG. EXCITER CURRENT
8.1	MEG W	21 INT. X+Y STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA TO 2 INT. MEGAWATTS
7.9	MEG W	2 TOTAL STATION USE AUX + RSA INT
1172.9	AMPS	21 BUS AVG. A PHASE CURRENT
1225.9	AMPS	22 BUS AVG. A PHASE CURRENT
4.4	AMPS	1 RSA TO 22 A PHASE AVG. CURRENT
3.1	AMPS	2 RSA TO 21 A PHASE AVG. CURRENT
7.2	INCHES	2 AVG. CONDENSOR DIFF/PRESS
109.8/	109.1	2 AVG. N/S NOX PPM
22.5/	48.6	2 AVG. N/S CO PPM
114.1/	123.9	2 AVG. N/ S DEWPOINT
7.7/	9.9	2 AVG. N/S H20 %
7.6/	6.6	2 AVG. N/S 02 %
0.376/	0.362	2 AVG. N/S S02 #/MBTU
0.0	SCFH	2 INT. TOTAL BURNER FUEL GAS FLOW
0.1	GPM	2 INT. TOTAL BURNER FUEL OIL FLOW

RAMSEY COAL SCALE VALUES

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49.9	#/CUFT	21CELL DENSITY	
55.5	#/CUFT	22CELL DENSITY	
56.2	#/CUFT	23CELL DENSITY	
50.6	#/CUFT	24CELL DENSITY	
11.6	TPH	21CELL SCALE	11499 .1 TON TOTAL
13.6	TPH	22CELL SCALE	19859 .1 TON TOTAL
13.3	TPH	23CELL SCALE	20164 .1 TON TOTAL
11.1	TPH	24CELL SCALE	9974 .1 TON TOTAL

2FWP	2095.8	PSIG	2 AVG. FEEDWATER PRESS
2MWH	85.1	MEG W	2 INT. GROSS MEGAWATTS
2FFH	689.4	K #/HR	2 INT. FEEDWATER FLOW
2FWT	438.0	DEG F	2 AVG. FEEDWTR TO ECON TEMP
2MSP	851.7	PSIG	2 AVG. FINAL STEAM PRESS
2MST	995.1	DEG F	2 AVG. FINAL STEAM TEMP
2ATT	303.6	DEG F	2 AVG. ATTEMP INLET FW TEMP
2AFH	3.2	K #/HR	2 INT. TOTAL ATTEMP FLOW
2BPH	29.5	INCHES	AVG. PLANT BAROMETRIC PRESS
2CVP	28.0	INCHES	2 AVG. CONDENSER VACUUM
2CWP			
2CIT	40.6	DEG F	21 AVG. CIRC WATER INLET TEMP
OR	38.9	DEG F	22 AVG. CIRC WATER INLET TEMP
2COT	59.1	DEG F	2 AVG. CIRC WATER OUTLET TEMP
2HWT	76.5	DEG F	2 AVG. HOTWELL OUTLET TEMP
	1.00	HOURS	2 INT. GEN. ON-LINE % HOUR
	986.5	DEG F	2 AVG. THROTTLE STEAM TEMP
	674.4	K #/HR	2 INT. FINAL STEAM FLOW
	0.0	K #/HR	2 INT. TURB BYPASS STEAM FLOW
	3.2	K #/HR	2 INT. A NORMAL SPRAY FLOW
	0.0	K #/HR	2 INT. B NORMAL SPRAY FLOW
	3.2	K #/HR	2 INT. A+B SPRAY FLOW
	0.0	K #/HR	2 INT. EMERGENCY SPRAY FLOW
	1471.7	PSIG	2 AVG. DRUM PRESSURE

77.0	MEG W	2 INT. NET MEGAWATTS
13.8	KVOLTS	2 AVG. GENERATOR AB PHASE
43.4	M-VARS	2 AVG. GENERATOR VARS
3953.5	AMPS	2 AVG. GENERATOR B PHASE
6.9	AMPS	2 AVG. EXCITER CURRENT
8.1	MEG W	21 INT. X+Y STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA TO 2 INT. MEGAWATTS
7.9	MEG W	2 TOTAL STATION USE AUX + RSA INT
1172.2	AMPS	21 BUS AVG. A PHASE CURRENT
1225.1	AMPS	22 BUS AVG. A PHASE CURRENT
4.4	AMPS	1 RSA TO 22 A PHASE AVG. CURRENT
3.1	AMPS	2 RSA TO 21 A PHASE AVG. CURRENT
7.3	INCHES	2 AVG. CONDENSOR DIFF/PRESS
112.9/	111.8	2 AVG. N/S NOX PPM
27.8/	50.8	2 AVG. N/S CO PPM
113.6/	124.1	2 AVG. N/ S DEWPOINT
7.5/	10.0	2 AVG. N/S H2O %
7.6/	6.6	2 AVG. N/S O2 %
0.355/	0.353	2 AVG. N/S SO2 #/MBTU
0.0	SCFH	2 INT. TOTAL BURNER FUEL GAS FLOW
0.1	GPM	2 INT. TOTAL BURNER FUEL OIL FLOW

RAMSEY COAL SCALE VALUES

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51.3	#/CUFT	21CELL DENSITY
57.0	#/CUFT	22CELL DENSITY
56.1	#/CUFT	23CELL DENSITY
39.2	#/CUFT	24CELL DENSITY
11.7	TPH	21CELL SCALE 11616 .1 TON TOTAL
13.8	TPH	22CELL SCALE 19999 .1 TON TOTAL
13.4	TPH	23CELL SCALE 20299 .1 TON TOTAL
10.2	TPH	24CELL SCALE 10069 .1 TON TOTAL

2 HOURLY — UNIT 2 HOURLY LOG — 12:04:18 — 1/31/92

2FWP	2091.3	PSIG	2 AVG. FEEDWATER PRESS
2MWH	85.1	MEG W	2 INT. GROSS MEGAWATTS
2FFH	697.9	K #/HR	2 INT. FEEDWATER FLOW
2FWT	438.0	DEG F	2 AVG. FEEDWTR TO ECON TEMP
2MSP	853.3	PSIG	2 AVG. FINAL STEAM PRESS
2MST	990.4	DEG F	2 AVG. FINAL STEAM TEMP
2ATT	304.0	DEG F	2 AVG. ATTEMP INLET FW TEMP
2AFH	3.2	K #/HR	2 INT. TOTAL ATTEMP FLOW
2BPH	29.5	INCHES	AVG. PLANT BAROMETRIC PRESS
2CVP	28.0	INCHES	2 AVG. CONDENSER VACUUM
2CWP			
2CIT	40.7	DEG F	21 AVG. CIRC WATER INLET TEMP
OR	39.0	DEG F	22 AVG. CIRC WATER INLET TEMP
2COT	59.1	DEG F	2 AVG. CIRC WATER OUTLET TEMP
2HWT	76.5	DEG F	2 AVG. HOTWELL OUTLET TEMP
	1.00	HOURS	2 INT. GEN. ON-LINE % HOUR
	982.1	DEG F	2 AVG. THROTTLE STEAM TEMP
	677.7	K #/HR	2 INT. FINAL STEAM FLOW
	0.0	K #/HR	2 INT. TURB BYPASS STEAM FLOW
	3.2	K #/HR	2 INT. A NORMAL SPRAY FLOW
	0.0	K #/HR	2 INT. B NORMAL SPRAY FLOW
	3.2	K #/HR	2 INT. A+B SPRAY FLOW
	0.0	K #/HR	2 INT. EMERGENCY SPRAY FLOW
	1472.0	PSIG	2 AVG. DRUM PRESSURE

77.0	MEG W	2 INT. NET MEGAWATTS
13.9	KVOLTS	2 AVG. GENERATOR AB PHASE
44.5	M-VARS	2 AVG. GENERATOR VARS
3951.6	AMPS	2 AVG. GENERATOR B PHASE
6.9	AMPS	2 AVG. EXCITER CURRENT
8.1	MEG W	21 INT. X+Y STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA TO 2 INT. MEGAWATTS
7.9	MEG W	2 TOTAL STATION USE AUX + RSA INT
1171.9	AMPS	21 BUS AVG. A PHASE CURRENT
1225.2	AMPS	22 BUS AVG. A PHASE CURRENT
4.4	AMPS	1 RSA TO 22 A PHASE AVG. CURRENT
3.1	AMPS	2 RSA TO 21 A PHASE AVG. CURRENT
7.2	INCHES	2 AVG. CONDENSOR DIFF/PRESS
113.6/	107.9	2 AVG. N/S NOX PPM
13.5/	45.2	2 AVG. N/S CO PPM
116.4/	127.4	2 AVG. N/ S DEWPOINT
8.1/	10.8	2 AVG. N/S H20 %
7.5/	6.5	2 AVG. N/S 02 %
0.346/	0.324	2 AVG. N/S S02 #/MBTU
0.0	SCFH	2 INT. TOTAL BURNER FUEL GAS FLOW
0.1	GPM	2 INT. TOTAL BURNER FUEL OIL FLOW

RAMSEY COAL SCALE VALUES

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49.0	#/CUFT	21CELL DENSITY	
58.2	#/CUFT	22CELL DENSITY	
56.0	#/CUFT	23CELL DENSITY	
50.7	#/CUFT	24CELL DENSITY	
11.8	TPH	21CELL SCALE	11734 .1 TON TOTAL
13.9	TPH	22CELL SCALE	20138 .1 TON TOTAL
13.4	TPH	23CELL SCALE	20432 .1 TON TOTAL
11.1	TPH	24CELL SCALE	10185 .1 TON TOTAL

2 HOURLY UNIT 2 HOURLY LOG 13:04:17 1/31/92

2FWP	2081.3	PSIG	2 AVG. FEEDWATER PRESS
2MWH	85.5	MEG W	2 INT. GROSS MEGAWATTS
2FFH	705.5	K #/HR	2 INT. FEEDWATER FLOW
2FWT	438.3	DEG F	2 AVG. FEEDWTR TO ECON TEMP
2MSP	857.0	PSIG	2 AVG. FINAL STEAM PRESS
2MST	991.8	DEG F	2 AVG. FINAL STEAM TEMP
2ATT	304.3	DEG F	2 AVG. ATTEMP INLET FW TEMP
2AFH	3.2	K #/HR	2 INT. TOTAL ATTEMP FLOW
2BPH	29.5	INCHES	AVG. PLANT BAROMETRIC PRESS
2CVP	28.0	INCHES	2 AVG. CONDENSER VACUUM
2CWP			
2CIT	40.7	DEG F	21 AVG. CIRC WATER INLET TEMP
OR	39.1	DEG F	22 AVG. CIRC WATER INLET TEMP
2COT	59.3	DEG F	2 AVG. CIRC WATER OUTLET TEMP
2HWT	76.4	DEG F	2 AVG. HOTWELL OUTLET TEMP
	1.00	HOURS	2 INT. GEN. ON-LINE % HOUR
	983.6	DEG F	2 AVG. THROTTLE STEAM TEMP
	681.0	K #/HR	2 INT. FINAL STEAM FLOW
	0.0	K #/HR	2 INT. TURB BYPASS STEAM FLOW
	3.2	K #/HR	2 INT. A NORMAL SPRAY FLOW
	0.0	K #/HR	2 INT. B NORMAL SPRAY FLOW
	3.2	K #/HR	2 INT. A+B SPRAY FLOW
	0.0	K #/HR	2 INT. EMERGENCY SPRAY FLOW
	1471.8	PSIG	2 AVG. DRUM PRESSURE

77.5	MEG W	2 INT. NET MEGAWATTS
13.9	KVOLTS	2 AVG. GENERATOR AB PHASE
42.0	M-VARS	2 AVG. GENERATOR VARS
3913.5	AMPS	2 AVG. GENERATOR B PHASE
6.9	AMPS	2 AVG. EXCITER CURRENT
8.1	MEG W	21 INT. X+Y STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA TO 2 INT. MEGAWATTS
7.9	MEG W	2 TOTAL STATION USE AUX + RSA INT
1167.2	AMPS	21 BUS AVG. A PHASE CURRENT
1223.2	AMPS	22 BUS AVG. A PHASE CURRENT
4.4	AMPS	1 RSA TO 22 A PHASE AVG. CURRENT
3.1	AMPS	2 RSA TO 21 A PHASE AVG. CURRENT
7.2	INCHES	2 AVG. CONDENSOR DIFF/PRESS
115.2/	113.4	2 AVG. N/S NOX PPM
12.9/	41.1	2 AVG. N/S CO PPM
116.5/	126.8	2 AVG. N/ S DEWPOINT
8.1/	10.7	2 AVG. N/S H20 %
7.5/	6.5	2 AVG. N/S 02 %
0.358/	0.341	2 AVG. N/S S02 #/MBTU
0.0	SCFH	2 INT. TOTAL BURNER FUEL GAS FLOW
0.1	GPM	2 INT. TOTAL BURNER FUEL OIL FLOW

RAMSEY COAL SCALE VALUES

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51.9	#/CUFT	21CELL DENSITY	
58.1	#/CUFT	22CELL DENSITY	
56.7	#/CUFT	23CELL DENSITY	
51.8	#/CUFT	24CELL DENSITY	
11.7	TPH	21CELL SCALE	11852 .1 TON TOTAL
13.9	TPH	22CELL SCALE	20278 .1 TON TOTAL
13.5	TPH	23CELL SCALE	20567 .1 TON TOTAL
11.1	TPH	24CELL SCALE	10296 .1 TON TOTAL

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2FWP  2089.8  PSIG    2 AVG. FEEDWATER PRESS          77.4    MEG W    2 INT. NET MEGAWATTS
                                                      13.9    KVOLTS   2 AVG. GENERATOR AB PHASE
2MWH    85.6  MEG W   2 INT. GROSS MEGAWATTS          44.2    M-VARS   2 AVG. GENERATOR VARS
                                                    3955.1    AMPS     2 AVG. GENERATOR B PHASE
2FFH   698.6  K #/HR  2 INT. FEEDWATER FLOW
                                                       7.0    AMPS     2 AVG. EXCITER CURRENT
2FWT   438.4  DEG F   2 AVG. FEEDWTR TO ECON TEMP
                                                       8.1    MEG W    21 INT. X+Y STATION AUX MEGAWATTS
2MSP   857.8  PSIG    2 AVG. FINAL STEAM PRESS        -0.2    MEG W    1+2 RSA TO 2 INT. MEGAWATTS
                                                       7.9    MEG W    2 TOTAL STATION USE AUX + RSA INT
2MST   991.3  DEG F   2 AVG. FINAL STEAM TEMP       1168.1    AMPS     21 BUS AVG. A PHASE CURRENT
                                                    1233.9    AMPS     22 BUS AVG. A PHASE CURRENT
2ATT   304.3  DEG F   2 AVG. ATTEMP INLET FW TEMP      4.4    AMPS     1 RSA TO 22 A PHASE AVG. CURRENT
                                                       3.1    AMPS     2 RSA TO 21 A PHASE AVG. CURRENT
2AFH     3.2  K #/HR  2 INT. TOTAL ATTEMP FLOW
                                                       7.3    INCHES   2 AVG. CONDENSOR DIFF/PRESS
2BPH    29.5  INCHES  AVG. PLANT BAROMETRIC PRESS

2CVP    28.0  INCHES  2 AVG. CONDENSER VACUUM        113.1/ 111.0     2 AVG. N/S NOX PPM
                                                      13.3/  42.1     2 AVG. N/S CO PPM
2CWP                                                 116.3/ 127.2     2 AVG. N/ S DEWPOINT
                                                       8.0/  10.8     2 AVG. N/S H20 %
2CIT    40.9  DEG F   21 AVG. CIRC WATER INLET TEMP    7.5/   6.5     2 AVG. N/S O2 %
  OR    39.1  DEG F   22 AVG. CIRC WATER INLET TEMP  0.374/ 0.338     2 AVG. N/S SO2 #/MBTU

2COT    59.4  DEG F   2 AVG. CIRC WATER OUTLET TEMP    0.0    SCFH     2 INT. TOTAL BURNER FUEL GAS FLOW
                                                       0.1    GPM      2 INT. TOTAL BURNER FUEL OIL FLOW
2HWT    76.5  DEG F   2 AVG. HOTWELL OUTLET TEMP
                                                              RAMSEY COAL SCALE VALUES
        1.00  HOURS   2 INT. GEN. ON-LINE % HOUR    @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
                                                      51.1    #/CUFT   21CELL DENSITY
       983.0  DEG F   2 AVG. THROTTLE STEAM TEMP      57.2    #/CUFT   22CELL DENSITY
       680.1  K #/HR  2 INT. FINAL STEAM FLOW         56.7    #/CUFT   23CELL DENSITY
         0.0  K #/HR  2 INT. TURB BYPASS STEAM FLOW   51.8    #/CUFT   24CELL DENSITY
         3.2  K #/HR  2 INT. A NORMAL SPRAY FLOW
         0.0  K #/HR  2 INT. B NORMAL SPRAY FLOW      11.8    TPH      21CELL SCALE   11969 .1 TON TOTAL
         3.2  K #/HR  2 INT. A+B SPRAY FLOW           13.9    TPH      22CELL SCALE   20417 .1 TON TOTAL
         0.0  K #/HR  2 INT. EMERGENCY SPRAY FLOW     13.4    TPH      23CELL SCALE   20702 .1 TON TOTAL
      1471.6  PSIG    2 AVG. DRUM PRESSURE            11.1    TPH      24CELL SCALE   10407 .1 TON TOTAL
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2 HOURLY UNIT 2 HOURLY LOG 15:04:18 1/31/92

Tag	Value	Units	Description
2FWP	2084.9	PSIG	2 AVG. FEEDWATER PRESS
2MWH	85.5	MEG W	2 INT. GROSS MEGAWATTS
2FFH	703.3	K #/HR	2 INT. FEEDWATER FLOW
2FWT	438.4	DEG F	2 AVG. FEEDWTR TO ECON TEMP
2MSP	856.6	PSIG	2 AVG. FINAL STEAM PRESS
2MST	990.2	DEG F	2 AVG. FINAL STEAM TEMP
2ATT	304.3	DEG F	2 AVG. ATTEMP INLET FW TEMP
2AFH	3.2	K #/HR	2 INT. TOTAL ATTEMP FLOW
2BPH	29.5	INCHES	AVG. PLANT BAROMETRIC PRESS
2CVP	28.0	INCHES	2 AVG. CONDENSER VACUUM
2CWP			
2CIT	40.8	DEG F	21 AVG. CIRC WATER INLET TEMP
OR	39.1	DEG F	22 AVG. CIRC WATER INLET TEMP
2COT	59.4	DEG F	2 AVG. CIRC WATER OUTLET TEMP
2HWT	76.6	DEG F	2 AVG. HOTWELL OUTLET TEMP
	1.00	HOURS	2 INT. GEN. ON-LINE % HOUR
	981.9	DEG F	2 AVG. THROTTLE STEAM TEMP
	679.3	K #/HR	2 INT. FINAL STEAM FLOW
	0.0	K #/HR	2 INT. TURB BYPASS STEAM FLOW
	3.2	K #/HR	2 INT. A NORMAL SPRAY FLOW
	0.0	K #/HR	2 INT. B NORMAL SPRAY FLOW
	3.2	K #/HR	2 INT. A+B SPRAY FLOW
	0.0	K #/HR	2 INT. EMERGENCY SPRAY FLOW
	1471.9	PSIG	2 AVG. DRUM PRESSURE

Value	Units	Description
77.4	MEG W	2 INT. NET MEGAWATTS
13.9	KVOLTS	2 AVG. GENERATOR AB PHASE
40.7	M-VARS	2 AVG. GENERATOR VARS
3881.0	AMPS	2 AVG. GENERATOR B PHASE
6.8	AMPS	2 AVG. EXCITER CURRENT
8.1	MEG W	21 INT. X+Y STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA TO 2 INT. MEGAWATTS
7.9	MEG W	2 TOTAL STATION USE AUX + RSA INT
1167.5	AMPS	21 BUS AVG. A PHASE CURRENT
1243.5	AMPS	22 BUS AVG. A PHASE CURRENT
4.4	AMPS	1 RSA TO 22 A PHASE AVG. CURRENT
3.1	AMPS	2 RSA TO 21 A PHASE AVG. CURRENT
7.3	INCHES	2 AVG. CONDENSOR DIFF/PRESS
108.4/ 112.7		2 AVG. N/S NOX PPM
16.1/ 50.7		2 AVG. N/S CO PPM
114.6/ 122.6		2 AVG. N/ S DEWPOINT
7.7/ 9.5		2 AVG. N/S H20 %
7.5/ 6.5		2 AVG. N/S 02 %
0.347/ 0.339		2 AVG. N/S S02 #/MBTU
0.0	SCFH	2 INT. TOTAL BURNER FUEL GAS FLOW
0.1	GPM	2 INT. TOTAL BURNER FUEL OIL FLOW

RAMSEY COAL SCALE VALUES

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Value	Units	Description	Total		
51.3	#/CUFT	21CELL DENSITY			
57.7	#/CUFT	22CELL DENSITY			
56.8	#/CUFT	23CELL DENSITY			
52.0	#/CUFT	24CELL DENSITY			
11.8	TPH	21CELL SCALE	12087	.1	TON TOTAL
13.9	TPH	22CELL SCALE	20556	.1	TON TOTAL
13.5	TPH	23CELL SCALE	20837	.1	TON TOTAL
11.2	TPH	24CELL SCALE	10516	.1	TON TOTAL

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2 HOURLY                          UNIT 2 HOURLY LOG                              16:04:18        1/31/92

2FWP  2087.2  PSIG     2 AVG. FEEDWATER PRESS            77.4   MEG W     2 INT. NET MEGAWATTS
                                                          13.9   KVOLTS    2 AVG. GENERATOR AB PHASE
2MWH    85.5  MEG W    2 INT. GROSS MEGAWATTS             39.2   M-VARS    2 AVG. GENERATOR VARS
                                                        3854.9   AMPS      2 AVG. GENERATOR B PHASE
2FFH   702.1  K #/HR   2 INT. FEEDWATER FLOW
                                                           6.7   AMPS      2 AVG. EXCITER CURRENT
2FWT   438.4  DEG F    2 AVG. FEEDWTR TO ECON TEMP
                                                           8.1   MEG W     21 INT. X+Y STATION AUX MEGAWATTS
2MSP   857.7  PSIG     2 AVG. FINAL STEAM PRESS           -0.2   MEG W     1+2 RSA TO 2 INT. MEGAWATTS
                                                           7.9   MEG W     2 TOTAL STATION USE AUX + RSA INT
2MST   985.4  DEG F    2 AVG. FINAL STEAM TEMP          1168.9   AMPS      21 BUS AVG. A PHASE CURRENT
                                                        1222.9   AMPS      22 BUS AVG. A PHASE CURRENT
2ATT   304.3  DEG F    2 AVG. ATTEMP INLET FW TEMP         4.4   AMPS      1 RSA TO 22 A PHASE AVG. CURRENT
                                                           3.1   AMPS      2 RSA TO 21 A PHASE AVG. CURRENT
2AFH     3.2  K #/HR   2 INT. TOTAL ATTEMP FLOW
                                                           7.3   INCHES    2 AVG. CONDENSOR DIFF/PRESS
2BPH    29.5  INCHES   AVG. PLANT BAROMETRIC PRESS

2CVP    28.0  INCHES   2 AVG. CONDENSER VACUUM       112.1/ 115.1     2 AVG. N/S NOX PPM
                                                      20.0/  57.6     2 AVG. N/S CO PPM
2CWP                                                 113.9/ 120.3     2 AVG. N/ S DEWPOINT
                                                       7.6/   9.0     2 AVG. N/S H20 %
2CIT    40.8  DEG F    21 AVG. CIRC WATER INLET TEMP   7.5/   6.5     2 AVG. N/S O2 %
  OR    39.1  DEG F    22 AVG. CIRC WATER INLET TEMP 0.341/ 0.328     2 AVG. N/S SO2 #/MBTU

2COT    59.3  DEG F    2 AVG. CIRC WATER OUTLET TEMP     0.0   SCFH      2 INT. TOTAL BURNER FUEL GAS FLOW
                                                          0.1   GPM       2 INT. TOTAL BURNER FUEL OIL FLOW
2HWT    76.5  DEG F    2 AVG. HOTWELL OUTLET TEMP
                                                               RAMSEY COAL SCALE VALUES
        1.00  HOURS    2 INT. GEN. ON-LINE % HOUR    @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
                                                          50.0   #/CUFT    21CELL DENSITY
      976.9  DEG F    2 AVG. THROTTLE STEAM TEMP         57.5   #/CUFT    22CELL DENSITY
      681.5  K #/HR   2 INT. FINAL STEAM FLOW            56.2   #/CUFT    23CELL DENSITY
        0.0  K #/HR   2 INT. TURB BYPASS STEAM FLOW      51.2   #/CUFT    24CELL DENSITY
        3.2  K #/HR   2 INT. A NORMAL SPRAY FLOW
        0.0  K #/HR   2 INT. B NORMAL SPRAY FLOW         11.8   TPH       21CELL SCALE   12205 .1 TON TOTAL
        3.2  K #/HR   2 INT. A+B SPRAY FLOW              13.9   TPH       22CELL SCALE   20696 .1 TON TOTAL
        0.0  K #/HR   2 INT. EMERGENCY SPRAY FLOW        13.5   TPH       23CELL SCALE   20972 .1 TON TOTAL
     1471.9  PSIG     2 AVG. DRUM PRESSURE               11.2   TPH       24CELL SCALE   10629 .1 TON TOTAL
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2 HOURLY   UNIT 2 HOURLY LOG   17:04:20   1/31/92

2FWP	2087.1	PSIG	2 AVG.	FEEDWATER PRESS
2MWH	85.5	MEG W	2 INT.	GROSS MEGAWATTS
2FFH	702.9	K #/HR	2 INT.	FEEDWATER FLOW
2FWT	438.4	DEG F	2 AVG.	FEEDWTR TO ECON TEMP
2MSP	858.2	PSIG	2 AVG.	FINAL STEAM PRESS
2MST	985.1	DEG F	2 AVG.	FINAL STEAM TEMP
2ATT	304.3	DEG F	2 AVG.	ATTEMP INLET FW TEMP
2AFH	3.2	K #/HR	2 INT.	TOTAL ATTEMP FLOW
2BPH	29.5	INCHES	AVG.	PLANT BAROMETRIC PRESS
2CVP	28.0	INCHES	2 AVG.	CONDENSER VACUUM
2CWP				
2CIT	40.8	DEG F	21 AVG.	CIRC WATER INLET TEMP
OR	39.0	DEG F	22 AVG.	CIRC WATER INLET TEMP
2COT	59.3	DEG F	2 AVG.	CIRC WATER OUTLET TEMP
2HWT	76.5	DEG F	2 AVG.	HOTWELL OUTLET TEMP
	1.00	HOURS	2 INT.	GEN. ON-LINE % HOUR
	976.4	DEG F	2 AVG.	THROTTLE STEAM TEMP
	681.8	K #/HR	2 INT.	FINAL STEAM FLOW
	0.0	K #/HR	2 INT.	TURB BYPASS STEAM FLOW
	3.2	K #/HR	2 INT.	A NORMAL SPRAY FLOW
	0.0	K #/HR	2 INT.	B NORMAL SPRAY FLOW
	3.2	K #/HR	2 INT.	A+B SPRAY FLOW
	0.0	K #/HR	2 INT.	EMERGENCY SPRAY FLOW
	1472.0	PSIG	2 AVG.	DRUM PRESSURE

77.4	MEG W	2 INT.	NET MEGAWATTS
13.9	KVOLTS	2 AVG.	GENERATOR AB PHASE
39.1	M-VARS	2 AVG.	GENERATOR VARS
3853.4	AMPS	2 AVG.	GENERATOR B PHASE
6.7	AMPS	2 AVG.	EXCITER CURRENT
8.1	MEG W	21 INT.	X+Y STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA TO 2 INT.	MEGAWATTS
7.9	MEG W	2 TOTAL	STATION USE AUX + RSA INT
1168.0	AMPS	21 BUS AVG.	A PHASE CURRENT
1225.0	AMPS	22 BUS AVG.	A PHASE CURRENT
4.4	AMPS	1 RSA TO 22	A PHASE AVG. CURRENT
3.1	AMPS	2 RSA TO 21	A PHASE AVG. CURRENT
7.3	INCHES	2 AVG.	CONDENSOR DIFF/PRESS
113.3/	116.3	2 AVG.	N/S NOX PPM
17.8/	54.3	2 AVG.	N/S CO PPM
114.6/	123.4	2 AVG.	N/ S DEWPOINT
7.8/	9.7	2 AVG.	N/S H20 %
7.5/	6.5	2 AVG.	N/S O2 %
0.370/	0.353	2 AVG.	N/S SO2 #/MBTU
0.0	SCFH	2 INT.	TOTAL BURNER FUEL GAS FLOW
0.1	GPM	2 INT.	TOTAL BURNER FUEL OIL FLOW

RAMSEY COAL SCALE VALUES

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51.7	#/CUFT	21CELL DENSITY	
57.4	#/CUFT	22CELL DENSITY	
55.9	#/CUFT	23CELL DENSITY	
52.7	#/CUFT	24CELL DENSITY	
11.9	TPH	21CELL SCALE	12324 .1 TON TOTAL
13.7	TPH	22CELL SCALE	20833 .1 TON TOTAL
13.5	TPH	23CELL SCALE	21109 .1 TON TOTAL
11.0	TPH	24CELL SCALE	10737 .1 TON TOTAL

2 HOURLY — UNIT 2 HOURLY LOG — 18:04:18 — 1/31/92

2FWP	2085.9	PSIG	2 AVG. FEEDWATER PRESS
2MWH	85.5	MEG W	2 INT. GROSS MEGAWATTS
2FFH	704.9	K #/HR	2 INT. FEEDWATER FLOW
2FWT	438.3	DEG F	2 AVG. FEEDWTR TO ECON TEMP
2MSP	858.3	PSIG	2 AVG. FINAL STEAM PRESS
2MST	986.5	DEG F	2 AVG. FINAL STEAM TEMP
2ATT	304.3	DEG F	2 AVG. ATTEMP INLET FW TEMP
2AFH	3.2	K #/HR	2 INT. TOTAL ATTEMP FLOW
2BPH	29.5	INCHES	AVG. PLANT BAROMETRIC PRESS
2CVP	28.0	INCHES	2 AVG. CONDENSER VACUUM
2CWP			
2CIT	40.7	DEG F	21 AVG. CIRC WATER INLET TEMP
OR	39.0	DEG F	22 AVG. CIRC WATER INLET TEMP
2COT	59.3	DEG F	2 AVG. CIRC WATER OUTLET TEMP
2HWT	76.5	DEG F	2 AVG. HOTWELL OUTLET TEMP
	1.00	HOURS	2 INT. GEN. ON-LINE % HOUR
	977.8	DEG F	2 AVG. THROTTLE STEAM TEMP
	683.3	K #/HR	2 INT. FINAL STEAM FLOW
	0.0	K #/HR	2 INT. TURB BYPASS STEAM FLOW
	3.2	K #/HR	2 INT. A NORMAL SPRAY FLOW
	0.0	K #/HR	2 INT. B NORMAL SPRAY FLOW
	3.2	K #/HR	2 INT. A+B SPRAY FLOW
	0.0	K #/HR	2 INT. EMERGENCY SPRAY FLOW
	1472.0	PSIG	2 AVG. DRUM PRESSURE

77.3	MEG W	2 INT. NET MEGAWATTS
13.9	KVOLTS	2 AVG. GENERATOR AB PHASE
46.8	M-VARS	2 AVG. GENERATOR VARS
4007.6	AMPS	2 AVG. GENERATOR B PHASE
7.1	AMPS	2 AVG. EXCITER CURRENT
8.1	MEG W	21 INT. X+Y STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA TO 2 INT. MEGAWATTS
8.0	MEG W	2 TOTAL STATION USE AUX + RSA INT
1171.0	AMPS	21 BUS AVG. A PHASE CURRENT
1228.1	AMPS	22 BUS AVG. A PHASE CURRENT
4.4	AMPS	1 RSA TO 22 A PHASE AVG. CURRENT
3.0	AMPS	2 RSA TO 21 A PHASE AVG. CURRENT
7.3	INCHES	2 AVG. CONDENSOR DIFF/PRESS
106.8/	113.2	2 AVG. N/S NOX PPM
13.7/	52.1	2 AVG. N/S CO PPM
115.8/	125.6	2 AVG. N/ S DEWPOINT
8.0/	10.3	2 AVG. N/S H2O %
7.5/	6.5	2 AVG. N/S O2 %
0.333/	0.326	2 AVG. N/S SO2 #/MBTU
0.0	SCFH	2 INT. TOTAL BURNER FUEL GAS FLOW
0.1	GPM	2 INT. TOTAL BURNER FUEL OIL FLOW

RAMSEY COAL SCALE VALUES

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51.6	#/CUFT	21CELL DENSITY	
57.3	#/CUFT	22CELL DENSITY	
56.8	#/CUFT	23CELL DENSITY	
51.2	#/CUFT	24CELL DENSITY	
12.0	TPH	21CELL SCALE	12444 .1 TON TOTAL
13.7	TPH	22CELL SCALE	20972 .1 TON TOTAL
13.7	TPH	23CELL SCALE	21246 .1 TON TOTAL
11.1	TPH	24CELL SCALE	10848 .1 TON TOTAL

APPENDIX F

PROCEDURES

4500 BALL ROAD N.E.
CIRCLE PINES, MN 55014-1819
(612) 786-6020

11/7188

APPENDIX A

METHODOLOGY FOR THE DETERMINATION OF METALS EMISSIONS IN EXHAUST GASES FROM STATIONARY SOURCE COMBUSTION PROCESSES

1. Applicability and Principle

1.1 Applicability. This method is applicable for the determination of total chromium (Cr), cadmium (Cd), arsenic (As), nickel (Ni), manganese (Mn), beryllium (Be), copper (Cu), zinc (Zn), lead (Pb), selenium (Se), phosphorus (P), thallium (Tl), silver (Ag), antimony (Sb), barium (Ba), and mercury (Hg) emissions from municipal waste incinerators, sewage sludge incinerators, and hazardous waste incinerators. This method may also be used for the determination of particulate emissions following the additional procedures described. Modifications to the sample recovery and analysis procedures described in this protocol for the purpose of determining particulate emissions may potentially impact the front half mercury determination.*

1.2 Principle. Particulate and gaseous metal emissions are withdrawn isokinetically from the source and collected on a heated filter, and in a series of chilled impingers containing a solution of dilute nitric acid in hydrogen peroxide in two impingers, and acidic potassium permanganate solution in two (or one) impingers. Sampling train components are recovered and digested in separate front and back half fractions. Materials collected in the sampling train are digested with acid solutions to dissolve inorganics and to remove organic constituents that may create analytical interferences. Acid digestion is performed using conventional Parr^{R} Bomb or microwave digestion techniques. The nitric acid and hydrogen peroxide impinger solution, the acidic potessium permanganate impinger solution, and the probe rinse and digested filter solutions are analyzed for mercury by cold vapor atomic absorption spectroscopy (CVAAS). Except for the permanganate solution, the

*Field tests to date have shown that of the total amount of mercury measured by the method, only 0 to <2% was measured in the front half. Therefore, it is tentatively concluded, based on the above data, that particulate emissions may be measured by this train, without significantly altering the mercury results.

This document is a preliminary draft. It has not been formally released by EPA and should not at this stage be construed to represent Agency policy. It is being circulated for comment on its technical accuracy and policy implications

remainder of the sampling train catches are analyzed for Cr, Cd, Ni, Mn, Be, Cu, Zn, Pb, Se, P, Tl, Ag, Sb, Ba, and As by inductively coupled argon plasma emission spectroscopy (ICAP) or atomic absorption spectroscopy (AAS). Graphite furnace atomic absorption spectroscopy (GFAAS) is used for analysis of antimony, arsenic, cadmium, lead, selenium, and thallium, if these elements require greater analytical sensitivity than can be obtained by ICAP. Additionally, if desired, the tester may use AAS for analyses of all metals if the detection limits meet the goal of the testing program. For convenience, aliquots of each digested sample fraction can be combined proportionally for a single analytical determination. The efficiency of the analytical procedure is quantified by the analysis of spiked quality control samples containing each of the target metals including actual sample matrix effects checks.

2. Range, Sensitivity, Precision, and Interferences

2.1 Range. For the analyses described in this methodology and for similar analyses, the ICAP response is linear over several orders of magnitude. Samples containing metal concentrations in the nanograms per milliliter (ng/ml) to micrograms per milliliter (ug/ml) range in the analytical finish solution can be analyzed using this technique. Samples containing greater than approximately 50 ug/ml of chromium, lead, or arsenic should be diluted before analysis. Samples containing greater than approximately 20 ug/ml of cadmium should be diluted before analysis.

2.2 Analytical Sensitivity. ICAP detection limits in the analytical solution (based on SW-846, Method 6010) are approximately as follows: Sb (32 ng/ml), As (53 ng/ml), Ba (2 ng/ml), Be (0.3 ng/ml), Cd (4 ng/ml), Cr (7 ng/ml), Cu (6 ng/ml), Pb (42 ng/ml), Mn (2 ng/ml), Ni (15 ng/ml), P (75 ng/ml), Se (75 ng/ml), Ag (7 ng/ml), Ti (40 ng/ml), and Zn (2 ng/ml). The actual method detection limits are sample dependent and may vary as the sample matrix may affect the limits. The detection limits for analysis by direct aspiration AAS (based on SW-846, Method 7000) are approximately as follows: Sb (200 ng/ml), As (2 ng/ml), Ba (100 ng/ml), Be (5 ng/ml), Cd (5 ng/ml), Cr (50 ng/ml), Cu (20 ng/ml), Pb (100 ng/ml), Mn (10 ng/ml), Ni (40 ng/ml), Se (2 ng/ml), Ag (10 ng/ml), Tl (100 ng/ml), and Zn (5 ng/ml). The detection limit for mercury by CVAAS is approximately 0.2 ng/ml. The use of GFAAS can give added sensitivity compared to the use of direct aspiration AAS for the following metals: Sb (3 ng/ml), As (1 ng/ml), Be (0.2 ng/ml), Cd (0.1 ng/ml),

Cr (1 ng/ml), Pb (1 ng/ml), Se (2 ng/ml), and Tl (1 ng/ml). To ensure the possibility of optimum ease in obtaining accurate measurements, the concentration of target metals in samples should be at least ten times the detection limit. Under certain conditions, and with greater care in the analytical procedure, this concentration can be as low as approximately three times the detection limit. However, the scatter of such data may render them unacceptable or may require many analyses before the desired reliability of analytical data is obtained.

Using the procedures described in this method, the theoretical analytical detection limits shown above, a volume of 300 ml for the front half and 150 ml for the back half samples, and a stack gas sample volume of 1.25 m^3, the corresponding in-stack detection limits are presented in Table A-1 and calculated as shown:

$$\frac{A \times B}{C} = D$$

where: A = analytical detection limit, ug/ml.
B = volume of sample prior to aliquot for analysis, ml.
C = stack sample volume, dscm, m^3.
D = in-stack detection limit, ug/m^3.

Values in Table A-1 are calculated for the front and back half and/or the total train.

Actual method in-stack detection limits are based on actual test values. If required, this method's in-stack detection limits listed can be improved for a specific test by using one or more of the following options:

- A normal 1-hour sampling run collects a stack gas sampling volume of about 1.25 m^3. If the sampling time is increased and 5 m^3 is collected, the in-stack method detection limits would be one fourth of the values shown above (this means that with this change, the method is four times more sensitive than normal).
- The in-stack detection limits assume that all of the sample is digested (with exception of the aliquot for mercury) and the final liquid volume for analysis is 300 ml for the front half and 150 ml for the back half sample. If the front half volume is reduced from 300 ml to 30 ml, the front half in-stack detection limits would be one tenth of the values shown above (ten times more sensitive). If the back half volume is reduced from 150 ml to 25 ml the in-stack detection limits would be one sixth of the above values. Matrix effects checks are necessary on

TABLE A-1. IN-STACK METHOD DETECTION LIMITS (ug/m^3)
FOR TRAIN FRACTIONS USING ICAP AND AAS

Metal	Front Half Fraction 1 Probe and Filter	Back Half$_1$ Fraction 2 Impingers 1-3	Back Half$_2$ Fraction 3 Impingers 4-5	Total Train
Antimony	7.7 (0.7)*	3.8 (0.4)*		11.5 (1.1)*
Arsenic	12.7 (0.3)*	6.4 (0.1)*		19.1 (0.4)*
Barium	0.5	0.3		0.8
Beryllium	0.07 (0.05)*	0.04 (0.03)*		0.11 (0.08)*
Cadmium	1.0 (0.02)*	0.5 (0.01)*		1.5 (0.3)*
Chromium	1.7 (0.2)*	0.8 (0.1)*		2.5 (0.3)*
Copper	1.4	0.7		2.1
Lead	10.1 (0.2)*	5.0 (0.1)*		15.1 (0.3)*
Manganese	0.5 (0.2)*	0.2 (0.1)*		0.7 (0.3)*
Mercury	0.05**	0.03**	0.03**	0.11**
Nickel	3.6	1.8		5.4
Phosphorus	18	9		27
Selenium	18 (0.5)*	9 (0.3)*		27 (0.8)*
Silver	1.7	0.9		2.6
Thallium	9.6 (0.2)*	4.8 (0.1)*		14.4 (0.3)*
Zinc	0.5	0.3		0.8

( )* Detection limit when analyzed by GFAAS.
** Detection limit when analyzed by CVAAS.
Actual method in-stack detection limits are based on actual test values.

analyses of samples and typically are of greater significance for samples that have been concentrated below the normal sample volume. A volume less than 25 ml may not allow resolubilization of the residue and may increase interference by other compounds.

- When both of the above two improvements are used on one sample at the same time, the resultant improvements are multiplicative. For example, where stack gas volume is increased by a factor of five and the total liquid sample digested volume of both the front and back halves is reduced by factor of six, the in-stack method detection limit is reduced by a factor of thirty (the method is thirty times more sensitive).
- Conversely, reducing stack gas sample volume and increasing sample liquid volume will increase limits. The front half and back half$_1$ samples (Fractions 1 and 2) can be combined prior to analysis. The resultant liquid volume (excluding Fraction 3 which must be analyzed separately) is recorded. Combining the sample as described does not allow determination (whether front or back half$_1$) of where in the train

the sample was captured. The in-stack method detection limit then becomes a single value for all metals, except mercury for which the contribution of Fraction 3 must be considered.

- o The above discussion assumes no blank correction. Blank corrections are discussed later in this method.

2.3 Precision. The precisions (relative standard deviation) for each metal detected in a method development test at a sewage sludge incinerator, are as follows: Sb (13.9%), As (13.5%), Ba (13.1%), Cd (11.5%), Cr (12.5%), Cu (11.9%), Pb (11.6%), Ni (7.7%), P (13.5%), Se (15.3%), Tl (12.3%), and Zn (11.8%). Beryllium, manganese and silver were not detected in the tests; however, based on the analytical sensitivity of the ICAP for these metals, it is assumed that their precisions should be similiar to those for the other metals.

2.4 Interferences. Iron can be a spectral interference during the analysis of arsenic, chromium, and cadmium by ICAP. Aluminum can be a spectral interference during the analysis of arsenic and lead by ICAP. Generally, these interferences can be reduced by diluting the sample, but this increases the method detection limit. Refer to EPA Method 6010 (SW-846) for details on potential interferences for this method. For all GFAAS analyses, matrix modifiers should be used to limit interferences, and standards should be matrix matched.

3. Apparatus

3.1 Sampling Train. A schematic of the sampling train is shown in Figure A-1. It is similar to the Method 5 train. The sampling train consists of the following components.

3.1.1 Probe Nozzle (Probe Tip) and Borosilicate or Quartz Glass Probe Liner. Same as Method 5, Sections 2.1.1 and 2.1.2. Glass nozzles are required unless an alternate probe tip prevents the possibility of contamination or interference of the sample with its materials of construction. If a probe tip other than glass is used, no correction of the stack sample test results can be made because of the effect on the results by the probe tip.

3.1.2 Pitot Tube and Differential Pressure Gauge. Same as Method 2, Sections 2.1 and 2.2, respectively.

3.1.3 Filter Holder. Glass, same as Method 5, Section 2.1.5, except that a Teflon filter support may be used, if desired, to replace the glass frit.

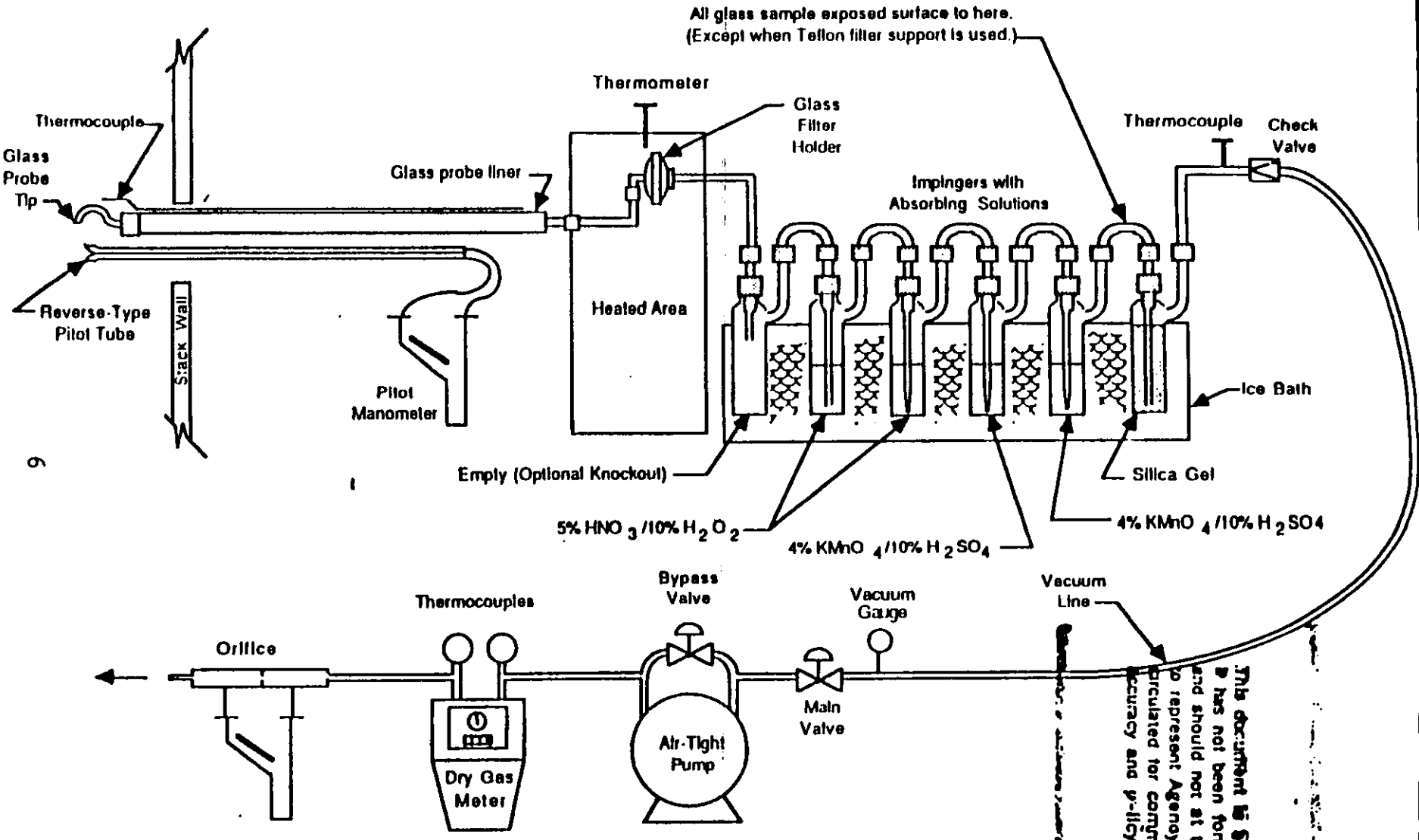

Figure A-1. Schematic of multiple metals sampling train.

3.1.4 Filter Heating System. Same as Method 5, Section 2.1.6.

3.1.5 Condenser. The following system shall be used for the condensation and collection of gaseous metals and for determining the moisture content of the stack gas. The condensing system should consist of four to six impingers connected in series with leak-free ground glass fittings or other leak-free, non-contaminating fittings. The first impinger is optional and is recommended as a water knockout trap for use during test conditions which require such a trap. The impingers to be used in the metals train are now described. When the first impinger is used as a water knockout, it shall have a short stem. The second impinger (or the first HNO_3/H_2O_2 impinger) shall be as described for the first impinger in Method 5, Paragraph 2.1.7. The third impinger (or the impinger used as the second HNO_3/H_2O_2 impinger in any case) is the same as the Greenburg Smith impinger with the standard tip described as the second impinger in Method 5, Paragraph 2.1.7. All other impingers used in the metals train are the same as the second impinger previously described. The first impinger should be empty, the second and third shall contain known quantities of a nitric acid/hydrogen peroxide solution (Section 4.2.1), the fourth (and fifth, if required) shall contain a known quantity of acidic potassium permanganate solution (Section 4.2.2), and the last impinger shall contain a known quantity of silica gel or equivalent desiccant. A thermometer capable of measuring to within 1°C (2°F) shall be placed at the outlet of the last impinger. When the water knockout impinger is not needed, it is removed from the train and the other impingers remain the same. If mercury analysis is not needed, the potassium permanganate impingers are removed.

3.1.6 Metering System, Barometer, and Gas Density Determination Equipment. Same as Method 5, Sections 2.1.8 through 2.1.10, respectively.

3.2 Sample Recovery. The following items are needed for sample recovery:

3.2.1 Nonmetallic Probe Liner and Probe Nozzle Brushes, Wash Bottles, Sample Storage Containers, Petri Dishes, Graduated Cylinders, Plastic Storage Containers, Funnel and Rubber Policeman, and Glass Funnel. Same as Method 5, Sections 2.2.1 through 2.2.8, respectively.

3.2.2 Labels. For identification of samples.

3.2.3 Polypropylene Tweezers and/or Plastic Gloves. For recovery of the filter from the sampling train filter holder.

3.2.4 Nonmetallic Bristle Brush. For quantitative recovery of materials collected in the front half of the sampling train.

3.3 Sample Preparation and Analysis. For the analysis, the following equipment is needed:

3.3.1 Volumetric Flasks, 100 ml, 250 ml, and 1000 ml. For preparation of standards and sample dilution.

3.3.2 Graduated Cylinders. For preparation of reagents.

3.3.3 Parr^{R} Bombs or Microwave Pressure Relief Vessels with Capping Station (CEM Corporation model or equivalent).

3.3.4 Beakers and Watchglasses. 250 ml beakers for sample digestion with watchglasses to cover the tops.

3.3.5 Ring Stands and Clamps. For securing equipment such as filtration apparatus.

3.3.6 Filter Funnels. For holding filter paper.

3.3.7 Whatman 541 Filter Paper (or equivalent).For filtration of digested samples.

3.3.8 Disposable Pasteur Pipets and Bulbs.

3.3.9 Volumetric Pipets.

3.3.10 Analytical Balance. Accurate to within 0.1 mg.

3.3.11 Microwave or Conventional Oven. For heating samples at fixed power levels or temperatures.

3.3.12 Hot Plates.

3.3.13 Atomic Absorption Spectrometer (AAS). Equipped with a background corrector.

3.3.13.1 Graphite Furnace Attachment. With antimony, arsenic, cadmium, lead, selenium, thalium, and hollow cathode lamps (HCLs) or electrodeless discharge lamps (EDLs). Same as EPA Methods 7041 (antimony), 7060 (arsenic), 7131 (cadmium), 7421 (lead), 7740 (selenium), and 7841 (thallium).

3.3.13.2 Cold Vapor Mercury Attachment. With a mercury HCL or EDL. The equipment needed for the cold vapor mercury attachment includes an air recirculation pump, a quartz cell, an aerator apparatus, and a heat lamp or desiccator tube. The heat lamp should be capable of raising the ambient temperature at the quartz cell by 10°C such that no condensation forms on the wall of the quartz cell. Same as EPA Method 7470.

3.3.14 Inductively Coupled Argon Plasma Spectrometer. With either a direct or sequential reader and an alumina torch. Same as EPA Method 6010.

4. Reagents

Unless otherwise indicated, it is intended that all reagents conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available; otherwise, use the best available grade.

4.1 Sampling. The reagents used in sampling are as follows:

4.1.1 Filters. The filters shall contain less than 1.25 ug of each of the metals to be measured. Analytical results provided by filter manufacturers are acceptable. However, if no such results are available, filter blanks must be analyzed for each target metal prior to emission testing. Quartz fiber or glass fiber filters without organic binders shall be used. The filters should exhibit at least 99.95 percent efficiency (<0.05 percent penetration) on 0.3 micron dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM Standard Method D2986-71 (incorporated by reference). For particulate determination, the filter should have a surface alkalinity less than 7.5 pH. Again, analytical results provided by filter manufacturers are acceptable. Pallflex^{R} type 2500 QAT-UP Ultra Pure Filters have been found to meet these limits.

4.1.2 Water. To conform to ASTM Specification D1193.77, Type II (incorporated by reference). Analyze the water for all target metals prior to field use. All target metals should be less than 1 ng/ml.

4.1.3 Nitric Acid. Concentrated. Baker Instra-analyzed or equivalent.

4.1.4 Hydrochloric Acid. Concentrated. Baker Instra-analyzed or equivalent.

4.1.5 Hydrogen Peroxide, 30 Percent (V/V).

4.1.6 Potassium Permanganate.

4.1.7 Sulfuric Acid. Concentrated.

4.1.8 Silica Gel and Crushed Ice. Same as Method 5, Sections 3.1.2 and 3.1.3, respectively.

4.2 Pretest Preparation for Sampling Reagents.

4.2.1 Nitric Acid/Hydrogen Peroxide Absorbing Solution. Add 50 ml of concentrated nitric acid and 333 ml of 30 percent hydrogen peroxide to a 1000 ml volumetric flask or graduated cylinder containing approximately 500 ml of water. Dilute to volume with water. The reagent shall contain less than 2 ng/ml of each target metal.

4.2.2 Acidic Potassium Permanganate Solution. Fill a 1 liter volumetric flask or graduated cylinder with approximately 800 ml of water. Weigh out 40.0 g of potassium permanganate and dissolve it in the water. Add 100 ml of concentrated sulfuric acid and mix well. Let the solution cool and dilute to volume with water. The reagent shall contain less than 2 ng/ml of each target metal.

Precaution: To prevent autocatalytic decomposition of the permanganate solution, filter the solution through Whatman 541 filter paper. Also due to reaction of the potassium permanganate with the acid, there may be pressure buildup in the sample storage bottle. These bottles should not be filled full and should be vented both to relieve excess pressure and to prevent explosion due to pressure buildup. Venting is highly recommended, but should not allow contamination of the sample; a No. 70-72 hole drilled in the container cap and Teflon liner has been used.

4.2.3 Nitric Acid, 0.1 N. Add 6.3 ml of concentrated nitric acid (70 percent) to a graduated cylinder containing approximately 900 ml of water. Dilute to 1000 ml with water. Mix well. The reagent shall contain less than 2 ng/ml of each target metal.

4.2.4 Hydrochloric Acid, 8 N. Add 690 ml of concentrated hydrochloric acid to a graduated cylinder containing 250 ml of water. Dilute to 100 ml with water. Mix well. The reagent shall contain less than 2 ng/ml of each the target metals.

4.3 Glassware Cleaning Reagents.

4.3.1 Nitric Acid, Concentrated. Fisher ACS grade or equivalent.

4.3.2 Water. To conform to ASTM Specifications D1193-77, Type II.

4.3.3 Nitric Acid, 10 Percent (V/V). Add 500 ml of concentrated nitric acid to a graduated cylinder containing approximately 4000 ml of water. Dilute to 5000 ml with water.

4.4 Sample Digestion and Analysis Reagents.

4.4.1 Hydrochloric Acid, Concentrated.

4.4.2 Hydrofluoric Acid, Concentrated.

4.4.3 Nitric Acid, Concentrated. Baker Instra-analyzed or equivalent.

4.4.4 Nitric Acid, 10 Percent (V/V). Add 100 ml of concentrated nitric acid to 800 ml of water. Dilute to 1000 ml with water. Mix well. Reagent shall contain less than 2 ng/ml of each target metal.

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4.4.5 Nitric Acid, 5 Percent (V/V). Add 50 ml of concentrated nitric acid to 800 ml of water. Dilute to 1000 ml with water. Reagent shall contain less than 2 ng/ml of each target metal.

4.4.6 Water. To conform to ASTM Specifications D1193-77, Type II.

4.4.7 Hydroxylamine Hydrochloride and Sodium Chloride Solution. See EPA Method 7470 for preparation.

4.4.8 Stannous Chloride.

4.4.9 Potassium Permanganate, 5 Percent (W/V).

4.4.10 Sulfuric Acid, Concentrated.

4.4.11 Nitric Acid, 50 Percent (V/V).

4.4.12 Potassium Persulfate, 5 Percent (W/V).

4.4.13 Nickel Nitrate, $Ni(NO_3)_2 \cdot 6H_2O$.

4.4.14 Lanthanum Oxide, La_2O_3.

4.4.15 AAS Grade Hg Standard, 1000 ug/ml.

4.4.16 AAS Grade Pb Standard, 1000 ug/ml.

4.4.17 AAS Grade As Standard, 1000 ug/ml.

4.4.18 AAS Grade Cd Standard, 1000 ug/ml.

4.4.19 AAS Grade Cr Standard, 1000 ug/ml.

4.4.20 AAS Grade Sb Standard, 1000 ug/ml.

4.4.21 AAS Grade Ba Standard, 1000 ug/ml.

4.4.22 AAS Grade Be Standard, 1000 ug/ml.

4.4.23 AAS Grade Cu Standard, 1000 ug/ml.

4.4.24 AAS Grade Mn Standard, 1000 ug/ml.

4.4.25 AAS Grade Ni Standard, 1000 ug/ml.

4.4.26 AAS Grade P Standard, 1000 ug/ml.

4.4.27 AAS Grade Se Standard, 1000 ug/ml.

4.4.28 AAS Grade Ag Standard, 1000 ug/ml.

4.4.29 AAS Grade Tl Standard, 1000 ug/ml.

4.4.30 AAS Grade Zn Standard, 1000 ug/ml.

4.4.31 AAS Grade Al Standard, 1000 ug/ml.

4.4.32 AAS Grade Fe Standard, 1000 ug/ml.

4.4.33 The metals standards may also be made from solid chemicals as described in EPA Method 200.7. EPA Method 7470 or Standard Methods for the Analysis of Water and Wastewater, 15th Edition, Method 303F should be referred to for additional information on mercury standards.

4.4.34 Mercury Standards and Quality Control Samples. Prepare a 10 ug/ml mercury standard by adding 5 ml of 1000 ug/ml mercury standard to a 500 ml volumetric flask. Dilute to 500 ml with 20 ml of 15 percent nitric acid and then water. Prepare a 200 ng/ml standard by adding 5 ml of the 10 ug/ml standard to a 250 ml volumetric flask and dilute to 250 ml with 5 ml of 4% $KMnO_4$, 5 ml 15 percent nitric acid, and then water. Other standards should be prepared by dilution of the 200 ng/ml mercury standard. At least four standards should be used to prepare the standard curve. Standards containing 0.25, 0.50, 1.00, and 2.00 total ng are suggested. Quality control samples should be prepared by making a separate 10 ng/ml standard and diluting until it is in the range of the samples.

4.4.35 ICAP Standards and Quality Control Samples. Calibration standards for ICAP analysis can be combined into four different mixed standard solutions as shown below.

MIXED STANDARD SOLUTIONS FOR ICAP ANALYSIS

Solution	Elements
I	As, Be, Cd, Mn, Pb, Se, Zn
II	Ba, Cu, Fe
III	Al, Cr, Ni
IV	Ag, P, Sb, Tl

Prepare these standards by combining and diluting the appropriate volumes of the 1000 ug/ml solutions with 5 percent nitric acid. A minimum of one standard and a blank can be used to form each calibration curve. However, a separate quality control sample spiked with known amounts of the target metals in quantities expected to be in the midrange of the calibration curve should be prepared. Suggested standard levels are 50 ug/ml for Al, 25 ug/ml for Cr and Pb, 15 ug/ml for Fe, and 10 ug/ml for the remaining elements. Standards containing less than 1 ug/ml of metal should be prepared daily. Standards containing greater than 1 ug/ml of metal should be stable for a minimum of 1 to 2 weeks.

4.4.36 Graphite Furnace AAS Standards for Antimony, Arsenic, Cadmium, Lead, Selenium, and Thallium. Prepare a 10 ug/ml standard by adding 1 ml of 1000 ug/ml standard to a 100 ml volumetric flask. Dilute to 100 ml with 10 percent nitric acid. For graphite furnace AAS, the standards must be matrix matched; e.g., if the samples contain 6 percent nitric acid and 4 percent hydrofluoric acid, the standards should also be made up with 6 percent nitric

acid and 4 percent hydrofluoric acid. Prepare a 100 ng/ml standard by adding 1 ml of the 10 ug/ml standard to a 100 ml volumetric flask and dilute to 100 ml with the appropriate matrix solution. Other standards should be prepared by dilution of the 100 ng/ml standards. At least four standards should be used to make up the standard curve. Suggested levels are 10, 50, 75, and 100 ng/ml. Quality control samples should be prepared by making a separate 10 ug/ml standard and diluting until it is in the range of the samples. Standards containing less than 1 ug/ml of metal should be prepared daily. Standards containing greater than 1 ug/ml of metal should be stable for a minimum of 1 to 2 weeks.

4.4.37 Matrix Modifiers.

4.4.37.1 Nickel Nitrate, 1 Percent (V/V). Dissolve 4.956 g of $Ni(NO_3)_2 \cdot 6H20$ in approximately 50 ml of water in a 100 ml volumetric flask. Dilute to 100 ml with water.

4.4.37.2 Nickel Nitrate, One-tenth Percent (V/V). Dilute 10 ml of 1 percent nickel nitrate solution to 100 ml with water. Inject an equal amount of sample and this modifier into the graphite furnace during AAS analysis for As.

4.4.37.3 Lanthanum. Dissolve 0.5864 g of La_2O_3 in 10 ml of concentrated HNO_3 and dilute to 100 ml with water. Inject an equal amount of sample and this modifier into the graphite furnace during AAS analysis for Pb.

5. Procedure

5.1 Sampling. The complexity of this method is such that, in order to obtain reliable results, testers should be trained and experienced with the test procedures.

5.1.1 Pretest Preparation. Follow the same general procedure given in Method 5, Section 4.1.1, except that, unless particulate emissions are to be determined, the filter need not be desiccated or weighed. All sampling train glassware should first be rinsed with hot tap water and then washed in hot soapy water. Next, glassware should be rinsed three times with tap water, followed by three additional rinses with water. All glassware should then be soaked in a 10 percent (V/V) nitric acid solution for a minimum of 4 hours, rinsed three times with water, rinsed a final time with acetone, and allowed to air dry. All glassware openings where contamination can occur should be covered until the sampling train is assembled, prior to sampling.

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5.1.2 Preliminary Determinations. Same as Method 5, Section 4.1.2.

5.1.3 Preparation of Sampling Train. Follow the same general procedures given in Method 5, Section 4.1.3, except place 100 ml of the nitric acid/hydrogen peroxide solution (Section 4.2.1) in the two HNO_3/H_2O_2 impingers (normally the second and third impingers), place 100 ml of the acidic potassium permanganate solution (Section 4.2.2) in the fourth and fifth impinger, and transfer approximately 200 to 300 g of preweighed silica gel from its container to the last impinger. Alternatively, the silica gel may be weighed directly in the impinger just prior to train assembly.

Several options are available to the tester based on the sampling conditions. The use of an empty first impinger can be eliminated if the moisture to be collected in the impingers is calculated or determined to be less than 150 ml. The tester shall include two impingers containing the acidic potassium permanganate solution for the first test run, unless past testing experience at the same or similar sources has shown that only one is necessary. The last permanganate impinger may be discarded if both permanganate impingers have retained their original deep purple permanganate color. A maximum of 200 ml in each permanganate impinger (or a maximum of three permanganate impingers) may be used, if necessary, to maintain the desired color in the last permanganate impinger.

Retain for reagent blanks, 100 ml of the nitric acid/hydrogen peroxide solution and 100 ml of the acidic potassium permanganate solution. These solutions should be labeled and treated as described in Section 7. Set up the sampling train as shown in Figure A-1.

Precaution: Extreme care should be taken to prevent contamination within the train. Prevent the mercury collection reagent (acidic potassium permanganate) from contacting any glassware of the train which is washed and analyzed for Mn. Prevent hydrogen peroxide from mixing with the acidic potassium permanganate.

5.1.4 Leak-Check Procedures. Follow the leak-check procedures given in Method 5, Section 4.1.4.1 (Pretest Leak-Check), Section 4.1.4.2 (Leak-Checks During the Sample Run), and Section 4.1.4.3 (Post-Test Leak-Checks).

5.1.5 Sampling Train Operation. Follow the procedures given in Method 5, Section 4.1.5. For each run, record the data required on a data sheet such as the one shown in Figure 5-2 of Method 5.

5.1.6 Calculation of Percent Isokinetic. Same as Method 5, Section 4.1.6.

5.2 Sample Recovery. Begin cleanup procedures as soon as the probe is removed from the stack at the end of a sampling period.

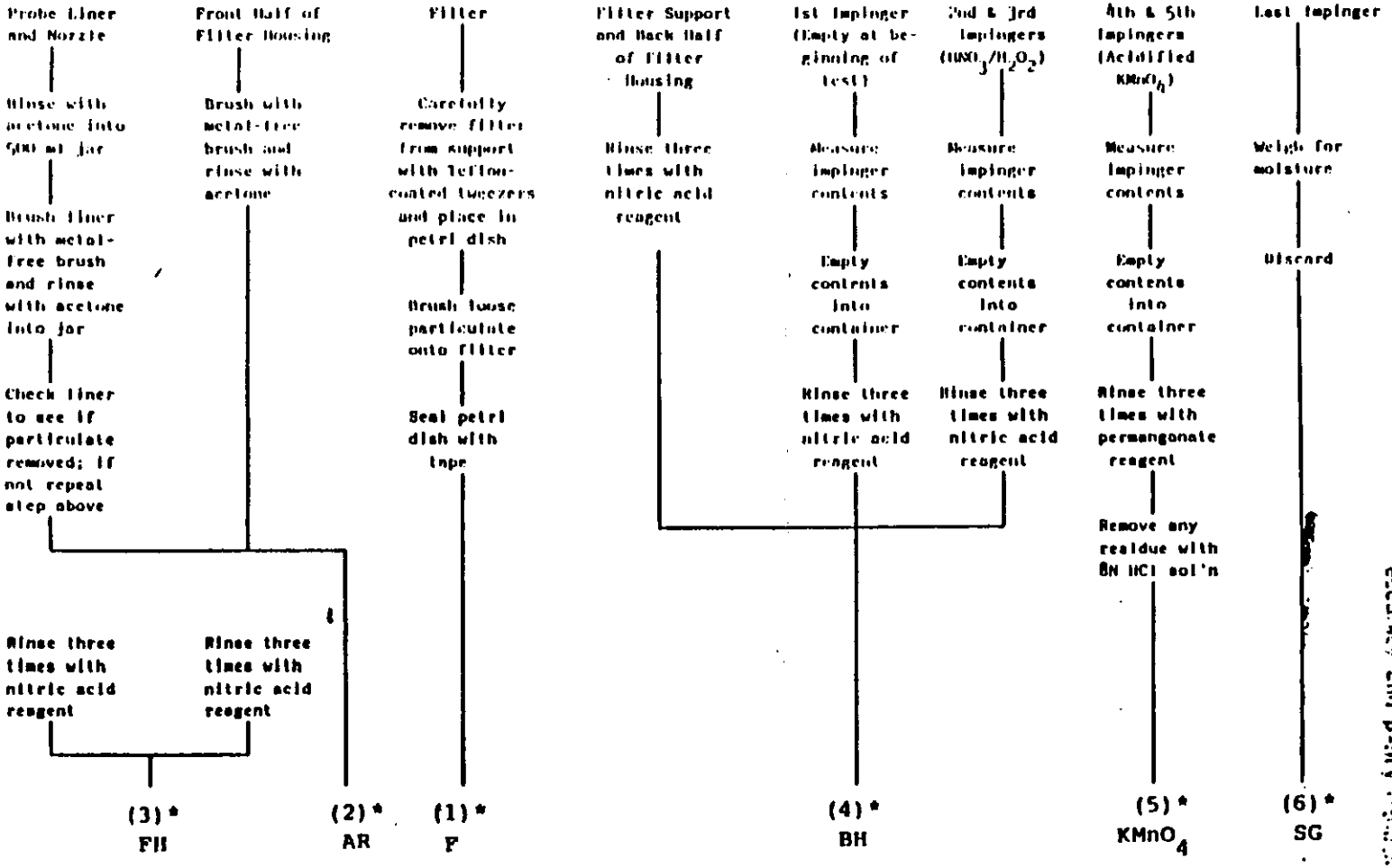
The probe should be allowed to cool prior to sample recovery. When it can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a rinsed, non-comtaminating cap over the probe nozzle to prevent losing or gaining particulate matter. Do not cap the probe tip tightly while the sampling train is cooling. This normally causes a vacuum to form in the filter holder, thus causing the undesired result of drawing liquid from the impingers into the filter.

Before moving the sampling train to the cleanup site, remove the probe from the sampling train and cap the open outlet. Be careful not to lose any condensate that might be present. Cap the filter inlet where the probe was fastened. Remove the umbilical cord from the last impinger and cap the impinger. Cap off the filter holder outlet and impinger inlet. Use non-contaminating caps, whether ground-glass stoppers, plastic caps, or serum caps, to close these openings.

Transfer the probe and filter-impinger assembly to a cleanup area that is clean and protected from the wind and other potential causes of contamination or loss of sample. Inspect the train before and during disassembly and note any abnormal conditions. The sample is recovered and treated as follows (see schematic in Figure A-2). Assure that all items necessary for recovery of the sample do not contaminate it.

5.2.1 Container No. 1 (Filter). Carefully remove the filter from the filter holder and place it in its identified petri dish container. Acid-washed polypropylene or Teflon coated tweezers or clean, disposable surgical gloves rinsed with water should be used to handle the filters. If it is necessary to fold the filter, make certain the particulate cake is inside the fold. Carefully transfer the filter and any particulate matter or filter fibers that adhere to the filter holder gasket to the petri dish by using a dry (acid-cleaned) nylon bristle brush. Do not use any metal-containing materials when recovering this train. Seal the labeled petri dish.

5.2.2 Container No. 2 (Probe). Note: Container No. 2 can be omitted if the testing does not include the determination of particulate concentration. Taking care to see that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover particulate



* Indicates container numbers.

Figure A-2. Sample recovery scheme.

matter or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components with acetone and placing the wash in a glass container. Distilled water may be used instead of acetone when approved by the Administrator and shall be used when specified by the Administrator; in these cases, save a water blank and follow the Administrator's directions on analysis. Perform the acetone rinses as follows: Carefully remove the probe nozzle and clean the inside surface by rinsing with acetone from a wash bottle and brushing with a metal-free Nylon bristle brush. Brush until the acetone rinse shows no visible particles, after which make a final rinse of the inside surface with acetone.

Brush and rinse the inside parts of the Swagelok fitting with acetone in a similar way until no visible particles remain.

Rinse the probe liner with acetone by tilting and rotating the probe while squirting acetone into its upper end so that all inside surfaces will be wetted with acetone. Let the acetone drain from the lower end into the sample container. A funnel (glass or polyethylene) may be used to aid on transferring liquid washings to the container. Follow the acetone rinse with a metal-free probe brush. Hold the probe in an inclined position, squirt acetone into the upper end as the probe brush is being pushed with a twisting action through the probe; hold a sample container underneath the lower end of the probe, and catch any acetone and particulate matter which is brushed through the probe three times or more until no visible particulate matter is carried out with the acetone or until none remains in the probe liner on visual inspection. Rinse the brush with acetone, and quantitatively collect these washings in the sample container. After the brushing, make a final acetone rinse of the probe as described above.

It is recommended that two people be used to clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contaminations.

After ensuring that all joints have been wiped clean of silicone grease, clean the inside of the front half of the filter holder by rubbing the surfaces with a metal-free nylon bristle brush and rinsing with acetone. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder. After all acetone washings and particulate matter have been collected in the sample container, tighten the lid on the sample container so that acetone will not leak out when it is shipped to

the laboratory. Mark the height of the fluid level to determine whether or not leakage occurred during transport. Label the container clearly to identify its contents.

5.2.3 Container No. 3 (Probe Rinse). Rinse the probe liner, probe nozzle, and front half of the filter holder by rinsing these components thoroughly with 0.1 N nitric acid and placing the wash into a sample storage container. Perform the rinses as described in Method 12, Section 5.2.2. Measure and record the volume of the combined rinses, and place the sample into a storage container. Mark the height of the fluid level on the outside of the container and use this mark to determine if leakage occurs during transport. Seal the container and clearly label the contents.

5.2.4 Container No. 4 (Impingers 1 through 3, Contents and Rinses). Due to the large quantity of liquid involved, the tester may place the impinger solutions in more than one container. Measure the liquid in the first three impingers volumetrically to within 0.5 ml using a graduated cylinder. Record the volume of liquid present. This information is required to calculate the moisture content of the sampled flue gas. Clean each of the first three impingers and connecting glassware by thoroughly rinsing with 0.1 N nitric acid as described in Method 12, Section 5.2.4. Combine the rinses and impinger solutions, measure and record the volume. Mark the height of the fluid level on the outside of the container to determine if leakage occurs during transport. Seal the container and clearly label the contents.

5.2.5 Container No. 5 (Acidified Potassium Permanganate Solution and Rinses, Impingers No. 4 & 5). Pour all the liquid from the permanganate impingers (fourth and fifth, if two permanganate impingers are used) into a graduated cylinder and measure the volume to within 0.5 ml. This information is required to calculate the moisture content of the sampled flue gas. Rinse the permanganate impinger(s) and connecting glass pieces a minimum of three times with acidified potassium permanganate solution. Combine the rinses with the permanganate impinger solution in a graduated cylinder and measure the total volume within 0.5 ml. Place the combined rinses and impinger contents in a labeled container. Mark the height of the fluid level on the outside of the container to determine if leakage occurs during transport. See the following note and the Precaution in Paragraph 4.2.2 and properly seal the container and clearly label the contents.

Note: Due to the potential reaction of the potassium permanganate with the acid, there may be pressure buildup in the sample storage bottles. These bottles should not be filled full and should be vented to relieve excess pressure. Venting is highly recommended. A No. 70-72 hole drilled in the container cap and Teflon liner has been found to allow adequate venting without loss of sample.

5.2.6 Container No. 6 (Silica Gel). Note the color of the indicating silica gel to determine whether it has been completely spent and make a notation of its condition. Transfer the silica gel from its impinger to its original container and seal. The tester may use a funnel to pour the silica gel and a rubber policeman to remove the silica gel from the impinger. The small amount of particles that may adhere to the impinger wall need not be removed. Do not use water or other liquids to transfer the silica gel since weight gained in the silica gel impinger is used for moisture calculations. Alternatively, if a balance is available in the field, record the weight of the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g.

5.2.7 Container No. 7 (Acetone Blank). Once during each field test, place 100 ml of the acetone used in the sample recovery process into a labeled container for use as a recovery solvent blank. Seal the container.

5.2.8 Container No. 8 (0.1 N Nitric Acid Blank). Once during each field test, place 100 ml of the 0.1 N nitric acid solution used in the sample recovery process into a labeled container for use as a recovery solvent blank. Seal the container.

5.2.9 Container No. 9 (5% Nitric Acid/10% Hydrogen Peroxide Blank). Once during each field test, place 100 ml of the 5% nitric acid/10% hydrogen peroxide solution used as the nitric acid impinger reagent into a labeled container for use as a blank. Seal the container.

5.2.10 Container No. 10 (Acidified Potassium Permanganate Blank). Once during each field test, place 100 ml of the acidified potassium permanganate solution used as the impinger solution and in the sample recovery process into a labeled container for use as a blank. Seal the container.

Note: This container should be vented, as described in Section 5.2.4, to relieve excess pressure.

5.2.11 Container No. 11 (Filter Blank). Once during each field test, place an unused filter from the same lot as the sampling filters in a labeled petri dish. Seal the petri dish.

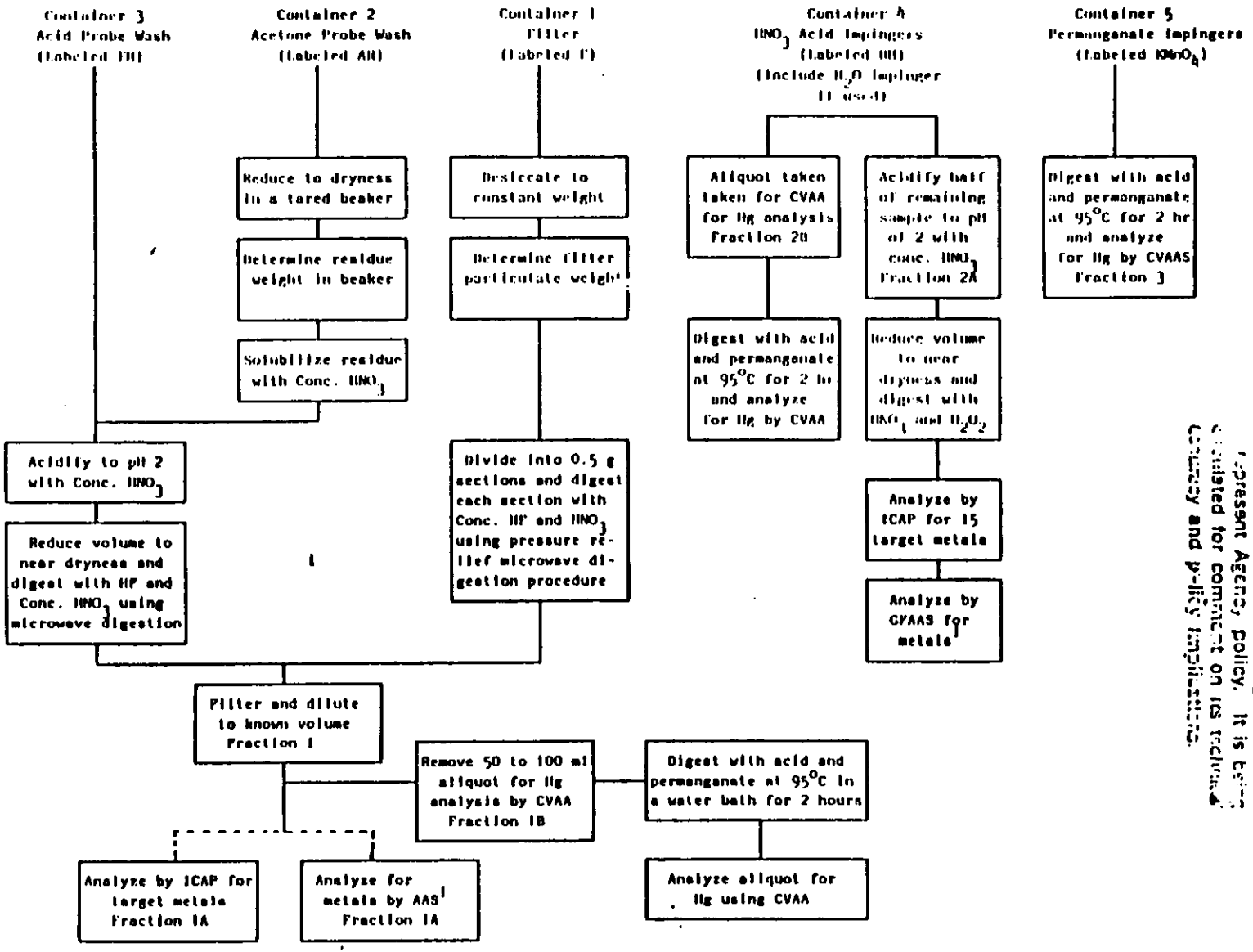
5.3 Sample Preparation. Note the level of the liquid in each of the containers and determine if any sample was lost during shipment. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results. A diagram illustrating sample preparation and analysis procedures for each of the sample train components is shown in Figure A-3.

5.3.1 Container No. 1 (Filter). The filter with its filter catch should be divided into portions containing approximately 0.5 g each and placed into the analyst's choice of either individual microwave pressure relief vessels or Parr^{R} Bombs. Six ml of concentrated nitric acid and 4 ml of concentrated hydrofluoric acid should be added to each vessel. For microwave heating, microwave the sample vessels for approximately 12-15 minutes in intervals of 1 to 2 minutes at 600 Watts. For conventional heating, heat the Parr Bombs at 140°C (285°F) for 6 hours. Then cool the samples to room temperature and combine with the acid digested probe rinse as required in Section 5.3.3, below.

Notes: 1. Suggested microwave heating times are approximate and are dependent upon the number of samples being digested. Twelve to 15 minute heating times have been found to be acceptable for simultaneous digestion of up to 12 individual samples. Sufficient heating is evidenced by sorbent reflux within the vessel.

2. If the sampling train uses an optional cyclone, the cyclone catch should be prepared and digested using the same procedures described for the filters and combined with the digested filter samples.

5.3.2 Container No. 2 (Probe). Note the level of liquid in the container and confirm on the analysis sheet whether or not leakage occurred during transport. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results. Measure the liquid in this container either volumetrically to ±1 ml or gravimetrically to ±0.5 g. Transfer the contents to an acid-cleaned tared 250-ml beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight according to the procedures described in Section 4.3 of Method 5. Report the results to the nearest 0.1 mg. Resolubilize the residue with concentrated nitric acid and combine the resultant sample including all liquid and any particulate matter with Container No. 3 prior to beginning the following step 5.3.3.



[1]Analysis by AAS for metals found at less than 2 ug/ml in digestate solution, if desired. Or analyze for each metal by AAS, if desired.

Figure A-3. Sample preparation and analysis scheme.

5.3.3 Container No. 3 (Probe Rinse). The pH of this sample shall be 2 or lower. If the pH is higher, the sample should be acidified with concentrated nitric acid to pH 2. The sample should be rinsed into a beaker with water and the beaker should be covered with a ribbed watchglass. The sample volume should be reduced to approximately 50 ml by heating on a hot plate at a temperature just below boiling. Inspect the sample for visible particulate matter, and depending on the results of the inspection, perform one of the following. If no particulate matter is observed, combine the sample directly with the acid digested portions of the filter prepared previously in Section 5.3.1. If particulate matter is observed, digest the sample in microwave vessels or Parr^{R} Bombs following the procedures described in Section 5.3.1; then combine the resultant sample directly with the acid digested portions of the filter prepared previously in Section 5.3.1. The resultant combined sample is referred to as Fraction 1. Filter the combined solution of the acid digested filter and probe rinse samples using Whatman 541 filter paper. Dilute to 300 ml (or the appropriate volume for the expected metals concentration) with water. Measure and record the combined volume of the Fraction 1 solution to within 0.1 ml. Quantitatively remove a 50 ml aliquot and label as Fraction 1B. Label the remaining 250 ml portion as Fraction 1A. Fraction 1A is used for ICAP or AAS analysis. Fraction 1B is used for the determination of front half mercury.

5.3.4 Container No. 4 (Impingers 1-3). Measure and record the total volume of this sample to within 0.5 ml. Remove a 50 ml aliquot for mercury analysis and label as Fraction 2B. The Fraction 2B aliquot should be prepared and analyzed as described in Section 5.4.3. The remaining portion of Container No. 3 should be labeled Fraction 2A and shall be pH 2 or lower. If necessary, use concentrated nitric acid to lower this fraction to pH 2. The sample should be rinsed into a beaker with water and the beaker should be covered with a ribbed watchglass. The sample volume should be reduced to approximately 20 ml by heating on a hot plate at a temperature just below boiling. Then follow either of the digestion procedures described in Sections 5.3.4.1 and 5.3.4.2, below.

5.3.4.1 Conventional Digestion Procedure. Add 30 ml of 50 percent nitric acid and heat for 30 minutes on a hot plate to just below boiling. Add 10 ml of 3 percent hydrogen peroxide and heat for 10 more minutes. Add 50 ml of hot water and heat the sample for an additional 20 minutes. Cool, filter the sample, and dilute to 150 ml (or the appropriate volume for the expected metals concentrations) with water.

5.3.4.2 Microwave Digestion Procedure. Add 10 ml of 50 percent nitric acid and heat for 6 minutes in intervals of 1 to 2 minutes at 600 Watts. Allow the sample to cool. Add 10 ml of 3 percent hydrogen peroxide and heat for 2 more minutes. Add 50 ml of hot water and heat for an additional 5 minutes. Cool, filter the sample, and dilute to 150 ml (or the appropriate volume for the expected metals concentrations) with water.

Note: All microwave heating times given are approximate and are dependent upon the number of samples being digested at a time. Heating times as given above have been found acceptable for simultaneous digestion of up to 12 individual samples. Sufficient heating is evidenced by solvent reflux within the vessel.

5.3.5 Container No. 5 (Impingers 4 & 5). Measure and record the total volume of this sample to within 0.5 ml. This sample is referred to as Fraction 3. Follow the analysis procedures described in Section 5.4.3.

5.3.6 Container No. 6 (Silica Gel). Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g using a balance. (This step may be conducted in the field.)

5.4 Sample Analysis. For each sampling train, five individual samples are generated for analysis. A schematic identifying each sample and the prescribed sample preparation and analysis scheme is shown in Figure A-3. The first two samples, labeled Fractions 1A and 1B, consist of the digested samples from the front half of the train. Fraction 1A is for ICAP or AAS analysis as described in Sections 5.4.1 and/or 5.4.2. Fraction 1B is for determination of front half mercury as described in Section 5.4.3.

The back half of the train was used to prepare the third through fifth samples. The third and fourth samples, labeled Fractions 2A and 2B, contain the digested samples from the H_2O and NHO_3/H_2O_2 Impingers 1 through 3. Fraction 2A is for ICAP or AAS analysis. Fraction 2B will be analyzed for mercury.

The fifth sample, labeled Fraction 3, consists of the impinger contents and rinses from the permanganate Impingers 4 and 5. This sample is analyzed for mercury as described in Section 5.4.3. The total back half mercury catch is determined from the sum of Fraction 2B and Fraction 3.

5.4.1 ICAP Analysis. Fraction 1A and Fraction 2A are analyzed by ICAP using EPA Method 200.7 (40 CFR 136, Appendix C). Calibrate the ICAP and set up an analysis program as described in Method 200.7. The quality control procedures described in Section 7.3.1 of this method shall be followed.

Recommended wavelengths for use in the analysis are listed below.

Element	Wavelength
Aluminum	308.215
Antimony	206.833
Arsenic	193.696
Barium	455.403
Beryllium	313.042
Cadmium	226.502
Chromium	267.716
Copper	324.754
Iron	259.940
Lead	220.353
Manganese	257.610
Nickel	231.604
Selenium	196.026
Silver	328.068
Thallium	190.864
Zinc	213.856

The wavelengths listed are recommended because of their sensitivity and overall acceptance. Other wavelengths may be substituted if they can provide the needed sensitivity and are treated with the same corrective techniques for spectral interference.

Initially, analyze all samples for the target metals plus iron and aluminum. If iron and aluminum are present in the sample, the sample may have to be diluted so that each of these elements is at a concentration of less than 50 ppm to reduce their spectral interferences on arsenic and lead.

Note: When analyzing samples in a hydrofluoric acid matrix, an alumina torch should be used; since all front half samples will contain hydrofluoric acid, use an alumina torch.

5.4.2 AAS by Direct Aspiration and/or Graphite Furnace. If analysis of metals in Fraction 1A and Fraction 2A using graphite furnace or direct aspiration AAS is desired, Table A-2 should be used to determine which techniques and methods should be applied for each target metal. Table A-2 should also be consulted to determine possible interferences and techniques to be followed for their minimization. Calibrate the instrument according to Section 6.3 and follow the quality control procedures specified in Section 7.3.2.

5.4.3 Cold Vapor AAS Mercury Analysis. Fraction 1B, Fraction 3, and Fraction 2B should be analyzed for mercury using cold vapor atomic absorption spectroscopy following the method outlined in EPA Method 7470 or in Standard

TABLE A-2. APPLICABLE TECHNIQUES, METHODS, AND MINIMIZATION OF INTEFERENCE FOR AAS ANALYSIS

Metal	Technique	Method No.	Wavelength (nm)	Interference	
				Cause	Minimization
Sb	Aspiration	7040	217.6	1000 mg/ml Pb Ni, Cu, or acid	Use secondary wavelenght of 231.1 nm. Match sample & standards acid concentration or use nitrous oxide/acetylene flame
Sb	Furnace	7041	217.6	High Pb	Secondary wavelength or Zeeman correction
As	Furnace	7060	193.7	Arsenic volati - zation Aluminium	Spiked samples & add nickel nitrate solution to digestates prior to analyses Use Zeeman background correction
Ba	Aspiration	7080	553.6	Calcium Barium ionization	High hollow cathode current & narrow band set 2 mL of KCl per 100 mL of sample
Be	Aspiration	7090	234.9	500 ppm Al High Mg & Si	Add 0.1% flouride Use method of standard additions
Be	Furnace	7091	234.9	Be in optical path	Optimize parameters to miminize effects
Cd	Aspiration	7130	228.8	Absorption & light scattering	Background correction is required
Cd	Furnace	7131	228.8	As above Excess chloride Pipet tips	As above Ammonium phosphate used as a matrix modifier Use cadmium-free tips
Cr	Aspiration	7190	357.9	Alkali metal Absorption & scatt	KCl ionization suppressant in sample & stand Consult manufacturer's literature
Cr	Furnace	7191	357.9	200 mg/L calcium & phosphate	All calcium nitrate for a know constant effect and to eliminate effect of phosphate

(continued)

TABLE A-2 (CONTINUED)

Metal	Technique	Method No.	Wavelength (nm)	Interference	
				Cause	Minimization
Cu	Aspiration	7210	324.7	Absorpt & scatter	Consult manufacturer's manual
Fe	Aspiration	7380	248.3	Contamination	Great care taken to avoid contamination
Pb	Aspiration	7420	283.3	217.0 nm alternat	Background correction required
Pb	Furnace	7421	283.3	Poor recoveries	Matrix modifier, add 10 uL of phosphorus aci to 1-mL of prepared sample in sampler cup
Mn	Aspiration	7460	279.5	403.1 nm alternat	Background correction required
Ni	Aspiration	7520	232.0	352.4 nm alternat	Background correction required
				Fe, Co, & Cr	Matrix matching or a nitrous-oxide/acety fl
				Nonlinear respons	Sample dilution or use 352.4 nm line
Se	Furnace	7740	196.0	Volitality	Spike samples & reference materials & add n nitrate to minimize volatilization
				Adsorpt & scatter	Background correction is required & Zeeman background correction can be useful
Ag	Aspiration	7760	328.1	Absorpt & scatter	Background correction is required
				AgCl insoluble	Avoid hydrochloric acid unless silver is in solution as a chloride complex
				Viscosity	Sample & standards monitored for apiration
Tl	Aspiration	7840	276.8		Background correction is required
					Hydrochloric acid should not be used
Tl	Furnace	7841	276.8		Background correction is required
				Hydrochloric acid or chloride	Verify that losses are not occuring for volitization by spiked samples or standad
					Palladium is a suitable matrix modifier
Zn	Aspiration	7950	213.9	High Si, Cu & P	Strontium removes Cu and phosphate
				Contamination	Care should be taken to avid contamination

Methods for Water and Wastewater Analysis, 15th Edition, Method 303F. Set up the calibration curve as described in Section 7.3 of Method 303F. Add approximately 5 ml of each sample to BOD bottles. Record the amount of sample added. The amount used is dependent upon the expected levels of mercury. Dilute to approximately 120 ml with mercury-free water. Add approximately 15 ml of 5 percent potassium permanganate solution to the Fraction 2B and Fraction 3 samples. Add 5 percent potassium permanganate solution to the Fraction 1B sample as needed to produce a purple solution lasting at least 15 minutes. A minimum of 25 ml is suggested. Add 5 ml of 50 percent nitric acid, 5 ml of concentrated sulfuric acid, and 9 ml of 5 percent potassium persulfate to each sample and each standard. Digest the solution in the capped BOD bottle at 95°C (205°F) in a convection oven or water bath for 2 hours. Cool. Add 5 ml of hydroxylamine hydrochloride solution and mix the sample. Then add 7 ml of stannous chloride to each sample and analyze immediately.

6. Calibration

Maintain a laboratory log of all calibrations.

6.1 Sampling Train Calibration. Calibrate the sampling train components according to the indicated sections of Method 5: Probe Nozzle (Section 5.1); Pitot Tube (Section 5.2); Metering System (Section 5.3); Probe Heater (Section 5.4); Temperature Gauges (Section 5.5); Leak-Check of the Metering System (Section 5.6); and Barometer (Section 5.7).

6.2 Inductively Coupled Argon Plasma Spectrometer Calibration. Prepare standards as outlined in Section 4.6.4. Profile and calibrate the instrument according to the instrument manufacturer's recommended procedures using the above standards. The instrument calibration should be checked once per hour. If the instrument does not reproduce the concentrations of the standard within 10 percent, the complete calibration procedures should be performed.

6.3 Atomic Absorption Spectrometer - Direct Aspiration, Graphite Furnace and Cold Vapor Mercury Analyses. Prepare the standards as outlined in Section 4.6.5. Calibrate the spectrometer using these prepared standards. Calibration procedures are also outlined in the EPA methods referred to in Table A-2 and in Standard Methods for Water and Wastewater, 15th Edition, Method 303F (for mercury). Each standard curve should be run in duplicate and the mean values used to calculate the calibration line. The instrument should be recalibrated approximately once every 10 to 12 samples.

7. Quality Control

7.1 Sampling. Field Reagent Blanks. The blank samples in Container Numbers 7 through 11 produced previously in Sections 5.2.7 through 5.2.11, respectively, shall be processed, digested, and analyzed as follows. Digest and process Container No. 11 contents per Section 5.3.1, Container No. 7 per Section 5.3.2, and Container No. 8 per Section 5.3.3. This produces Fraction Blank 1A and Fraction Blank 1B. Digest and process Container No. 9 contents per Section 5.3.4. This produces Fraction Blank 2A and Fraction Blank 2B. Container No. 11 contents are Fraction Blank 3. Analyze Fraction Blank 1A and Fraction Blank 2A per Section 5.4.1 and/or 5.4.2. Analyze Fraction Blank 1B, Fraction Blank 2B, and Fraction Blank 3 per Section 5.4.3. The maximum correction allowed to the field source sample value is the lesser of the following: (1) the actual blank value, or (2) the maximum blank correction allowed per the Note in Section 8.4.3 and the Note in Section 8.5.2.

7.2 With prior approval by the Administrator, an attempt may be made to determine if the reagents used in Section 5.3 caused contamination. They should be analyzed by the procedures in Section 5.4. Then the Administrator will determine whether or not the laboratory blank values can be used in the calculation of the stationary source test results.

7.3 Quality Control Samples. The following quality control samples should be analyzed.

7.3.1 ICAP Analysis. Follow the quality control shown in Section 8 of Method 6010. For the purposes of a three run test series, these requirements have been modified to include the following: two instrument check standard runs, two calibration blank runs, one interference check sample at the beginning of the analysis (must be within 25% or analyze by standard addition), one quality control sample to check the accuracy of the calibration standards (must be within 25% of calibration), and one duplicate analysis (must be within 5% of average or repeat all analysis).

7.3.2 Direct Aspiration and/or Graphite Furnace AAS Analysis for Antimony, Arsenic, Barium, Beryllium, Cadmium, Copper, Chromium, Lead, Nickel, Manganese, Mercury, Phosphorus, Selenium, Silver, Thallium, and Zinc. All samples should be analyzed in duplicate. Perform a matrix spike on one front half sample and one back half sample or one combined sample. If recoveries of less than 75 percent or greater than 125 percent are obtained for the matrix spike, analyze each sample by the method of additions. A quality control sample should be

analyzed to check the accuracy of the calibration standards. The results must be within 10% or the calibration repeated.

7.3.3 Cold Vapor AAS Analysis for Mercury. All samples should be analyzed in duplicate. A quality control sample should be analyzed to check the accuracy of the calibration standards (within 10% or repeat calibration). Perform a matrix spike on one sample from the nitric impinger portion (must be within 25% or samples must be analyzed by the method of standard additions). Additional information on quality control can be obtained from EPA Method 7470 or in Standard Methods for Water and Wastewater, 15th Edition, Method 303F.

8. Calculations

8.1 Dry Gas Volume. Using the data from this test, calculate $V_{m(std)}$, the dry gas sample volume at standard conditions as outlined in Section 6.3 of Method 5.

8.2 Volume of Water Vapor and Moisture Content. Using the data obtained from this test, calculate the volume of water vapor $V_{w(std)}$ and the moisture content B_{ws} of the stack gas. Use Equations 5-2 and 5-3 of Method 5.

8.3 Stack Gas Velocity. Using the data from this test and Equation 2-9 of Method 2, calculate the average stack gas velocity.

8.4 Metals (Except Mercury) in Source Sample.

8.4.1 Fraction 1A, Front Half, Metals (except Hg). Calculate the amount of each metal collected in Fraction 1 of the sampling train using the following equation:

$$M_{fh} = C_a F_{dm} V_{soln} \qquad \text{Eq. 1}$$

where:

M_{fh} = total mass of each metal (except Hg) collected in the front half of the sampling train (Fraction 1), ug.

C_a = concentration of metal in sample Fraction 1A as read from the standard curve (ug/ml).

F_{dm} = dilution factor (F_{dm} = the inverse of the fractional portion V_{conc-p} in V_{conc}. V_{conc} is the solution actually used in the instrument to produce the reading which is C_a. V_{conc} is either a pure or a diluted solution of Fraction 1A. When V_{conc} has been diluted to bring it into the analytical range based on the calibration of the instrument, V_{conc} will have the following two portions: V_{conc-d}, which is the diluent solution, and V_{conc-p}, which is the original Fraction 1A solution. For example, when the dilution of Fraction 1A is from 2 to 10 ml, the fractional portion V_{conc-p} (2 ml) in V_{conc} (10 ml) is 1/5, and F_{dm} = 5).

V_{soln} = total volume of digested sample solution (Fraction 1), ml.

8.4.2 Fraction 2A, Back Half, Metals (except Hg). Calculate the amount of each metal collected in Fraction 2 of the sampling train using the following equation.

$$M_{bh} = C_a F_a V_a \qquad \text{Eq. 2}$$

where:

M_{bh} = total mass of metal (except Hg) collected in the back half of the sampling train (Fraction 2), ug.
C_a = concentration of metal in sample Fraction 2A, as read from the standard curve (ug/ml).
F_a = aliquot factor, volume of Fraction 2 divided by volume of aliquot Fraction 2A.
V_a = volume of sample aliquot analyzed (concentrated Fraction 2A), ml.

8.4.3 Total Train, Metals (except Hg). Calculate the total amount of each of the quantified metals collected in the sampling train as follows:

$$M_t = (M_{fh} - M_{fb}) + (M_{bh} - M_{bb}) \qquad \text{Eq. 3}$$

where:

M_t = total mass of each metal (separately stated for each metal) collected in the sampling train, ug.
M_{fb} = blank correction value of mass of metal detected in front half of field reagent blank, ug.
M_{bb} = blank correction value of mass of metal detected in back half of field reagent blank, ug.

Note: The maximum value of field reagent blank that may be subtracted is 2 ug for the front half and 1 ug for the back half, or 3 ug for an analysis of the solution resulting from combining Fraction 1A and Fraction 2A;* or 5% of the average mass for the correponding fraction of the sampling train, whichever is greater.

8.5 Mercury in Source Sample.

8.5.1 Fraction 1B, Front Half, Hg. Calculate the amount of mercury collected in the front half, Fraction 1, of the sampling train using the following equation:

$$Hg_{fh} = \left(\frac{C}{V_{bf}}\right) \times V_{soln} \qquad \text{Eq. 4}$$

*In combining Fractions 1A and 2A, proportional aliquots must be used. Appropriate changes must be made in Equations 1-3 to reflect this approach.

where:

Hg_{fh} = total mass of mercury collected in the front half of the sampling train (Fraction 1), ug.
C = quantity of mercury in analyzed sample, ug.
V_{soln} = total volume of digested sample solution (Fraction 1), ml.
V_{bf} = volume of Fraction 1B analyzed, ml. See the following Note.

Note: V_{bf} is the actual amount of Fraction 1B analyzed. For example, if 1 ml of Fraction 1B were diluted to 100 ml to bring it into the proper analytical range, V_{bf} would be 0.01, etc.

8.5.2 Fraction 2B and Fraction 3, Back Half, Hg. Calculate the amount of mercury collected in Fractions 2B and 3 using Equations 5 and 6, respectively. Calculate the total amount of mercury collected in the back half of the sampling train using Equation 7.

$$Hg_{(F2B)} = \left(\frac{C}{V_{bb2}}\right) \times V_{soln} \qquad \text{Eq. 5}$$

where:

$Hg_{(F2B)}$ = total mass of mercury collected in Fraction 2, ug.
C = quantity of mercury in analyzed sample, ug.
V_{bb2} = volume of Fraction 2B analyzed, ml (see Note in Section 8.5.1).
V_{soln} = total volume of Fraction 2, ml.

$$Hg_{(F3)} = \left(\frac{C}{V_{bb3}}\right) \times V_{soln} \qquad \text{Eq. 6}$$

where:

$Hg_{(F3)}$ = total mass of mercury collected in Fraction 3, ug.
C = quantity of mercury in analyzed sample, ug.
V_{bb3} = volume of Fraction 3 analyzed, ml (see Note in Section 8.5.1).
V_{soln} = total volume of Fraction 3, ml.

$$Hg_{bh} = Hg_{(F2B)} + Hg_{(F3)} \qquad \text{Eq. 7}$$

where:

Hg_{bh} = total mass of mercury collected in the back half of the sampling train, ug.

8.5.3 Total Train Mercury Catch. Calculate the total amount of mercury collected in the sampling train using Equation 8.

$$M_t = (Hg_{fh} - Hg_{fb}) + (Hg_{bh} - Hg_{bb}) \qquad \text{Eq. 8}$$

where:

M_t = total mass of mercury collected in the sampling train, ug.
Hg_{fb} = blank correction value of mass of mercury detected in the front half of the field reagent blank, ug.
Hg_{bb} = blank correction value of mass of mercury detected in the back half of the field reagent blank, ug.

Note: The maximum value of field reagent blank that may be subtracted is 1 ug for the front half and 2 ug for the back half, or 3 ug for a combined front half/back half analysis; or 5% of the average mass of mercury for the correponding fraction of the sampling train; whichever is greater.

8.6 Metal Concentration of Stack Gas. Calculate the cadmium, total chromium, arsenic, nickel, manganese, beryllium, copper, lead, phosphorus, thallium, silver, barium, zinc, selenium, antimony, and mercury concentrations in the stack gas (dry basis, adjusted to standard conditions) as follows:

$$C_s = K_4 \, (M_t / V_{m(std)}) \qquad \text{Eq. 9}$$

where:

C_s = concentration of each metal in the stack gas, mg/dscm.
K_4 = 10^{-3} mg/ug.
M_t = total mass of each metal collected in the sampling train, ug.
$V_{m(std)}$ = volume of gas sample as measured by the dry gas meter, corrected to dry standard conditions, dscm.

8.7 Isokinetic Variation and Acceptable Results. Same as Method 5, Sections 6.11 and 6.12, respectively. To calculate the average stack gas velocity, use Equation 2-9 of Method 2 and the data from this field test.

9. Bibliography

9.1 Ward, T.E., S.C. Steinsberger, W.G. DeWees, R.R. Segall, W.S. Smith, K.M. Luk, and P.M. Grohse. "Laboratory and Field Evaluation of Methodology for Measuring Emissions of Trace Metals for Stationary Sources." Draft report prepared for U.S. Environmental Protection Agency, Environmental Monitoring

PM-10 Emissions and Particle Size Testing

The PM-10 concentration and the size distribution will be determined in accordance with EPA's interim "Guidelines for Source Testing for Size Specific Particulate Emissions," (1) using an inertial cascade impactor currently manufactured by Anderson 2000 Inc., the exact model of which is known as "Flow Sensor."

The Flow Sensor impactor is a high flow rate (10-30 LPM) eight-stage cascade impactor which is equipped with a special high capacity preimpactor to collect particles approximately 10 microns and larger (50% cut point at 0.6 ACFM). This preimpactor has an inlet which is at 90 degrees to the exit.

Since the complete size distribution is required as well as the PM-10 concentration, the entire cascade impactor with the preimpactor is used in conjunction with an EPA Method 5 sampling train except that the final filter and its support are removed from the impactor.

The preimpactor and cascade impactor is attached to the in-stack end of the probe. The classifier is equipped with the appropriate "straight" type nozzle and nozzle plug and inserted into the stack gas to preheat for a 20-minute period to prevent condensation prior to initiating sampling. The exact nozzle diameter is selected based on a pretest velocity traverse.

A simple four point sampling grid is used. If the velocities at the four traverse points are ± 20% of one another, one sampler is used to sample each of the four grid points. Otherwise a separate sample is required for each traverse point which does not fall in the ± 20% velocity range. Experience has shown that this requirement is not as stringent as it appears and one sampler can usually be used for all four points.

(1) PM-10 SIP Development Guideline USEPA EPA-450/2-86-001, June 1987: Appendix C.

The velocity pressure, stack gas temperature, moisture content and static pressure for each traverse point from a preliminary test is used together with the impactor 50% cut point curves to select the appropriate nozzle required to give isokinetic sampling with the desired 50% cut points. If the site meets the ± 20% velocity requirements, sampling is initiated after a 20 minute warm up period by uncapping the nozzle and positioning the in-situ impactor nozzle at the first traverse point. The pump is activated and the flow is rapidly adjusted using the calibrated orifice to the desired rate. The data recording by the operator during the test is identical to that for Method 5 sampling except that the flow rate is held constant. Sampling is continued until all four points are sampled.

After sampling is complete, the coarse valve is closed, the pump turned off and the probe withdrawn from the stack. The preimpactor sample is recovered in the field and the impactor catch is returned in tact to the laboratory for gravimetric analysis. The Method 5 Sampling train is also processed up and through the glass fiber filter since the in-stack filter in the impactor is not being used. The EPA Method 5 probe rinse and filter catch are then substituted for the impactor filter catch in the calculations.

The impactor may be operated with bare collection plates or with a coating. The PM-10 Guidelines recommends that a coating be used. A very light film of high temperature silicone grease is applied to each stage before conditioning and weighing. Chemical reactions can occur with this coating which could alter the apparent weight collected by each stage. A control sampling of the same duration is run with an in-stack filter assembly in place of the preimpactor. The instack filter is discarded at the end of the run. The control sample is collected and processed in an identical manner as the other impactor samplings. The change in weight in the stages in the control run is then used to correct the subsequent determinations.

Impactors are not designed in a manner such that they will meet a Method 5 leak check, nor need they be. The maximum pressure drop across the housing is only a few hundredths IN.WC. since the flow has free access to the inside of the impactor through the open nozzle. For this reason, the pre- and post test leak checks are conducted prior to and after removing the impactor assembly from the end of the probe. The standard EPA Method 5 leak specifications are then used for this portion of the sampling train.

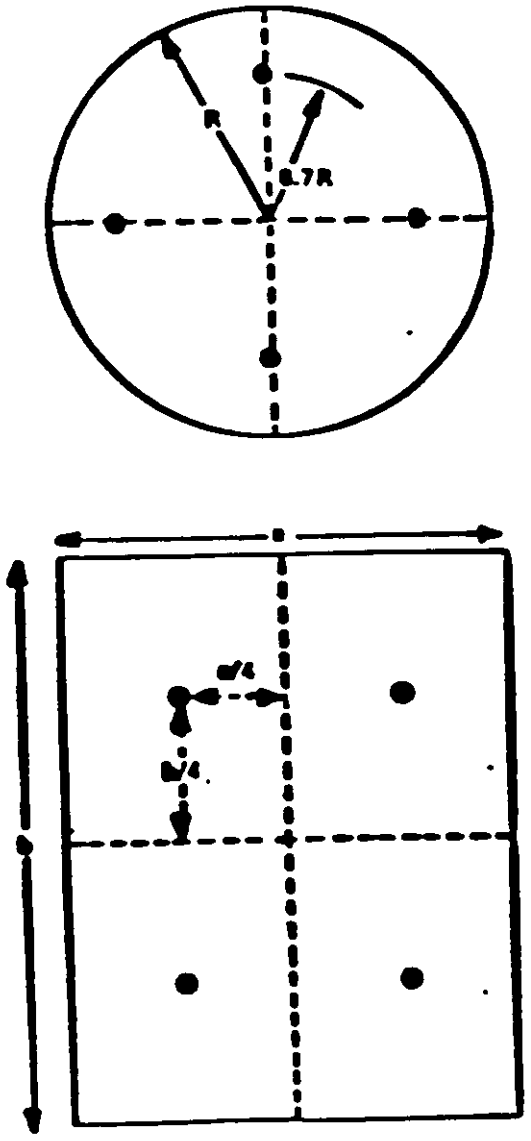


FIGURE 1. RECOMMENDED SAMPLING POINTS FOR CIRCULAR AND SQUARE OR RECTANGULAR DUCTS.

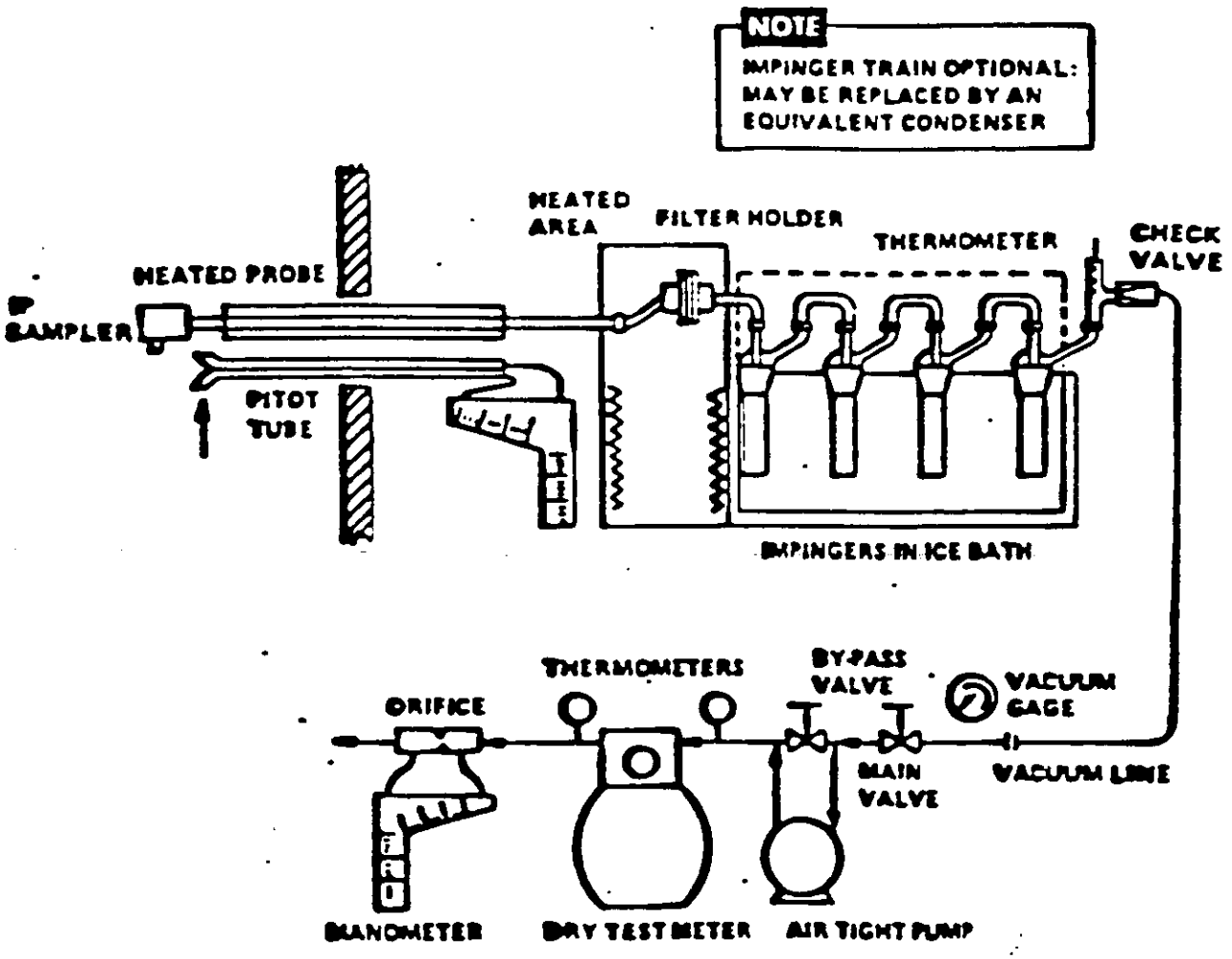


FIGURE 2. PM 10 PARTICULATE SAMPLING TRAIN FOR CONDENSIBLE AND NONCONDENSIBLE PARTICULATE (MODIFIED EPA METHOD 5 TRAIN).

TABLE II

50% EFFECTIVE CUT DIAMETER, μ
PARTICLE DENSITY - 1.0 gm/cm^3

FLOW ACFM	PREIMPACTOR	STAGE NO. 1	STAGE NO. 2	STAGE NO. 3	STAGE NO. 4	STAGE NO. 5	STAGE NO. 6	STAGE NO. 7
				AIR TEMP = 70.0°F				
0.1	24.3	15.6	9.8	6.3	3.8	2.5	1.7	0.95
0.2	17.2	11.0	7.0	4.5	2.7	1.8	1.1	0.66
0.3	14.0	9.0	5.6	3.6	2.2	1.4	0.92	0.53
0.4	12.2	7.8	4.9	3.1	1.9	1.2	0.78	0.45
0.5	11.0	7.0	4.4	2.8	1.7	1.1	0.70	0.40
0.6	10.0	6.4	4.0	2.6	1.6	1.0	0.64	0.36
0.7	9.2	6.0	3.7	2.4	1.4	0.92	0.58	0.33
0.75	9.0	5.7	3.6	2.3	1.4	0.89	0.56	0.32
				AIR TEMP = 150°F				
0.1	25.6	17.0	10.6	6.8	4.2	2.8	1.7	1.0
0.2	18.2	11.8	7.5	4.8	2.9	2.0	1.2	0.70
0.3	15.0	9.6	6.1	3.9	2.4	1.6	0.96	0.55
0.4	13.0	8.2	5.2	3.4	2.0	1.4	0.84	0.47
0.5	11.7	7.4	4.7	3.0	1.8	1.2	0.74	0.42
0.6	10.6	6.7	4.3	2.7	1.6	1.1	0.66	0.38
0.7	9.8	6.2	4.0	2.5	1.5	1.0	0.62	0.35
0.75	9.5	6.0	3.8	2.4	1.4	0.96	0.59	0.33
				AIR TEMP = 300°F				
0.1	28.1	18.0	11.3	7.2	4.7	3.1	1.8	1.1
0.2	20.0	13.0	8.1	5.2	3.2	2.3	1.3	0.76
0.3	16.2	10.3	6.6	4.2	2.6	1.7	1.0	0.60
0.4	14.2	9.0	5.7	3.6	2.3	1.5	0.90	0.52
0.5	12.8	8.1	5.1	3.2	2.0	1.3	0.80	0.46
0.6	11.6	7.4	4.7	2.9	1.8	1.2	0.73	0.44
0.7	10.8	6.8	4.3	2.7	1.7	1.1	0.67	0.39
0.75	10.5	6.6	4.2	2.6	1.6	1.0	0.65	0.37

(TABLE continued...)

TABLE II (continued)

AIR TEMP = 500°F								
0.1	31.0	20.0	11.9	8.0	4.8	3.3	2.1	1.2
0.2	22.0	14.0	8.7	5.6	3.4	2.3	1.5	0.83
0.3	17.8	11.4	7.1	4.5	2.7	1.8	1.2	0.66
0.4	15.3	9.8	6.1	3.9	2.4	1.6	1.0	0.56
0.5	13.9	8.8	5.5	3.5	2.1.	1.4	0.89	0.50
0.6	12.5	8.0	5.0	3.2	1.9	1.3	0.80	0.45
0.7	11.5	7.4	4.6	2.9	1.8	1.2	0.74	0.42
0.75	11.2	7.2	4.4	2.8	1.7	1.1	0.71	0.40
AIR TEMP = 1000°F								
0.1	34.6	22.2	14.0	9.0	5.4	3.6	2.3	1.4
0.2	24.6	15.7	9.8	6.3	3.8	2.6	1.6	0.94
0.3	20.0	12.8	8.0	5.2	3.2	2.1	1.3	0.75
0.4	17.2	11.0	6.9	4.5	2.7	1.8	1.1	0.64
0.5	15.6	9.9	6.2	4.0	2.4	1.6	1.0	0.57
0.6	10.4	9.0	5.6	3.6	2.2	1.5	0.91	0.52
0.7	10.3	8.3	5.2	3.4	2.0	1.4	0.84	0.47
0.75	10.3	8.0	5.0	3.3	2.0	1.3	0.80	0.46

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, ^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_{Ptwb} = 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, ^{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

$\overline{V}_s$ = 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

CALCULATIONS FOR METALS

1. CONCENTRATION (ug/Nm^3)

$$ug/Nm^3 = \frac{35.31\ ft^3}{m^3} \times \frac{ug\ in\ sample}{V_m\ (DSCF)}$$

where V_m = Exhaust gas volume through meter (DSCF)

2. EMISSION RATE (lb/hr)

$$(lb/hr) = \frac{ug}{Nm^3} \times \frac{lb}{454g} \times \frac{g}{1000mg} \times \frac{mg}{1000ug} \times \frac{DSCF}{min} \times \frac{60\ min}{hr} \times \frac{0.0283\ Nm^3}{DSCF}$$

$$(lb/hr) = (3.74 \times 10^{-9}) \times DSCFM \times \frac{ug}{Nm^3}$$

where DSCFM = Volumetric flow rate in the source

Calculation of Elemental Emission Factors

$$E_i = \frac{1.2762 \times 10^{-5} \, C_i}{20.9 - O_2}$$

where E = emission factor of element i in $LB/10^6 BTU$

C_i = concentration of element i in ug/Nm^3

O_2 = oxygen content in flue gas at point of sample collection in %v/v,d

INTERPOLL LABORATORIES, INC.
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Results of Trace Metals Analysis

Facility: NSP/Black Dog
Test: 1
Source: Unit #2, ESP Inlet
Test Type: Particulate

Total Mass of Elements in Sample (ug)

Element	Method	Field Blank 1	Field Blank 2	Run 1	Run 2	Run 3
(Log No.)				(5282-06)	(5282-10)	(5282-14)
(Wt. (g))	EPA 5	ND	ND	7.2804	9.9118	7.1961
Ag	EPA 6010	ND	ND	< 14.56	< 19.82	< 14.39
Al	EPA 6010	ND	ND	591168.48	793935.18	601593.96
As	EPA 7060	ND	ND	112.12	141.74	97.87
B	EPA 6010	ND	ND	4288.16	5164.05	4209.72
Ba	EPA 6010	ND	ND	4623.05	* 1675.09	9642.77
Be	EPA 7091	ND	ND	21.77	34.49	20.72
C	ASTM D3178	ND	ND	78628.32	107047.44	73400.22
Ca	EPA 6010	ND	ND	1456080.00	1843594.80	1561553.70
Cd	EPA 6010	ND	ND	< 14.56	< 19.82	< 14.39
Co	EPA 6010	ND	ND	171.09	369.71	276.33
Cr	EPA 6010	ND	ND	348.73	474.78	350.45
Cu	EPA 6010	ND	ND	1295.91	1536.33	1144.18
Fe	EPA 6010	ND	ND	321793.68	402419.08	302236.20
Hg (F)	EPA 7470	ND	ND	< 0.29	< 0.40	< 0.29
Hg (B)	EPA 7470	ND	0.12	6.17	11.50	7.78
K	EPA 6010	ND	ND	21695.59	25770.68	21588.30
Li	SM 317A	ND	ND	276.66	465.85	237.47
Mg	EPA 6010	ND	ND	254814.00	321142.32	244667.40
Mn	EPA 6010	ND	ND	721.49	1040.74	741.20
Mo	EPA 6010	ND	ND	66.98	82.27	61.53
Na	EPA 6010	ND	ND	115758.36	153632.90	125212.14
Ni	EPA 6010	ND	ND	447.02	558.03	429.61
P	EPA 6010	ND	ND	0.00	0.00	0.00
Pb	EPA 6010	ND	ND	193.66	185.35	207.97
S	ASTM D1552	ND	ND	349459.20	436119.20	338216.70
Sb	EPA 7041	ND	ND	10.92	13.88	15.83
Se	EPA 7740	ND	ND	46.96	48.37	43.10
Si	EPA 6010	ND	ND	829965.60	1169592.40	856335.90
Sn	EPA 6010	ND	ND	0.00	0.00	0.00
Sr	SM 326A	ND	ND	25481.40	31916.00	24754.58
Ti	EPA 6010	ND	ND	54821.41	72157.90	54978.20
Tl	EPA 6010	ND	ND	0.00	0.00	0.00
V	EPA 6010	ND	ND	1565.29	2002.18	1539.97
Zn	EPA 6010	ND	ND	793.56	981.27	675.71

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QA Summary for Compositional Analysis

Facility: NSP/Black Dog
Test: 1
Source: Unit #2, ESP Inlet
Test Type: Particulate

Element as the Oxide		Concentration in Sample (% w/w) Run 1		Run 2		Run 3
(Log No.)		(5282-06)		(5282-10)		(5282-14)
(Wt. (g))		7.2804		9.9118		7.1961
Ag2O	<	0.000215	<	0.000215	<	0.000215
Al2O3		15.343128		15.135278		15.796620
As2O3		0.002033		0.001888		0.001796
B2O3		0.189668		0.167771		0.188380
BaO		0.625199	•	0.628548		0.636363
BeO		0.000830		0.000966		0.000799
C		1.080000		1.080000		1.020000
CaO		27.984032		26.025150		30.362675
CdO	<	0.000228	<	0.000228	<	0.000228
CoO		0.002988		0.004743		0.004883
Cr2O3		0.007001		0.007001		0.007118
CuO		0.022282		0.019402		0.019903
Fe2O3		6.318978		5.804310		6.004458
HgO (F)	<	0.000004	<	0.000004	<	0.000004
HgO (B)		0.000092		0.000125		0.000117
K2O		0.358987		0.313211		0.361397
Li2O		0.008180		0.010118		0.007104
MgO		5.804527		5.373333		5.638683
Mn3O4		0.013757		0.014577		0.014299
MoO3		0.001380		0.001245		0.001283
Na2O		2.143284		2.089365		2.345481
NiO		0.007813		0.007164		0.007597
PO3		0.000000		0.000000		0.000000
PbO		0.002865		0.002014		0.003113
SO3		11.986525		10.987648		11.736806
Sb2O3		0.000180		0.000168		0.000263
SeO2		0.000906		0.000686		0.000842
SiO2		24.382770		25.238305		25.452189
SnO2		0.000000		0.000000		0.000000
SrO		0.413912		0.380799		0.406817
TiO2		1.256048		1.214347		1.274397
Tl2O		0.000000		0.000000		0.000000
V2O5		0.038383		0.036062		0.038204
ZnO		0.013567		0.012323		0.011688
TOTAL		98.009764		94.556994		101.343721

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QA Summary for Compositional Analysis

Facility: NSP/Black Dog
Test: 1
Source: Unit #2, Stack
Test Type: 4M5

Element as the Oxide		Concentration in Sample (% w/w) Run 1		Run 2		Run 3
(Log No.)		(5282-55)		(5282-56)		(5282-57)
(Wt. (g))		0.0365		0.0410		0.0415
Ag2O	<	0.003575	<	0.003109	<	0.003065
Al2O3		11.004022		11.813092		11.914125
As2O3		0.004275		0.003860		0.003503
B2O3		1.650268		1.575132		1.295416
BaO		0.333628		0.345753		0.366303
BeO	<	0.000462	<	0.000402	<	0.000396
C		0.000000		0.000000		0.000000
CaO		31.336528		31.102368		31.656687
CdO		0.025432		0.064805		0.031191
CoO		0.000000		0.000000		0.000000
Cr2O3		0.046256		0.079110		0.026772
CuO		0.096226		0.107605		0.067499
Fe2O3		7.659597		7.199888		7.790582
HgO (F)		0.013007		0.009032		0.010228
HgO (B)		0.004312		0.004813		0.004991
K2O	<	0.481061		0.627607		0.515545
Li2O		0.000000		0.000000		0.000000
MgO		6.457139		6.528143		6.576965
Mn3O4		0.040608		0.041386		0.059015
MoO3		0.053422		0.098139		0.036256
Na2O		6.235236		6.418011		5.307300
NiO		0.264245		0.290600		0.060631
PO3		0.000000		0.000000		0.000000
PbO		0.295026		1.636876		0.313485
SO3		0.000000		0.000000		0.000000
Sb2O3	<	0.003984	<	0.003465	<	0.003415
SeO2		0.004676		0.002034		0.002967
SiO2		0.000000		0.000000		0.000000
SnO2		0.000000		0.000000		0.000000
SrO		0.365998		0.373094		0.411635
TiO2		1.049128		1.052494		1.132662
Tl2O		0.000000		0.000000		0.000000
V2O5		0.043131		0.037513		0.036978
ZnO		0.840861		0.554811		0.283392
TOTAL		68.312105		69.973141		67.911002

	Inlet			Stack			Avg.	Avg.	Removal
	LB/HR			LB/HR					
	Run1	Run2	Run3	Run1	Run2	Run3	Inlet	Stack	Efficienc
Ag	-0.00626	-0.00844	-0.00610	-0.000602	-0.000597	-0.000601	-0.00693	-0.00060	91.347
Al	256	339	255	1.054	1.290	1.328	283.3982	1.223824	99.568
As	0.0486	0.0606	0.0415	0.000584	0.000603	0.000559	0.050216	0.000582	98.841
B	1.86	2.20	1.78	0.0927	0.1009	0.0847	1.948783	0.092790	95.239
Ba	17.7	23.8	17.4	0.0541	0.0639	0.0691	19.62563	0.062354	99.682
Be	0.00946	0.01471	0.00877	-0.000030	-0.000030	-0.000030	0.010981	-0.00003	99.727
Ca	634	785	661	4.05	4.59	4.76	693.1246	4.467752	99.355
Cd	-0.00634	-0.00844	-0.00610	0.00403	0.01171	0.00575	-0.00696	0.007161	-2.885
Cr	0.151	0.203	0.148	0.00573	0.01117	0.00386	0.167447	0.006917	95.869
Cu	0.564	0.657	0.483	0.01391	0.01774	0.01135	0.568000	0.014334	97.476
Fe	140	171	128	0.969	1.039	1.147	146.3843	1.052030	99.281
Hg	0.00268	0.00490	0.00330	0.00290	0.00265	0.00297	0.003626	0.002838	21.721
K	9.42	11.00	9.16	-0.0723	0.1075	0.0901	9.857783	0.041789	99.576
Mg	111	137	104	0.704	0.812	0.835	117.1264	0.783937	99.331
Mn	0.313	0.443	0.314	0.00529	0.00615	0.00895	0.356807	0.006798	98.095
Mo	0.0291	0.0351	0.0261	0.0064	0.0135	0.0051	0.030078	0.008343	72.261
Na	50.3	65.7	53.0	0.837	0.983	0.829	56.32904	0.882836	98.433
Ni	0.194	0.238	0.182	0.0376	0.0471	0.0100	0.204723	0.031577	84.575
Pb	0.0842	0.0789	0.0882	0.0496	0.3136	0.0613	0.083744	0.141474	-68.936
S	152	186	143	181	178	167	160.3234	175.2109	-9.286
Sb	0.00473	0.00593	0.00670	-0.000602	-0.000597	-0.000601	0.005784	-0.00060	89.627
Se	0.0204	0.0206	0.0183	0.000602	0.000299	0.000445	0.019767	0.000448	97.731
Si	360	499	363	0	0	0	407.2848	0	100.000
Sr	11.1	13.6	10.5	0.0560	0.0651	0.0733	11.72660	0.064796	99.447
V	0.681	0.853	0.653	0.00437	0.00434	0.00436	0.728952	0.004356	99.402
Zn	0.345	0.418	0.287	0.1222	0.0920	0.0479	0.349797	0.087384	75.018

Units 2 ESP Stack

Metal	(ug) Run1	(ug) Run2	(ug) Run3	ug/NM3 Run1	ug/NM3 Run2	ug/NM3 Run3
Ag	-1	-1	-1	-0.460	-0.460	-0.457
Al	1750	2160	2210	804	993	1011
As	0.97	1.01	0.93	0.446	0.465	0.425
B	154	169	141	70.8	77.7	64.5
Ba	89.8	107	115	41.3	49.2	52.6
Be	-0.05	-0.05	-0.05	-0.023	-0.023	-0.023
Ca	6730	7680	7930	3094	3532	3627
Cd	6.69	19.6	9.57	3.08	9.01	4.38
Cr	9.51	18.7	6.42	4.37	8.60	2.94
Cu	23.1	29.7	18.9	10.62	13.66	8.64
Fe	1610	1740	1910	740	800	873
Hg	4.82	4.43	4.94	2.22	2.04	2.26
K	-120	180	150	-55.2	82.8	68.6
Mg	1170	1360	1390	538	626	636
Mn	8.79	10.3	14.9	4.04	4.74	6.81
Mo	10.7	22.6	8.47	4.92	10.39	3.87
Na	1390	1645	1380	639	757	631
Ni	62.4	78.9	16.7	28.69	36.29	7.64
Pb	82.3	525	102	37.8	241.5	46.6
S	300000	298000	278000	137911	137063	127136
Sb	-1	-1	-1	-0.460	-0.460	-0.457
Se	1	0.5	0.74	0.460	0.230	0.338
Si	NM	NM	NM	0	0	0
Sr	93	109	122	42.8	50.1	55.8
V	7.26	7.26	7.26	3.34	3.34	3.32
Zn	203	154	79.8	93.3	70.8	36.5
Vm(DSCF)	76.82	76.78	77.22			
Vm(NM3)	2.18	2.17	2.19			
DSCFM	354000	351000	355000			
O2	10.4	10.2	10.2			

Stack

LB/HR				LB/MMBTU		
Run1	Run2	Run3		Run1	Run2	Run3
-0.000602	-0.000597	-0.000601	Ag	-5.57E-07	-5.47E-07	-5.44E-07
1.054	1.290	1.328	Al	9.76E-04	1.18E-03	1.20E-03
0.000584	0.000603	0.000559	As	5.41E-07	5.53E-07	5.06E-07
0.0927	0.1009	0.0847	B	8.59E-05	9.25E-05	7.67E-05
0.0541	0.0639	0.0691	Ba	5.01E-05	5.86E-05	6.26E-05
-0.000030	-0.000030	-0.000030	Be	-2.79E-08	-2.74E-08	-2.72E-08
4.05	4.59	4.76	Ca	3.75E-03	4.20E-03	4.32E-03
0.00403	0.01171	0.00575	Cd	3.73E-06	1.07E-05	5.21E-06
0.00573	0.01117	0.00386	Cr	5.30E-06	1.02E-05	3.49E-06
0.01391	0.01774	0.01135	Cu	1.29E-05	1.63E-05	1.03E-05
0.969	1.039	1.147	Fe	8.98E-04	9.52E-04	1.04E-03
0.00290	0.00265	0.00297	Hg	2.69E-06	2.42E-06	2.69E-06
-0.0723	0.1075	0.0901	K	-6.69E-05	9.85E-05	8.16E-05
0.704	0.812	0.835	Mg	6.52E-04	7.44E-04	7.57E-04
0.00529	0.00615	0.00895	Mn	4.90E-06	5.64E-06	8.11E-06
0.0064	0.0135	0.0051	Mo	5.97E-06	1.24E-05	4.61E-06
0.837	0.983	0.829	Na	7.75E-04	9.00E-04	7.51E-04
0.0376	0.0471	0.0100	Ni	3.48E-05	4.32E-05	9.09E-06
0.0496	0.3136	0.0613	Pb	4.59E-05	2.87E-04	5.55E-05
181	178	167	S	1.67E-01	1.63E-01	1.51E-01
-0.000602	-0.000597	-0.000601	Sb	-5.57E-07	-5.47E-07	-5.44E-07
0.000602	0.000299	0.000445	Se	5.57E-07	2.74E-07	4.03E-07
0	0	0	Si	0.00E+00	0.00E+00	0.00E+00
0.0560	0.0651	0.0733	Sr	5.18E-05	5.97E-05	6.64E-05
0.00437	0.00434	0.00436	V	4.05E-06	3.97E-06	3.95E-06
0.1222	0.0920	0.0479	Zn	1.13E-04	8.43E-05	4.34E-05

NSP High Bridge - Metals
Units 2 ESP Inlet

	(ug)			ug/NM3	
Metal	Run1	Run2	Run3	Run1	Run2	Run3
Ag	-14.6	-19.8	-14.4	-4.79	-6.63	-4.81
Al	591000	794000	602000	193949	266006	201053
As	112	142	97.9	36.8	47.6	32.7
B	4290	5160	4210	1408	1729	1406
Ba	40800	55800	41000	13389	18694	13693
Be	21.8	34.5	20.7	7.15	11.56	6.91
Ca	1460000	1840000	1560000	479130	616437	521000
Cd	-14.6	-19.8	-14.4	-4.79	-6.63	-4.81
Cr	349	475	350	115	159	117
Cu	1300	1540	1140	427	516	381
Fe	322000	402000	302000	105671	134678	100860
Hg	6.17	11.5	7.78	2.02	3.85	2.60
K	21700	25800	21600	7121	8644	7214
Mg	255000	321000	245000	83684	107541	81824
Mn	721	1040	741	237	348	247
Mo	67	82.3	61.5	22.0	27.6	20.5
Na	116000	154000	125000	38068	51593	41747
Ni	447	558	430	147	187	144
Pb	194	185	208	63.7	62.0	69.5
S	349460	436120	338220	114683	146109	112957
Sb	10.9	13.9	15.8	3.58	4.66	5.28
Se	47	48.4	43.1	15.4	16.2	14.4
Si	830000	1169600	856300	272382	391840	285982
Sr	25500	31900	24800	8368	10687	8283
V	1570	2000	1540	515	670	514
Zn	794	981	676	261	329	226
Vm(DSCF)	107.61	105.41	105.74			
Vm(NM3)	3.05	2.98	2.99			
DSCFM	353000	344000	343000			
O2	7.6	7.7	7.2			

LB/HR				LB/MMBTU		
Run1	Run2	Run3		Run1	Run2	Run3
-0.00626	-0.00844	-0.00610	Ag	-4.59E-06	-6.40E-06	-4.47E-06
256	339	255	Al	1.86E-01	2.57E-01	1.87E-01
0.0486	0.0606	0.0415	As	3.52E-05	4.59E-05	3.04E-05
1.86	2.20	1.78	B	1.35E-03	1.67E-03	1.31E-03
17.7	23.8	17.4	Ba	1.28E-02	1.80E-02	1.27E-02
0.00946	0.01471	0.00877	Be	6.85E-06	1.11E-05	6.43E-06
634	785	661	Ca	4.59E-01	5.95E-01	4.84E-01
-0.00634	-0.00844	-0.00610	Cd	-4.59E-06	-6.40E-06	-4.47E-06
0.151	0.203	0.148	Cr	1.10E-04	1.54E-04	1.09E-04
0.564	0.657	0.483	Cu	4.08E-04	4.98E-04	3.54E-04
140	171	128	Fe	1.01E-01	1.30E-01	9.37E-02
0.00268	0.00490	0.00330	Hg	1.94E-06	3.72E-06	2.42E-06
9.42	11.00	9.16	K	6.82E-03	8.34E-03	6.71E-03
111	137	104	Mg	8.01E-02	1.04E-01	7.61E-02
0.313	0.443	0.314	Mn	2.27E-04	3.36E-04	2.30E-04
0.0291	0.0351	0.0261	Mo	2.11E-05	2.66E-05	1.91E-05
50.3	65.7	53.0	Na	3.64E-02	4.98E-02	3.88E-02
0.194	0.238	0.182	Ni	1.40E-04	1.80E-04	1.33E-04
0.0842	0.0789	0.0882	Pb	6.10E-05	5.98E-05	6.46E-05
152	186	143	S	1.10E-01	1.41E-01	1.05E-01
0.00473	0.00593	0.00670	Sb	3.42E-06	4.49E-06	4.90E-06
0.0204	0.0206	0.0183	Se	1.48E-05	1.56E-05	1.34E-05
360	499	363	Si	2.61E-01	3.78E-01	2.66E-01
11.1	13.6	10.5	Sr	8.01E-03	1.03E-02	7.70E-03
0.681	0.853	0.653	V	4.93E-04	6.46E-04	4.78E-04
0.345	0.418	0.287	Zn	2.49E-04	3.17E-04	2.10E-04

NSP Black Dog
BTX Calculation

	Test/Run	Mass (ug)	Vstd (DSCF)	Concentration (ppm,d)	Concentration (LB/DSCF)	Gas Flow (DSCFM)	Mass Rate (LB/HR)
Benzene	3/1	< 5	2.35	0.02	4.69E-09	354118	0.099664
	3/2	< 5	2.32	0.02	4.75E-09	354118	0.101
	3/3	< 5	2.36	0.02	4.67E-09	347749	0.097
Toluene	3/1	< 5	2.35	0.02	4.69E-09	354118	0.100
	3/2	< 5	2.32	0.02	4.75E-09	354118	0.101
	3/3	< 5	2.36	0.02	4.67E-09	347749	0.097
Xylene	3/1	< 5	2.35	0.02	4.69E-09	354118	0.09966
	3/2	< 5	2.32	0.02	4.75E-09	354118	0.10095
	3/3	< 5	2.36	0.02	4.67E-09	347749	0.09746
Ethyl-Benzene	3/1	< 5	2.35	0.02	4.69E-09	354118	0.09966
	3/2	< 5	2.32	0.02	4.75E-09	354118	0.10095
	3/3	< 5	2.36	0.02	4.67E-09	347749	0.09746

APPENDIX H

SAMPLING TRAIN CALIBRATION DATA

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job NSP/ BLOCK DOG Date 1-30-92

Operator D. BRENNAN 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 29.22 in. Hg. γ = .9959 ^H@ 1.80 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(78.00)	[redacted]	
2.5	79.72	93	85
5.0	81.84	94	86
7.5	84.77	94	86
10	85.702	98	87
[redacted]	V_m = 7.702	Avg(t_m) = 96.375 °F	

Calculate Y_{en} as follows:

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

$$Y_{en} = \frac{1.786}{(.9959)(7.702)}\left[\frac{(96.375) + 460}{(29.22)}\right]^{0.5}$$

$$Y_{en} = 1.0105$$

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

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job NSP BLACKDOG Date 1-31-92

Operator BOB ASCHENBACH Module No. 7

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 29.04 in. Hg. γ = 1.0083 ^H@ 1.86 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	281.400	[redacted]	
2.5	283.24	50	45
5.0	285.08	51	46
7.5	286.94	51	47
10	288.805	53	48
[redacted]	V_m=7.405	Avg(t_m) = 48.875°F	

Calculate Y_{en} as follows:

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

$$Y_{en} = \frac{1.786}{(1.0083)(7.405)}\left[\frac{(48.875 + 460}{(29.04)}\right]^{0.5}$$

$$Y_{en} = 1.0013$$

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

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job NSP / BLACK DOG Date 1-31-92

Operator D. BROWN Module No. 8

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 29.64 in. Hg. Y = .9993 ^H@ 1.88 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(129.00)	[redacted]	
2.5	130.94	55	50
5.0	132.88	57	51
7.5	134.82	59	53
10	136.738	60	53
[redacted]	V_m = 7.738	Avg (t_m) = 54.75	°F

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(.9993)(7.738)}\left[\frac{(54.75) + 460}{(29.64)}\right]^{0.5}$$

Y_{cn} = .9724

If Y_{cn} 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

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: February 5, 1992

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

Date of Last Calibration: January 24, 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.)
January 31, 1992	2-3496	78.00	426.80	348.80	348.80

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: February 5, 1992

Meter Box No. : 7 (Rockwell Dry Test Meter Serial No. 964551)

Date of Last Calibration: January 3, 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.)
January 16, 1992	2-3485	892.00	1024.76	132.76	132.76
January 21, 1992	2-3490	1033.06	1172.81	139.75	272.51
January 22, 1992	2-3489	1173.66	1278.51	104.85	377.36
January 31, 1992	2-3496	1281.40	1523.37	241.97	619.33

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-620

Meter Box Calibration and Usage Status

Date of Report: February 5, 1992

Meter Box No. : 8 (Rockwell Dry Test Meter Serial No. 964553)

Date of Last Calibration: January 2, 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.)
January 16, 1992	2-3485	923.00	1122.81	199.81	199.81
January 31, 1992	2-3496	1129.00	1280.85	151.85	351.66

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: February 5, 1992

Meter Box Number: 1-S (Rockwell Dry Test Meter Serial No. 69184)

Date of Last Calibration: January 2, 1992
Calibration Technician: Duane VanHoever
Wet Test Meter Number: American Meter AL-17 (0.05 CF/REV)

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
January 7, 1992	2-3481	961.758	968.960	7.202	7.202
January 16, 1992	2-3485	970.092	977.228	7.136	14.338
January 31, 1992	2-3496	977.631	984.965	7.334	21.672

* Total volume through meter since last calibration.

Date 1-24-92

Bar. Press. 29.16 in. Hg

INTERPOLL LABORATORIES, INC.
METER CALIBRATION SHEET
EPA METHOD 5

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 ♦ (%)	* 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. ΔHθ	C_f
nominal	actual				V_{dI}	V_{df}	Wet Test t_w (°F)	Dry Test t_{dI} (°F)	Dry Test t_{do} (°F)				
0.5	.50	2	99.85	0.01	46.50	48.533	64.0	74	68	4.58	.9941	1.74	
1.2	1.2	3	99.91	0.025	49.50	52.558	64.0	72	69	4.50	.9930	1.75	
2.0	2.0	3	99.93	0.055	30.415	33.414	64.5	68	65	3.45	.9982	1.78	
3.3	3.3	5	100.00	0.09	34.000	39.031	64.5	75	67	4.59	.9976	1.85	
4.7	4.7	5	100.02	0.12	41.000	46.047	64.0	78	69	4.14	.9967	1.88	
	8	9	4	5	6	7	8	9	10	11/13	.9959	1.80	

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 L. Degan Date 1/27/92

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

Date 11/3/92

Bar. Press. 29.02 in. Hg

INTERPOLL LABORATORIES, INC.
METER CALIBRATION SHEET
EPA METHOD 5

Control Module No. 7
Serial No. DTM 965550
Wet Test Meter No. AL-20
Technician D. BRONNAN

ΔH (in. WC)		Gas Volume Wet Test Meter (ft^3)	* Cal. Index θ (X)	* Diff. Wet Test Meter ΔP_w (in.WC)	Gas Volume Dry test meter (ft^3)		Gas temperatures			Time θ	Meter Coeff.	Orifice Const.	C_f
							Wet Test	Dry Test					
nominal	actual				V_{d1}	V_{df}	t_w (°F)	t_{d1} (°F)	t_{do} (°F)	(min/sec)	Y	ΔH@	
0.5	.5	2	99.85	0.01	836.180	838.200	73	88	82	4/54	1.0095	1.77	
1.2	1.2	3	99.91	0.025	832.650	835.680	73	89	82	4/56	1.0092	1.85	
2.0	2.0	3	99.93	0.055	813.160	816.160	73	84	78	3/50	1.0090	1.88	
3.3	3.3	5	100.00	0.09	817.150	822.180	73	89	81	4/54	1.0077	1.87	
4.7	4.7	5	100.02	0.12	824.130	829.160	73	91	81	4/14	1.0061	1.91	
	8	8	4	8	6	7	8	8	10	11/13	1.0083	1.86	

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

Approved by Daniel J. Dezan Date 11/5/92

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

Date 11/2/92

Bar. Press. 29.11 in. Hg

INTERPOLL LABORATORIES, INC.
METER CALIBRATION SHEET
EPA METHOD 5

Control Module No. 8
Serial No. DTM 964 552
Wet Test Meter No. AL-20
Technician D. BRENNAN

ΔH (in. WC)		Gas Volume Wet Test Meter (ft^3)	* Cal. Index Φ (%)	* 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. ΔHθ	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	920.37	922.44	71°	89	83	5.03	.9907	1.80	
1.2	1.2	3	99.91	0.025	916.23	919.32	71°	91	83	4.57	.9961	1.84	
2.0	2.0	3	99.93	0.055	896.92	899.96	71°	84	80	3.54	1.0008	1.92	
3.3	3.3	5	100.00	0.09	904.02	909.09	71°	91	83	5.03	1.0013	1.89	
4.7	4.7	5	100.02	0.12	910.10	915.20	71°	94	81	4.17	1.0016	1.93	
	8	8	6	8	6	7	8	8	10	11/15 Avg.	.9993	1.88	

Positive leak check performed by XuH
Meter was in tolerance ☐
Meter was not in tolerance ☐; readjusted linkage
Meter was not in tolerance ☐; changed dry test meters

Approved by Daniel J. Dezan Date 1/2/91

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

Date 1/2/92

Bar. Press. 29.11 in. Hg

INTERPOLL LABORATORIES
MINIMODULE CALIBRATION SHEET
Flow Rate Range 0-0.13 CFM
(0-4 LPM)

Meter Box No. 15
Serial No. DTM 69184
Wet Test Meter No. AL-17 (.05 CF/REV)
Technician D. VanHoever

Rotameter Reading (cc/min)	ΔP_d (IN/WC)	Gas Volume Wet Test Meter (ft^3)	** Cal. Index ♦ (%)	Diff. Wet Test Meter ΔP_w (in.WC)	Gas Volume Dry test meter (ft^3) V_{d1}	Gas Volume Dry test meter (ft^3) V_{df}	Gas temperatures Wet Test t_w (°F)	Gas temperatures Dry Test t_{d1} (°F)	Gas temperatures Dry Test	Time ♦ (min/sec)	Meter Coeff. Y	Rotameter Coeff. Z
1000	.001	.2	99.55	0.04	960.792	961.00	68.2	87			.9947	
1000	.001	.2	99.55	0.04	961.212	961.421	68.2	92			.9990	
1000	.001	.2	99.55	0.04	961.421	961.833	68.2	95			.9902	
1	2	3	4	5	6	7	8	9		10/11 Average:	.9946	

Meter was in tolerance ☒
Meter was not in tolerance ☐; readjusted linkage
Meter was not in tolerance ☐; changed dry test meters

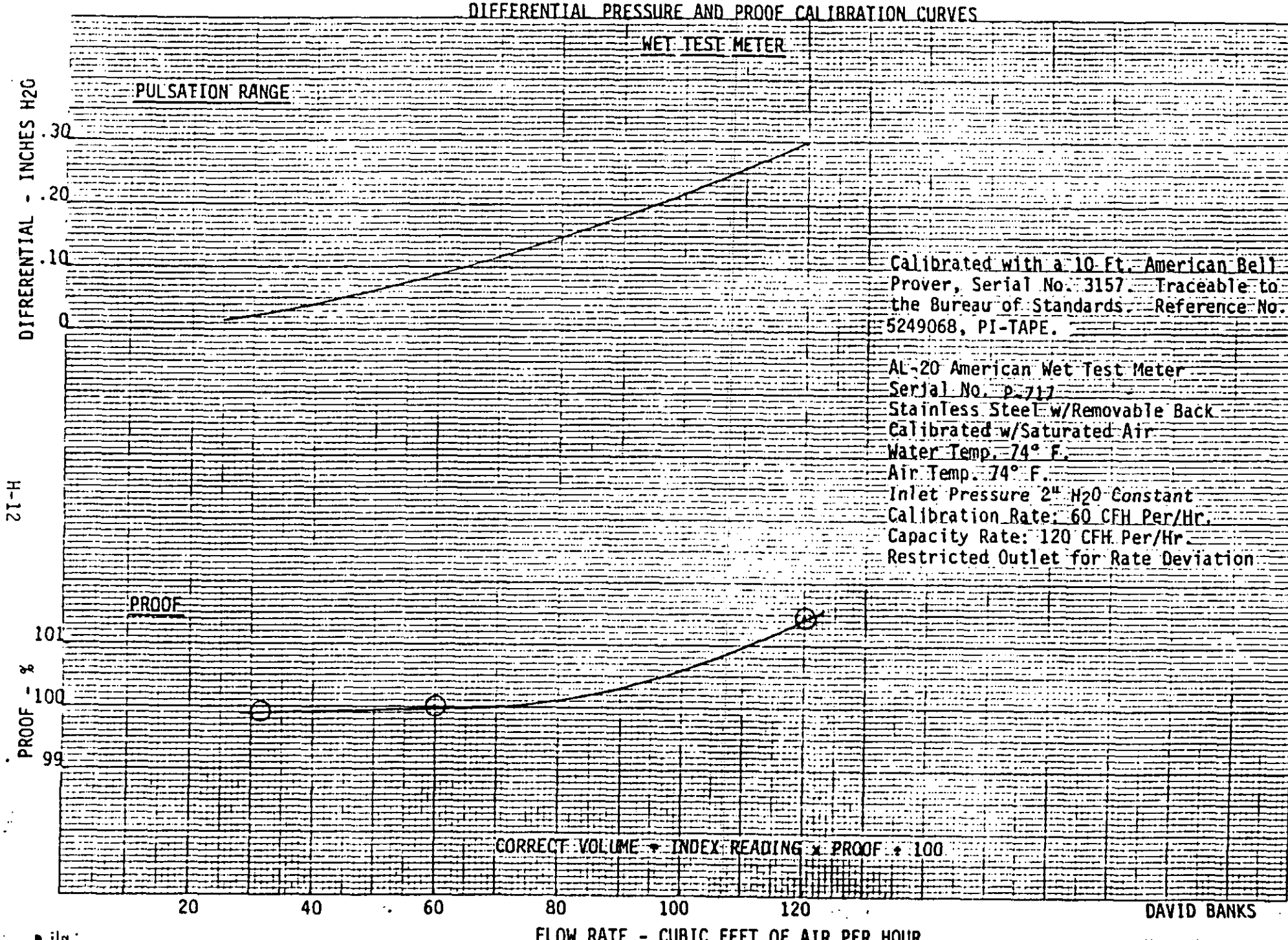
Gas Meter Bimetallic Therm. Calibration/Verification*
☐ ≥ ± 5°F (Out of control) ☐ Recalibrated 11
■ ≤ ± 5°F (in control) ☐ No action required

Approved by Daniel J. Dezzo Date 1/8/92

* Verified against mercury in glass thermometer or calibrated platinum resistance thermometer.

** Based on AL-17 wet test meter calibration in August 1989 against Bell Prover (NBS Traceable) - Carl Poe Co.

DIFFERENTIAL PRESSURE AND PROOF CALIBRATION CURVES



Calibrated with a 10 Ft. American Bell Prover, Serial No. 3157. Traceable to the Bureau of Standards. Reference No. 5249068, PI-TAPE.

AL-20 American Wet Test Meter
Serial No. P-717
Stainless Steel w/Removable Back
Calibrated w/Saturated Air
Water Temp. 74° F.
Air Temp. 74° F.
Inlet Pressure 2" H_2O Constant
Calibration Rate: 60 CFH Per/Hr.
Capacity Rate: 120 CFH Per/Hr.
Restricted Outlet for Rate Deviation

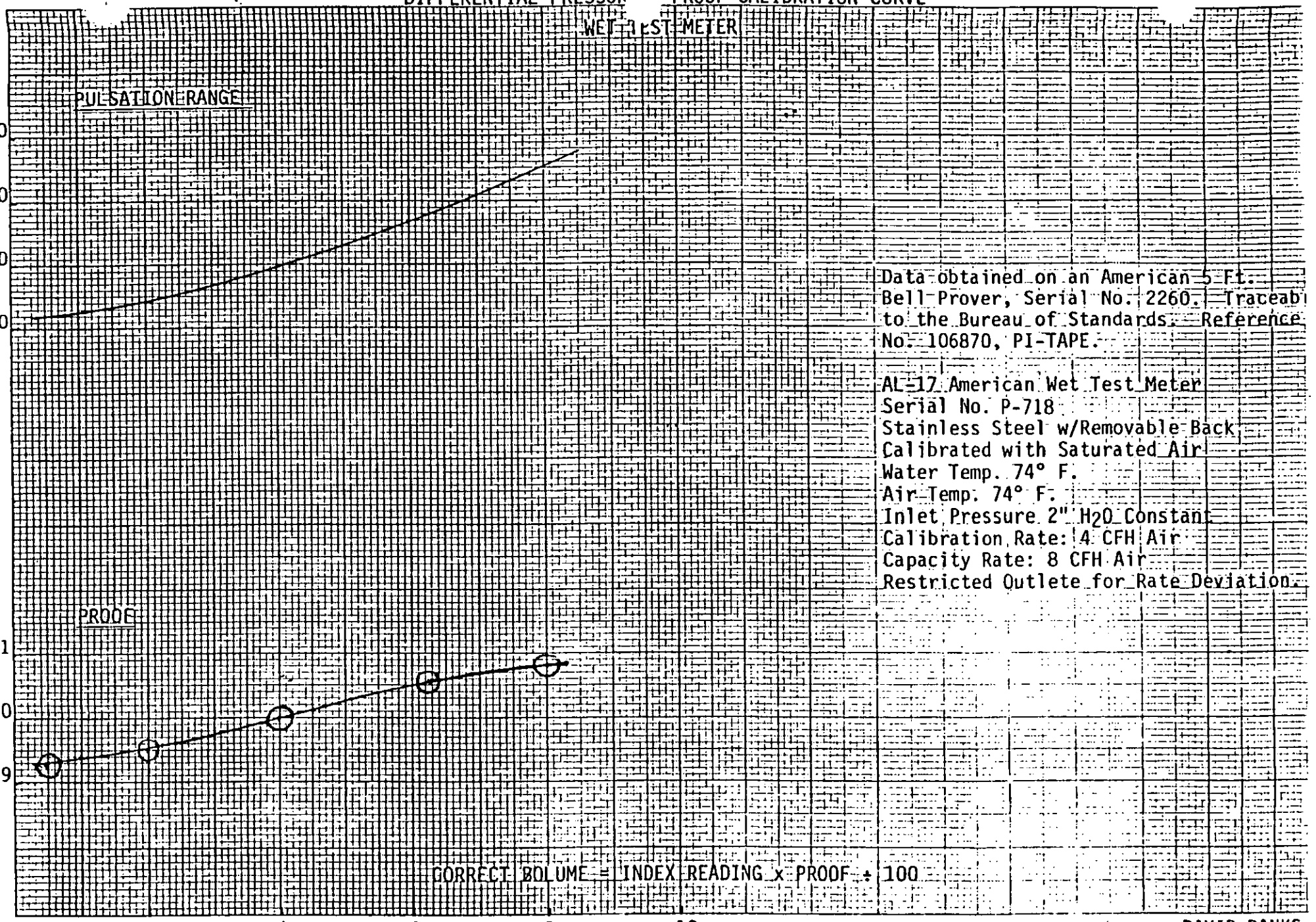
DAVID BANKS

November 1991

H-12

DIFFERENTIAL PRESSUR PROOF CALIBRATION CURVE

WET TEST METER



Data obtained on an American 5 Ft. Bell Prover, Serial No. 2260. Traceab to the Bureau of Standards. Reference No. 106870, PI-TAPE.

AL-17 American Wet Test Meter
Serial No. P-718
Stainless Steel w/Removable Back
Calibrated with Saturated Air
Water Temp. 74° F.
Air Temp. 74° F.
Inlet Pressure 2" H_2O Constant
Calibration Rate: 4 CFH Air
Capacity Rate: 8 CFH Air
Restricted Outlete for Rate Deviation.

CORRECT VOLUME = INDEX READING x PROOF ÷ 100

DAVID BANKS
AUGUST, 1989

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 1-31-92 Nozzle Number 1-4
Technician: E. Trowbridge

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	.250
2	.249
3	.250
Average:	.250

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 1-31-92 Nozzle: glass

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	.365
2	.365
3	.365
Average:	.365

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 1-31-92 Nozzle: Cascade
Technician: D. Van Hoever Impactor

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	.264
2	.262
3	.264
Average:	.263

Interpoll Laboratories, Inc.

Temperature Measurement Device Calibration Sheet

Unit under test: #12

Vendor: Fluke

Model: 51 — Serial Number: 5030375

Range: 0-2100 °F — Thermocouple Type: K

Date of Calibration: 1-3-92 — Technician: E. Trowbridge

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	1.0	+1.0	.21
100	100	100.6	+.6	.10
200	200	203	+3	.45
300	300	301.8	+1.8	.23
400	400	400.0	—	—
500	500	500.8	+.8	.09
600	600	602.8	+2.8	.24
700	700	700.6	+.6	.05
800	800	802.4	+2.4	.19
900	900	900.8	+.8	.05
1000	1000	1002.2	+2.2	.15
1100	1100	1101.8	+1.8	.11
1200	1200	1203.6	+3.6	.21
1300	1300	1300.8	+.8	.04
1400	1400	1404.0	+4.0	.21
1500	1500	1501.4	+1.4	.07
1600	1600	1602.4	+2.4	.11
1700	1700	1701.4	+1.4	.06
1800	1800	1802.4	+2.4	.10
1900	1900	1900.4	+.4	.01
2000	2000	2001.6	+1.6	.06
2100	2100	2099.0	-1.0	.02
		Averages:	1.07	.12

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

Interpoll Laboratories, Inc.

Temperature Measurement Device Calibration Sheet

Unit under test:

Vendor Beckman Industrial

Model HD110 T Serial Number 10507095 (PDT #18)

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

Date of Calibration 9/12/91 Technician D.W.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)	(%)
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. 23-6

Pitot tube dimensions:

1. External tubing diameter (D_t) .313 IN.
2. Base to Side A opening plane (P_A) .464 IN.
3. Base to Side B opening plane (P_B) .465 IN.

Alignment:

4. α_1 <10° 0
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 .758 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) .762 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: 2-11-94

Inspected by: [signature]

CFR Title 40 Part 60 Appendix A Method 2

Interpoll Inc.
(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 24-8

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .458 IN.
3. Base to Side B opening plane (P_B) .458 IN.

Alignment:

4. $\alpha_1 < 10^0$ .01
5. $\alpha_2 < 10^0$ .01

6. $B_1 < 5^0$ 0
7. $B_2 < 5^0$ .01

8. Z <.125" .01
9. W <.0625" .02

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .760 IN.
11. Pitot to probe sheath 3.0 IN.
12. Pitot to thermocouple (parallel to probe) _____ IN.
13. Pitot to thermocouple (perpendicular to probe) _____ IN.

Date of Inspection: 6-26-90

Inspected by: E Burkle

S-348(1)

Interpoll Laboratories
(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 4M5-8

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) .463 IN.

Alignment:

4. α_1 <10° 0
5. α_2 <10° 0

6. B_1 < 5° 0
7. B_2 < 5° 2

8. Z <.125" .02
9. W <.0625" .01

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .760 IN.
11. Pitot to probe sheath 3.00 IN.
12. Pitot to thermocouple (parallel to probe) 3.00 IN.
13. Pitot to thermocouple (perpendicular to probe) .762 IN.

Date of Inspection: 2-1-91

Inspected by: E Crawford

S-348(1)

INTERPOLL LABORATORIES
(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 1-6-92
Technician [illegible]
Mercury Column Barometer No.
Aneroid Barometer No. [illegible] Model 12 [illegible]

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjsted Mercury Barometer Read	Initial Aneriod Barometer Read	Difference (P_{ba}-P_{bm})
			29.06	29.06	0

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

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.

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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.

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APPENDIX I

MASS RATE CONVERSION FACTOR FOR G/SEC

Mass Rate Conversion Factor for g/sec

$$g/\text{sec} = \frac{LB}{HR} x \left[\frac{HR}{3600\,\text{sec}} x \frac{453.6\,g}{LB} \right]$$

$$g/s = 0.126\ (LB/HR)$$

APPENDIX J

RESULTS OF FLYASH COMPOSITION CALCULATION

Testing Laboratory Internal Correspondence

DATE March 20, 1992

FROM T M Leverentz LOCATION CSC-2

TO Roger Clarke LOCATION GO-2
Patricia Boyce GO-2

SUBJECT ANALYSIS OF COAL ASH

1.0 Purpose of Testing

The Testing Lab analyzed samples of coal ash from various plants to provide current information on coal ash generated from NSP's steam plants.

2.0 Test Methods

The samples were leached according to EPA's Methods 1311 and 1312. For Total Composition analyses, the samples were digested with a mixture of acids in a closed microwave vessel that resulted in a nearly complete dissolution of the sample.

3.0 Test Results

The results of the Lab's analyses are attached. Also attached are the results of Interpoll Lab's analyses of Riverside ash. All Total Composition results are reported on a dry weight basis. A floppy disk containing the Lab's results will also be sent to Roger Clarke.

T. M. LEVERENTZ, SUPERVISING CHEMIST, ENVIRONMENTAL LAB

BY T M Leverentz

T.M Leverentz
Supervising Chemist

Attachments

Coal Ash Total Comp.

Lab No.		170.34	171.01	171.02	171.03	171.04	171.05
Plant		Black Dog	Black Dog	Black Dog	Black Dog	High Bridge	High Bridge
Unit No(s).		#2	#2	#1,3,4	#1,3,4	#3,4,5,6	#3,4,5,6
Ash Type		Fly	Bed Material	Fly	Bottom	Fly	Bottom
Aluminum	% Al2O3	13.4	38.1	19.7	17.8	19.8	16.4
Calcium	% CaO	29.6	6.1	25.8	20.1	26.1	16.4
Iron	% Fe2O3	6.4	2.1	7.0	7.9	5.7	5.0
Magnesium	% MgO	5.9	1.3	6.1	5.1	6.4	4.3
Phosphorus	% P2O5	1.9	0.5	1.7	0.8	1.4	0.9
Potassium	% K2O	0.5	0.9	0.7	0.5	0.5	0.4
Silicon	% Si02	24.4	49.4	39.9	53.5	39.0	49.9
Sodium	% Na2O	1.4	1.3	1.8	0.9	2.1	1.2
Sulfur	%SO3	13.2	1.3	2.5	0.7	2.3	1.7
Titanium	% TiO2	1.2	1.7	1.4	1.4	1.5	1.3
Loss on Ignition	%	2.87	0.22	0.56	0.15	0.32	4.79
Carbon	% C	2.07	0.33	0.29	0.85	0.10	3.16
Antimony	mg/Kg Sb	3	2	4	2	3	2
Arsenic	mg/Kg As	15	10	19	7	13	2
Barium	mg/Kg Ba	4800	1500	7900	4200	6550	4000
Beryllium	mg/Kg Be	4	4	6	5	6	5
Boron	mg/Kg B	660	110	620	230	585	250
Bromine	% Br	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	mg/Kg Cd	<10	<10	<10	<10	<10	<10
Chlorine	% Cl	0.016	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/Kg Cr	70	300	100	70	75	40
Cobalt	mg/Kg Co	70	240	120	360	95	220
Copper	mg/Kg Cu	200	320	270	160	245	220
Fluorine	% F	0.034	0.003	0.036	<0.002	0.013	0.002
Lead	mg/Kg Pb	44	39	56	14	48	24
Lithium	mg/Kg Li	400	200	300	300	400	300
Manganese	mg/Kg Mn	220	80	310	290	215	150
Mercury	mg/Kg Hg	0.5	<0.2	<0.2	<0.2	0.2	<0.2
Molybdenum	mg/Kg Mo	80	60	110	110	105	90
Nickel	mg/Kg Ni	90	130	90	70	60	30
Nitrogen	% N	0.10	0.02	0.04	0.04	0.03	0.07
Selenium	mg/Kg Se	17	3	14	7	12	2
Silver	mg/Kg Ag	<5	<5	5	5	7	5
Strontium	mg/Kg Sr	4160	960	3390	2380	3120	2080
Thallium	mg/Kg Tl	20	30	70	50	50	30
Tin	mg/Kg Sn	<100	<100	<100	<100	<100	<100
Uranium	mg/Kg U	<500	<500	<500	<500	<500	<500
Vanadium	mg/Kg V	260	440	400	290	315	190
Zinc	mg/Kg Zn	140	230	240	70	70	30

Coal Ash 1312 Leach

Lab No.		171.06	171.07	171.08	171.09	171.10	171.11
Plant		Black Dog	Black Dog	Black Dog	Black Dog	High Bridge	High Bridge
Unit No(s).		#2	#2	#1,3,4	#1,3,4	#3,4,5,6	#3,4,5,6
Ash Type		Fly	Bed Material	Fly	Bottom	Fly	Bottom
Alkalinity	mg/L CaCO3	611	651	737	128	759	96
Aluminum	mg/L Al	46	175	169	20	55	13
Ammonia	mg/L N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Antimony	mg/L Sb	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/L As	0.004	0.002	0.001	0.001	<0.001	0.001
Barium	mg/L Ba	8.8	2.2	2.9	0.5	12.0	0.8
Beryllium	mg/L Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Boron	mg/L B	<0.05	<0.05	<0.05	0.41	<0.05	0.46
Cadmium	mg/L Cd	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	mg/L Ca	143	148	150	72	224	200
Chloride	mg/L Cl	1	1	3	1	1	<1
Chromium	mg/L Cr	0.15	0.03	0.03	0.02	0.02	0.09
Cobalt	mg/L Co	<0.05	<0.05	<0.05	<0.05	0.05	0.05
Copper	mg/L Cu	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide	mg/L CN	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	mg/L F	<0.1	<0.1	<0.1	<0.1	2.1	0.1
Iron	mg/L Fe	0.03	<0.03	<0.03	<0.03	0.10	0.05
Lead	mg/L Pb	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	mg/L Mg	<1	<1	<1	<1	<1	<1
Manganese	mg/L Mn	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Mercury	mg/L Hg	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum	mg/L Mo	0.23	0.14	0.14	0.06	0.11	0.09
Nickel	mg/L Ni	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrite	mg/L N	0.3	<0.2	<0.2	<0.2	0.4	<0.2
Nitrite + Nitrate	mg/L N	3.9	2.1	2.1	1.9	3.5	1.9
pH		11.7	11.2	11.6	11.0	11.9	10.6
Phosphorus	mg/L P	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Potassium	mg/L K	6.0	3.9	4.2	0.2	2.7	0.8
Selenium	mg/L Se	0.058	<0.005	<0.005	<0.005	0.012	<0.005
Silver	mg/L Ag	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	mg/L Na	53	16	29	<1	56	3
Strontium	mg/L Sr	13.4	10.1	10.6	1.6	21.5	4.4
Sulfate	mg/L SO4	20	60	20	100	5	460
TDS	mg/L	660	890	940	330	830	760
Thallium	mg/L Tl	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tin	mg/L Sn	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vanadium	mg/L V	<0.05	<0.05	<0.05	0.06	<0.05	<0.05
Zinc	mg/L Zn	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Coal Ash TCLP Leach

Lab No.		171.16	171.17	171.18	171.19	171.20	171.21
Plant		Black Dog	Black Dog	Black Dog	Black Dog	High Bridge	High Bridge
Unit No(s).		#2	#2	#1,3,4	#1,3,4	#3,4,5,6	#3,4,5,6
Ash Type		Fly	Bed Material	Fly	Bottom	Fly	Bottom
Arsenic	mg/L As	<0.005	0.007	<0.005	0.009	<0.005	0.006
Barium	mg/L Ba	0.39	0.26	0.36	0.88	2.25	0.32
Beryllium	mg/L Be	<0.005	<0.005	<0.005	0.009	<0.005	0.007
Boron	mg/L B	1.2	4.6	9.7	3.5	3.3	5.3
Cadmium	mg/L Cd	<0.001	0.002	<0.001	0.003	<0.001	0.006
Chromium	mg/L Cr	0.17	0.07	0.73	0.08	0.12	0.13
Copper	mg/L Cu	0.01	0.52	<0.01	0.14	0.01	0.05
Iron	mg/L Fe	0.17	1.89	0.21	15.0	0.24	6.57
Lead	mg/L Pb	<0.005	0.014	<0.005	0.008	<0.005	<0.005
Manganese	mg/L Mn	<0.01	0.22	<0.01	0.25	<0.01	0.29
Mercury	mg/L Hg	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum	mg/L Mo	0.53	0.22	0.51	0.20	0.42	0.27
Nickel	mg/L Ni	0.02	1.29	0.02	0.19	0.01	0.16
Nitrite + Nitrate	mg/L N	2.6	0.8	2.7	0.8	2.3	0.8
pH		10.1	5.0	8.8	4.7	10.3	5.1
Selenium	mg/L Se	0.031	<0.005	0.240	<0.005	0.031	<0.005
Silver	mg/L Ag	0.01	0.01	0.02	0.01	0.01	0.01
Sulfate	mg/L SO4	770	520	1170	190	120	820
Tin	mg/L Sn	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	mg/L Zn	<0.01	1.32	<0.01	0.27	0.01	0.10

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Results of Trace Metals Analysis

Facility: NSP/Black Dog
Test: 1
Source: Unit #2, Coal Composite
Test Type: Coal

ASH CONTENT IN PERCENT: 5.7900

ELEMENT (Log No.)	MW	MG/KG IN THE ASH* (5282-73)	ELEMENT AS THE OXIDE	MOLE WEIGHT	MG/KG AS THE OXIDE	PERCENT OF THE ASH
Ag	107.87	< 0.46	Ag2O	231.74	< 0.49	0.00005
Al	26.98	91500.00	Al2O3	101.96	172893.62	17.28936
As	74.92	14.70	As2O3	197.84	19.41	0.00194
B	10.81	506.00	B2O3	69.62	1629.40	0.16294
Ba	137.34	811.00	BaO	153.33	905.42	0.09054
Be	9.01	4.73	BeO	25.01	13.13	0.00131
C	12.01	ND	C	12.01	0.00	0.00000
Ca	40.08	174000.00	CaO	56.08	243461.08	24.34611
Cd	112.40	< 2.30	CdO	128.40	< 2.63	0.00026
Co	58.93	ND	CoO	74.93	0.00	0.00000
Cr	51.99	53.70	Cr2O3	151.98	78.49	0.00785
Cu	63.55	253.00	CuO	79.55	316.70	0.03167
Fe	55.85	45300.00	Fe2O3	159.69	64762.37	6.47624
Hg	200.59	< 0.04	HgO	216.59	< 0.04	0.0000043
K	39.09	4200.00	K2O	94.18	5059.55	0.50596
Li	6.94	21.00	Li2O	29.88	45.21	0.00452
Mg	24.30	30200.00	MgO	40.30	50084.77	5.00848
Mn	54.94	91.10	Mn3O4	228.81	126.47	0.01265
Mo	95.94	8.63	MoO3	143.94	12.95	0.00129
Na	22.99	20000.00	Na2O	61.98	26959.55	2.69595
Ni	58.71	79.20	NiO	74.71	100.78	0.01008
P	30.97	ND	PO3	78.97	0.00	0.00000
Pb	207.20	40.50	PbO	223.20	43.63	0.00436
S	32.06	4550.00	SO3	80.06	11362.23	1.13622
Sb	121.75	1.28	Sb2O3	291.50	1.53	0.00015
Se	78.96	4.90	SeO2	110.96	6.89	0.00069
Si	28.09	167000.00	SiO2	60.08	357186.19	35.71862
Sn	118.69	ND	SnO2	150.59	0.00	0.00000
Sr	87.62	2980.00	SrO	103.62	3524.17	0.35242
Ti	47.90	7140.00	TiO2	79.90	11909.94	1.19099
Tl	204.37	ND	Tl2O	424.74	0.00	0.00000
V	50.94	270.00	V2O5	181.88	482.01	0.04820
Zn	65.38	151.00	ZnO	81.38	187.95	0.01880
				TOTAL PERCENT		95.11766

APPENDIX K

SULFUR DIOXIDE DISPOSITION

QA/QC SO_2 Disposition Calculations

A. Maximum Potential SO_2 Emission Factor From Fuel Analysis

Based on the fuel analysis of the coal samples collected on the day of testing, the fuel contained 0.29% sulfur and had a heating value of 8553 BTU/LB. The potential sulfur dioxide emission rate can be caluclated directly from these values:

$$E = \frac{20000 B_s \phi}{HHV}$$

$$E = \frac{20000\,(0.29)\,(1)}{8553} = 0.68\ LB/10^6 BTU$$

$$E = \frac{20000\,(0.29)\,(0.8)}{8553} = 0.54\ LB/10^6 BTU$$

where $\phi = 1$ is equivalent to assuming that all the sulfur in the fuel is emitted as SO_2 and $\phi = 0.8$ assumes that 0.2 (20%) is retained in the ash (system).

B. From Emission Testing

Since the trace metal train impingers contain peroxide, the SO_2 emission factor can also be calculated from the emission data using the following expression:

$$E = \frac{29.2\, C_s}{20.9 - O_2}$$

Run	Mass (ug) S	Mass (ug) SO_2	V_{std} (Nm^3)	C (ug/Nm^3)	O_2 (%v/v)	E (LB/10^6 BTU)
1	138000	257710	2.18	118216	10.4	0.14
2	137000	273712	2.17	126135	10.2	0.15
3	127000	253733	2.19	115860	10.2	0.14

C. Comparison of Emission Factors

The results of the exhaust gas sampling are seen to be significantly lower than those predicted by the results of the fuel analyses. This result is expected in this case as the No. 2 Boiler is a fluidized bed boiler with lime injection, therefore significant amounts of SO_2 are removed in the combustion zone.