APPENDIX
A - Results and Calculations

Table 1

Boiler B

Mercury Emissions Results

		Inlet				Outlet			
RUN #	Units	1	2	3	AVERAGE	1	2	3	AVERAGE
Test Date		01/11/00	01/12/00	01/12/00		01/11/00	01/12/00	01/12/00	
Test Time		1423-1713	914-1209	1343-1632		1423-1713	914-1211	1342-1639	
Sample Volume	DSCM	1.766	1.816	1.817		3.307	3.387	3.369	
Isokinetic Variation	%	93.3	93.2	94.1		100.0	99.6	100.2	
Duct Temperature	°F	278.9	275.4	279.0	277.2	272.7	271.7	272.7	272.2
Velocity	M/sec	28.67	28.74	28.58	28.70	28.85	28.87	28.79	28.86
Flow Rate	ACMM	11,044	11,228	11,342	11,136	10,494	10,776	10,742	10,635
Flow Rate	DSCMM	6,892	7,099	7,033	6,996	6,664	6,856	6,776	6,760
H_2O	vol.%	9.2	8.6	9.9	8.9	7.7	7.5	8.2	7.6
O_2	vol.%	8.0	8.0	8.0 *	8.0	8.0	8.0	8.0	8.0
CO_2	vol.%	11.7	11.7	11.7 *	11.7	11.8	12.0	12.0	11.9
Particle Bound Hg Conc. (Hg_{TP})	$\mu g/m^3$	1.9E-01	2.5E-01	2.6E-01	2.2E-01	<3.0E-03	<3.0E-03	<3.0E-03	<3.0E-03
Particle Bound Hg Em. Rate (ER_{HgTP})	mg/min	1.3E+00	1.8E+00	1.9E+00	1.5E+00	<2.0E-02	<2.0E-02	<2.0E-02	<2.0E-02
Oxidized Hg Conc. (Hg_{2+})	$\mu g/m^3$	<5.7E-02	1.2E-01	7.7E-02	8.6E-02	<3.0E-02	<3.0E-02	<3.0E-02	<3.0E-02
Oxidized Hg Em. Rate (ER_{Hg2+})	mg/min	<3.9E-01	8.2E-01	5.4E-01	6.1E-01	<2.0E-01	<2.0E-01	<2.0E-01	<2.0E-01
Elemental Hg Conc. (Hg_O)	$\mu g/m^3$	9.3E-01	1.0E+00	8.5E-01	9.9E-01	4.9E-01	6.5E-01	4.0E-01	5.7E-01
Elemental Hg Em. Rate (ER_{HgO})	mg/min	6.4E+00	7.4E+00	6.0E+00	6.9E+00	3.3E+00	4.4E+00	2.7E+00	3.9E+00
Total Hg Conc. (Hg_T)	$\mu g/m^3$	1.2E+00	1.4E+00	1.2E+00	1.3E+00	5.3E-01	6.8E-01	4.4E-01	6.0E-01
Total Hg Em. Rate (ER_{HgT})	mg/min	8.1E+00	1.0E+01	8.4E+00	9.0E+00	3.5E+00	4.7E+00	3.0E+00	4.1E+00

* Assumed values

WHERE

H_2O, volume % = Stack gas percent water vapor
O_2 = Oxygen
CO_2 = Carbon Dioxide
ACMM = Actual Cubic Meters per Minute
DSCMM = Dry Standard Cubic Meters per Minute
Hg = Mercury (MW = 200.59)
$\mu g/m^3$ = Micrograms per Cubic Meter
mg/min = Milligrams per Minute

CALCULATIONS

$\mu g/m^3 = \mu g$ / DSCM
mg/min = $\mu g/m^3$ * DSCMM / 1000 $\mu g/mg$

Table 2

Boiler B

Mercury Emissions Reduction Results

		Inlet	Outlet	Reduction %
	Units	AVERAGE	AVERAGE	
Particle Bound Hg Concentration (Hg_P)	$\mu g/m^3$	2.2E-01	<3.0E-03	**98.6%**
Particle Bound Hg Emission Rate (E_{HgP})	mg/min	1.5E+00	<2.0E-02	**98.7%**
Oxidized Hg Concentration (Hg_O)	$\mu g/m^3$	8.6E-02	<3.0E-02	**65.3%**
Oxidized Hg Emission Rate (E_{HgO})	mg/min	6.1E-01	<2.0E-01	**66.7%**
Elemantal Hg Concentration (Hg_E)	$\mu g/m^3$	9.9E-01	5.7E-01	**42.2%**
Elemental Hg Emission Rate (E_{HgE})	mg/min	6.9E+00	3.9E+00	**44.0%**
Total Hg Concentration (Hg_T)	$\mu g/m^3$	1.3E+00	6.0E-01	**53.2%**
Total Hg Emission Rate (E_{HgT})	mg/min	9.0E+00	4.1E+00	**54.8%**

CALCULATIONS

Reduction % = (1 - (Inlet/Outlet)) * 100

Table 3

Boiler B

Fuel Bound Mercury and Chlorine Results

	Units	Run 1	Run 2	Run 3	**Average**
Coal Flow Rate	lbs/hr	83,060	84,330	84,850	84,080
Coal Flow Rate	kg/hr	37,676	38,252	38,488	38,138
Coal Mercury Concentration	ppm	0.030	0.030	0.020	**0.027**
Coal Mercury Feed Rate	mg/hr	1.13E+03	1.15E+03	7.70E+02	**1.02E+03**
Coal Chlorine Concentration	ppm	60	<50	52	**54**
Coal Chlorine Feed Rate	mg/hr	2.26E+06	<1.91E+06	2.00E+06	**2.06E+06**

Where:

lbs/hr = Pounds per hour
kg/hr = Kilograms per hour
mg/hr = Milligrams per hour
ppm = Parts per million, mg/kg

Calculations:

mg/hr = ppm * kg/hr

APPENDIX

B - Raw Field Data and Calibration Data Sheets
& Plant Operation Data

AES Hawaii Cogen Plant LOG #74
Control Room Daily Log

1 FROZEN TOT GEN XFMR NET
2 GENERATOR NET VAR
3 COMPENSATED PROCESS STEAM
4 FROZEN TOT GEN GROSS PASS I
5 SG1A TOTAL COAL FLOW
6 SG1B TOTAL COAL FLOW
7 TOTAL 1A LIMESTONE FEEDER FLC
8 TOTAL 1B LIMESTONE FEEDER FLOW
9 TOTAL AMMONIA CONSUMPTION
10 CHEVRON SERVICE WATER FLOW
11 FILTERED TDF FLOWRATE

	1	2	3	4	5	6	7	8	9	10	11
	GTAE01FZ	NET VARS	PSTMFLWX	TGBE07FZ	TCFLOW1A	TCFLOW1B	LMSTFL1A	LMSTFL1B	TOT-NH3	WSCF0001	TDFF0002
	MWHR	MVAR	KLBH	MWHR	KLBH	KLBH	KLBH	KLBH	LBH	GPH	TPH
01/11/00											
01/11/00	179.26	18.98	8.08	197.04	82.26	82.22	2961.76	2129.82	102.24	3865.11	0.02
02:00	179.12	18.13	8.05	196.76	82.64	82.72	2691.58	2473.83	101.06	3865.10	0.02
03:00	179.77	15.86	7.57	197.56	82.32	82.26	3308.30	2966.95	99.06	3880.45	0.02
04:00	179.03	15.01	7.90	196.72	80.78	80.81	3252.89	3210.82	96.80	3888.56	0.02
05:00	175.48	16.07	7.92	192.92	82.74	82.74	2338.72	3160.37	102.52	3887.08	0.02
06:00	179.68	15.61	7.71	197.32	82.82	82.84	3138.56	2677.64	101.65	3888.15	0.02
07:00	180.55	21.26	8.38	197.64	83.10	83.12	3174.49	3818.07	100.44	3876.23	0.02
08:00	180.55	49.10	9.32	197.60	83.18	83.25	3021.77	3801.79	100.23	3844.25	0.02
09:00	179.59	56.59	9.44	197.60	82.94	83.13	2833.53	3996.81	98.04	3848.95	0.02
10:00	179.26	55.56	9.91	197.60	83.24	83.29	3672.87	4335.45	97.12	3831.60	0.02
11:00	179.22	66.51	10.02	197.60	83.30	83.34	4514.97	4427.55	96.71	3832.38	0.02
12:00	179.35	68.16	9.75	197.52	83.38	83.36	4443.01	4644.51	90.94	3814.50	0.02
13:00	179.72	67.96	9.08	197.56	83.32	83.33	4735.46	4796.10	92.69	3823.09	0.02
14:00	180.14	68.59	7.04	197.64	83.14	83.16	4620.40	4894.83	92.52	3811.06	0.02
15:00	179.77	68.52	6.84	197.52	83.20	83.10	4616.61	4837.72	89.82	3814.16	0.02
16:00	179.72	68.40	6.75	197.56	83.00	82.92	5043.36	4748.08	90.15	3805.70	0.02
17:00	179.77	66.67	7.36	197.60	82.81	82.79	4999.13	3943.80	89.16	3825.60	0.04
18:00	179.72	58.50	10.24	197.56	83.03	82.97	4813.42	4400.12	90.45	3840.08	0.04
19:00	179.68	59.75	9.93	197.60	83.04	83.06	4753.98	4730.30	88.53	3859.24	0.04
20:00	179.86	61.89	9.80	197.60	83.49	83.53	4657.97	4998.09	92.96	3859.24	0.04
21:00	179.54	61.64	10.10	197.60	82.99	82.90	4941.81	5832.18	85.15	3859.24	0.04
22:00	179.72	67.59	9.84	197.56	83.01	83.00	4529.88	5018.05	89.54	3859.24	0.04
23:00	179.82	63.43	9.83	197.56	83.06	83.04	4324.01	4860.96	87.50	3859.24	0.04
00:00	179.72	51.26	9.82	197.44	83.05	83.02	4306.27	4563.36	88.15	3859.24	0.04
01/11/00	4308.0604	1181.0327	210.69004	4734.6812	1989.8382	1989.9190	95694.745	99267.220	2263.4255	92397.491	0.6057959

AES Hawaii Cogen Plant LOG #74
Control Room Daily Log

1 FROZEN TOT GEN XFMR NET
2 GENERATOR NET VAR
3 COMPENSATED PROCESS STEAM
4 FROZEN TOT GEN GROSS PASS I-
5 SG1A TOTAL COAL FLOW
6 SG1B TOTAL COAL FLOW
7 TOTAL 1A LIMESTONE FEEDER FL(
8 TOTAL 1B LIMESTONE FEEDER FLOW
9 TOTAL AMMONIA CONSUMPTION
10 CHEVRON SERVICE WATER FLOW
11 FILTERED TDF FLOWRATE

	1	2	3	4	5	6	7	8	9	10	11
	GTAE01FZ	NET VARS	PSTMFLWX	TGBE07FZ	TCFLOW1A	TCFLOW1B	LMSTFL1A	LMSTFL1B	TOT-NH3	WSCF0001	TDFF0002
	MWHR	MVAR	KLBH	MWHR	KLBH	KLBH	KLBH	KLBH	LBH	GPH	TPH
01/12/00											
01/12/00	179.54	18.27	9.74	197.04	82.51	82.52	4682.37	4932.92	85.44	3829.92	0.02
02:00	178.39	17.65	9.71	195.84	83.37	83.36	4004.94	4633.52	88.63	3834.15	0.02
03:00	179.82	18.61	9.87	197.68	78.65	78.61	5457.48	5582.18	70.40	3853.37	0.02
04:00	170.26	17.76	9.94	187.28	76.56	76.58	3122.93	4624.99	68.20	3853.37	0.02
05:00	165.14	18.96	10.08	181.72	83.06	83.09	2857.01	3603.09	85.76	3853.37	0.02
06:00	178.47	17.93	10.04	196.08	83.60	83.73	3927.24	4192.50	86.62	3853.37	0.02
07:00	180.65	20.52	10.06	197.64	84.00	83.97	4605.23	4652.07	83.13	3853.37	0.02
08:00	180.42	25.29	10.49	197.60	84.03	84.05	5392.76	4872.99	85.89	3859.91	0.02
09:00	179.68	31.21	14.56	197.60	84.02	84.06	5502.73	5329.38	88.53	3859.24	0.02
10:00	179.54	48.58	24.95	197.64	84.52	84.52	4530.44	5349.52	86.01	3870.18	0.02
11:00	179.40	73.38	25.01	197.56	84.40	84.42	4479.14	5903.27	84.33	3854.92	0.02
12:00	179.26	82.38	29.82	197.52	85.08	85.06	5664.86	6098.34	91.77	3863.94	0.02
13:00	179.17	74.92	33.98	197.56	85.06	85.06	4952.17	6353.90	88.77	3824.23	0.02
14:00	179.54	74.95	34.87	197.52	85.03	84.94	4665.82	6433.05	88.54	3849.91	0.02
15:00	179.49	75.09	35.18	197.52	84.79	84.78	5017.79	6805.96	94.81	3833.30	0.02
16:00	179.54	71.57	33.06	197.60	84.87	84.83	5680.06	7055.90	95.16	3813.87	0.02
17:00	179.54	68.61	32.70	197.52	84.72	84.72	5188.86	7764.07	97.94	3800.41	0.04
18:00	179.59	64.64	32.62	197.60	84.65	84.58	3702.91	6183.55	80.38	3828.40	0.04
19:00	179.31	68.89	32.71	197.52	84.75	84.73	3516.50	5926.20	74.88	3835.41	0.04
20:00	179.49	56.71	33.29	197.60	84.87	84.88	3794.40	5524.19	72.81	3279.75	0.04
21:00	179.12	42.69	32.99	197.56	84.41	84.41	3549.50	5423.69	69.43	1560.64	0.04
22:00	179.17	43.55	33.22	197.60	84.29	84.22	3278.67	4224.36	71.61	1560.12	0.04
23:00	179.22	50.60	33.49	197.60	84.54	84.49	3307.78	4279.07	72.03	1560.12	0.04
00:00	179.31	35.21	32.67	197.60	84.30	84.26	3777.85	5270.35	71.75	1560.12	0.04
01/12/00	4283.0414	1117.9665	575.07040	4711.9994	2010.0831	2009.8303	104659.45	131019.06	1982.8056	82545.390	0.6057953

-137.02

Enertec NTDAHS®
Average Values Report
03/08/00 13:20

Company: AES Hawaii, Inc.
Plant:
City/St: Kapolei, HI
Source: stacka, stackb

Period Start: 01/11/00 00:00
Period End: 01/11/00 23:59
Validation Type: 60/60 min
Averaging Period: 1 hr
Type: Block Avg

Period Start	Average CO2_A %	Average CO2_B %
01/11/00 00:00	N/A	N/A
01/11/00 01:00	12.9	12.0
01/11/00 02:00	13.0	12.0
01/11/00 03:00	12.9	11.9
01/11/00 04:00	12.7	12.0
01/11/00 05:00	12.8	11.9
01/11/00 06:00	N/A	12.0
01/11/00 07:00	N/A	N/A
01/11/00 08:00	12.7	N/A
01/11/00 09:00	12.8	11.8
01/11/00 10:00	13.0	11.8
01/11/00 11:00	13.0	11.7
01/11/00 12:00	13.0	11.7
01/11/00 13:00	13.0	11.8
01/11/00 14:00	13.0	11.8
01/11/00 15:00	13.0	11.9
01/11/00 16:00	N/A	N/A
01/11/00 17:00	13.0	11.9
01/11/00 18:00	13.0	12.0
01/11/00 19:00	13.0	11.9
01/11/00 20:00	13.0	12.1
01/11/00 21:00	13.0	12.1
01/11/00 22:00	13.0	12.0
01/11/00 23:00	12.9	11.9
Final Average*	**12.9**	**11.9**
Maximum*	13.0	12.1
Minimum*	12.7	11.7

*Does not include Invalid Averaging Periods ("N/A")

Enertec NTDAHS®
Average Values Report
03/08/00 13:20

Company: AES Hawaii, Inc.
Plant:
City/St: Kapolei, HI
Source: stacka, stackb

Period Start: 01/12/00 00:00
Period End: 01/12/00 23:59
Validation Type: 60/60 min
Averaging Period: 1 hr
Type: Block Avg

Period Start	Average CO2_A %	Average CO2_B %
01/12/00 00:00	N/A	N/A
01/12/00 01:00	12.9	12.0
01/12/00 02:00	13.1	12.1
01/12/00 03:00	12.8	12.0
01/12/00 04:00	12.6	12.0
01/12/00 05:00	12.8	12.0
01/12/00 06:00	N/A	12.0
01/12/00 07:00	N/A	N/A
01/12/00 08:00	13.0	N/A
01/12/00 09:00	13.0	12.0
01/12/00 10:00	12.9	12.1
01/12/00 11:00	12.9	12.1
01/12/00 12:00	13.0	12.2
01/12/00 13:00	13.0	12.2
01/12/00 14:00	12.9	12.1
01/12/00 15:00	12.9	12.1
01/12/00 16:00	N/A	N/A
01/12/00 17:00	12.9	12.2
01/12/00 18:00	12.9	12.3
01/12/00 19:00	13.0	12.3
01/12/00 20:00	13.1	12.3
01/12/00 21:00	13.0	12.2
01/12/00 22:00	12.9	12.2
01/12/00 23:00	13.0	12.2
Final Average*	**12.9**	**12.1**
Maximum*	13.1	12.3
Minimum*	12.6	12.0

*Does not include Invalid Averaging Periods ("N/A")

BEST ENVIRONMENTAL, INC. San Leandro, CA (510)278-4011

Isokinetic Sampling Data Sheet (Method Ind. H_2O-Hg)

1 of 2

Facility: AES **Date:** 1/11/00 **Run #:** 1 **Personnel:** GS, JRA

Facility Information		Equipment Information		Sampling Information	
Location:	B-Inlet	Meter #:	RAC#6	Pbar:	29.95
Port Dia.:	6"	Pitot #:	145	Pstatic:	-16
Depth:	36.5	Yd:	0.9882	% O_2:	4.5
Fitting:		Cp:	0.84	% CO_2:	4.9
Length:		ΔH@:	1.909	% H_2O:	8.5
Stack Dia:	109x127.5	Noz. #:	11A	Run Mins	150
Area:		Filter Box #:	2		
Upstream from disturbance:	<0.5	D_n:	0.180		
Downstream from disturbance:	<0.5	Filter #:	A1-A		
		Mag. #:			
		Probe #:	145		
		Umb. #			
		Pyrometer #:	145		

Initial LC: 0.004 CFM @ 10 "Hg Final LC: 0.008 CFM @ 10 "Hg Pitot LC: OK

	Point	Time	Gas Meter Vol, Ft^3	Meter Temp, °F In	Meter Temp, °F Out	Stack Temp, °F	ΔP	ΔH	Meter ACFM	SQRT ΔP	Temp, °F Probe	Temp, °F Filter	Temp, °F Imp.	Vac., "Hg	Notes H.L.
Set 1	1	1423	35.682	84	84	275	1.40	1.028	0.548	1.183	260	300	60	4	298
	2	1428	38.4	84	84	279	1.60	1.169	0.584	1.265	262	294	60	4	280
	3	1433	41.3	88	84	275	1.30	0.958	0.530	1.140	265	280	61	4	278
	4	1438	44.0	89	84	274	1.20	0.887	0.510	1.095	261	274	62	4	279
	5	1443	46.5	89	84	273	0.94	0.696	0.452	0.970	260	273	63	4	280
2	1	1448	48.65	88	84	273	1.10	0.813	0.488	1.049	265	282	64	4	280
	2	1453	51.2	88	84	274	1.05	0.775	0.477	1.025	263	278	63	4	280
	3	1458	53.65	88	84	278	0.93	0.683	0.448	0.964	263	281	64	5	280
	4	1503	56.0	89	85	275	0.90	0.665	0.442	0.949	262	275	65	5	280
	5	1508	58.2	89	85	272	0.65	0.482	0.377	0.806	262	270	66	5	280
3	1	1513	59.7	87	85	272	1.10	0.814	0.489	1.049	267	278	62	8	280
	2	1518	62.5	87	85	282	1.10	0.803	0.485	1.049	269	284	63	8	280
	3	1523	64.9	87	85	285	0.76	0.553	0.403	0.872	282	296	65	8	280
	4	1528	66.9	87	85	280	0.72	0.527	0.373	0.849	280	289	62	6	280
	5	1533	68.9	87	85	275	0.46	0.339	0.316	0.678	276	279	62	5	280
Stop		1538	70.604												
Filter change															

Moisture Data	Initial	Final	Net	Rinse
Impinger #1				
Impinger #2				
Impinger(s) #				
Impinger(s) #				
Silica Gel:				
Total Net / Rinse:				
Total Sample Volume:				

N 1 Dent
0 1
0 2
0 3
0 4
0 5
0 6

Field Calculations	
Sample Vol., dscf:	
% H_2O:	
MWs:	
MWd:	
Stack Vel, ft/s:	
Flow rate, acfm:	
Flow rate, dsfcm:	
% Isokinetics:	

Comments:

BEST ENVIRONMENTAL, INC. San Leandro, CA (510)278-4011

Isokinetic Sampling Data Sheet (Method 0011, HCl Hg)

Facility: AES Hawaii **Date:** 1/11/00 **Run #:** 1 cont. **Personnel:** JM

Facility Information		Equipment Information		Sampling Information	
Location:	B Inlet	Meter #:	RAK #6	Pbar:	29.95
Port Dia.:	6"	Pitot #:	145	Pstatic:	-16
Depth:	36.5"	Yd:	0.9832	% O_2:	4.5 8.0
Fitting:		Cp:	0.84	% CO_2:	4.9 11.7
Length:		ΔH@:	1.909	% H_2O:	8.5
Stack Dia:	109x102.5	Noz. #:	11A	Run Mins	150
Area:	96.51	Filter Box #:	2		
Upstream from disturbance:	<0.5	D_n:	0.180		
Downstream from disturbance:	<0.5	Filter #:	RKB		
		Mag. #:			
		Probe #:	145		
		Umb. #			
		Pyrometer #:	145		

Initial LC: 0.002 CFM @ 10 "Hg Final LC: 0.004 CFM @ 10 "Hg Pitot LC: OK

	Point	Time	Gas Meter Vol. Ft³	Meter Temp, °F In	Meter Temp, °F Out	Stack Temp, °F	ΔP	ΔH 0.850	Meter ACFM 0.495	SQRT ΔP	Temp, °F Probe	Temp, °F Filter	Temp, °F Imp.	Vac., "Hg	Notes H, L,
Pt 4	1	1558	70.817	84	84	270	0.95	~~0.829~~	~~0.544~~	1.072	272	358	59	4	277
	2	1603	73.4	85	84	284	1.20	0.872	0.505	1.095	270	288	55	4	275
	3	1608	75.8	87	84	279	0.74	0.542	0.399	0.860	271	250	57	4	277
	4	1613	77.7	87	84	275	0.84	0.619	0.426	0.917	272	284	58	4	278
	5	1618	79.9	87	84	273	0.47	0.347	0.319	0.686	273	280	58	4	280
5	1	1623	81.4	88	84	273	0.95	0.702	0.454	0.975	274	287	59	4	279
	2	1628	83.5	90	85	287	1.25	0.909	0.517	1.118	273	287	57	5	279
	3	1633	86.1	90	85	289	1.25	0.907	0.516	1.118	275	255	57	5	280
	4	1638	88.7	89	85	279	0.98	0.720	0.460	0.990	272	284	57	5	280
	5	1643	91.0	88	85	276	0.67	0.494	0.381	0.819	273	255	59	4	280
6	1	1648	93.0	88	84	275	1.00	0.737	0.465	1.000	273	284	60	6	280
	2	1653	95.3	88	84	290	1.30	0.939	0.525	1.140	274	291	59	10	282
	3	1658	97.7	88	85	296	1.05	0.753	0.470	1.025	258	300	60	9	285
	4	1703	100.2	87	84	291	1.20	0.865	0.503	1.095	286	302	60	10	285
	5	1708	102.7	86	84	287	0.78	0.565	0.407	0.883	289	297	61	9	280
		1713	104.867												
			68.972		85.9		278.9		0.736		0.991				

Moisture Data	Initial	Final	Net	Rinse
Impinger #1				
Impinger #2				
Impinger(s) #				
Impinger(s) #				
Silica Gel:				
Total Net / Rinse:				
Total Sample Volume:				

Field Calculations	
Sample Vol., dscf:	65.905
% H_2O:	
MWs:	
MWd:	
Stack Vel, ft/s:	67.64
Flow rate, acfm:	391,668
Flow rate, dsfcm:	232,461
% Isokinetics:	103.2

Comments:

Isokinetic Sampling Data Sheet (Method Out. H_2O A_7)

Facility: AES Hawaii **Date:** 1/12/00 **Run #:** 2 **Personnel:** GO, JM

Facility Information		Equipment Information		Sampling Information	
Location:	B-Inlet	Meter #:	RAC#6	Pbar:	30.00
Port Dia.:	6"	Pitot #:	145	Pstatic:	-16
Depth:	36.5"	Yd:	0.9882	Cp:	0.84
Fitting:		ΔH@:	1.909	% O_2:	8
Length:		Noz. #:	11A	% CO_2:	11.7
Stack Dia:	109x122.5	Filter Box #:	9	% H_2O:	8.2
Area:		D_n:	0.180	Run Mins	150
Upstream from disturbance:	<0.5	Filter #:	R2-A		
Downstream from disturbance:	>0.5	Mag. #:			
		Probe #:	145		
		Umb. #:			
		Pyrometer #:	145		

Initial LC: 0.004 CFM @ 9 "Hg Final LC: 0.004 CFM @ 11 "Hg Pitot LC: 0.4/0.4

Amb. 80

	Point	Time	Gas Meter Vol, Ft³	Meter Temp, °F In	Meter Temp, °F Out	Stack Temp, °F	ΔP	ΔH	Meter ACFM	SQRT ΔP	Temp, °F Probe	Temp, °F Filter	Temp, °F Imp.	Vac., "Hg	Notes H_i L_i
Port 1	1	0914	105.447	79	79	275	1.40	1.019	0.548	1.183	287	261	57	4	279
	2	0919	108.20	83	79	271	1.30	0.935	0.531	1.140	285	265	57	4	279
	3	0924	110.85	85	82	270	1.15	0.850	0.503	1.072	255	260	57	4	279
	4	0929	113.35	87	81	267	1.35	1.003	0.546	1.162	283	260	57	4	279
	5	0934	115.80	88	81	268	0.79	0.587	0.418	0.889	286	258	57	4	280
2	1	0939	117.85	93	82	269	1.00	0.742	0.470	1.000	285	260	57	4	280
	2	0944	120.20	91	82	274	1.000	0.739	0.470	1.000	280	265	57	4	280
	3	0949	122.55	91	82	275	1.05	0.775	0.481	1.025	282	267	58	5	280
	4	0954	124.95	91	82	275	0.90	0.664	0.446	0.949	287	280	60	5	280
	5	0959	127.15	91	82	269	0.65	0.484	0.381	0.806	287	276	63	5	280
3	1	1004	129.05	91	82	265	1.20	0.898	0.518	1.095	284	278	60	7	280
	2	1009	131.45	90	83	271	1.20	0.891	0.516	1.095	285	282	61	10	280
	3	1014	134.00	88	84	276	0.87	0.641	0.438	0.933	283	276	62	9	280
	4	1019	136.20	88	86	277	0.80	0.589	0.420	0.894	283	271	62	9	280
	5	1024	138.30	88	86	275	0.52	0.384	0.339	0.721	253	269	62	6	280
Stop		1029	140.119												Filter Change

Moisture Data	Initial	Final	Net	Rinse
Impinger #1				
Impinger #2				
Impinger(s) #				
Impinger(s) #				
Silica Gel:				
Total Net / Rinse:				
Total Sample Volume:				

N Port #
1 01
02
03
04
05
06

Field Calculations	
Sample Vol., dscf:	
% H_2O:	
MWs:	
MWd:	
Stack Vel, ft/s:	
Flow rate, acfm:	
Flow rate, dsfcm:	
% Isokinetics:	

Comments:

BEST ENVIRONMENTAL, INC. San Leandro, CA (510)278-4011

Isokinetic Sampling Data Sheet (Method Cal. Air Hg)

Facility: AES Hawaii **Date:** 1/12/00 **Run #:** 2 cont. **Personnel:** GB / MW

Facility Information		Equipment Information		Sampling Information	
Location:	B-Inlet	Meter #:	RAC#6	Pbar:	30.00
Port Dia.:	6"	Pitot #:	145	Pstatic:	-16
Depth:	36.5	Yd:	0.9882	% O_2:	8 8 Fyrite
Fitting:	–	Cp:	0.84	% CO_2:	11.7 11.7
Length:	–	ΔH@:	1.989	% H_2O:	8.5
Stack Dia:	109 x 127.5	Noz. #:	11A	Run Mins	150
Area:	96.51	Filter Box #:	9		
Upstream from disturbance:	0.5	D_n:	0.190		
Downstream from disturbance:	0.5	Filter #:	R2-B		
		Mag. #:			
		Probe #:	145		
		Umb. #			
		Pyrometer #:	145		

Initial LC: 0.004 CFM @ 10 "Hg Final LC: 0.004 CFM @ 12 "Hg Pitot LC: OK/OK

	Point	Time	Gas Meter Vol, Ft³	Meter Temp, °F In	Meter Temp, °F Out	Stack Temp, °F	ΔP	ΔH	Meter ACFM	SQRT ΔP	Temp, °F Probe	Temp, °F Filter	Temp, °F Imp.	Vac., "Hg	Notes H.L.
Port 4	1	1054	140.383	86	84	270	1.20	0.889	0.515	1.095	284	281	53	4	280
	2	1059	142.90	86	85	280	1.20	0.877	0.511	1.095	285	277	56	4	280
	3	1104	145.5	86	84	278	0.90	0.660	0.444	0.949	281	282	57	4	280
	4	1109	147.70	87	85	275	1.05	0.774	0.481	1.025	282	278	57	4	280
	5	1114	149.90	88	85	269	0.51	0.380	0.337	0.714	283	281	58	4	280
5	1	1119	151.65	88	85	269	1.15	0.856	0.506	1.072	280	282	59	4	280
	2	1124	154.10	88	85	284	1.30	0.948	0.532	1.140	286	280	59	5	280
	3	1129	156.85	88	86	276	1.15	0.848	0.504	1.072	284	276	59	7	280
	4	1134	159.45	89	86	276	1.05	0.775	0.482	1.025	283	282	59	5	280
	5	1139	161.90	90	87	278	0.69	0.509	0.391	0.831	283	278	60	4	280
6	1	1144	163.90	90	87	278	1.15	0.848	0.504	1.072	274	275	60	8	280
	2	1149	166.40	87	87	286	1.40	1.021	0.553	1.183	279	274	60	12	280
	3	1154	169.20	89	87	288	1.30	0.873	0.511	1.095	281	274	61	10	280
	4	1159	171.75	89	87	289	1.25	0.908	0.522	1.118	279	275	61	11	280
	5	1204	174.35	90	88	287	0.80	0.582	0.418	0.894	282	272	61	8	280
stop		1209	176.553												
			70.842	86.0		275.4		0.760		1.02					

Moisture Data	Initial	Final	Net	Rinse
Impinger #1				
Impinger #2				
Impinger(s) #				
Impinger(s) #				
Silica Gel:				
Total Net / Rinse:				
Total Sample Volume:				

Field Calculations	
Sample Vol., dscf:	68.002
% H_2O:	
MWs:	29.04
MWd:	
Stack Vel, ft/s:	68.09
Flow rate, acfm:	394,285
Flow rate, dsfcm:	246,947
% Isokinetics:	100.3

Comments:

BEST ENVIRONMENTAL, INC. San Leandro, CA (510)278-4011

Isokinetic Sampling Data Sheet (Method [illegible])

Facility: AES Hawaii **Date:** 11/12/00 **Run #:** 3 **Personnel:** [illegible]

Facility Information		Equipment Information		Sampling Information	
Location:	B-Inlet	Meter #:	RAG	Pbar:	30.00
Port Dia.:	6"	Pitot #:	145	Pstatic:	-16
Depth:	36.5"	Yd:	0.9882	% O_2:	8.0
Fitting:		Cp:	0.84	% CO_2:	11.7
Length:		ΔH@:	1.969	% H_2O:	8.5
Stack Dia:	108x127.5	Noz. #:	11A	Run Mins	150
Area:	95.61	Filter Box #:	9		
Upstream from disturbance:	<8.5	D_n:	0.180		
Downstream from disturbance:	<8.5	Filter #:	R3-A		
		Mag. #:	–		
		Probe #:	145		
		Umb. #	–		
		Pyrometer #:	145		

Initial LC: 0.004 CFM @ 9 "Hg Final LC: 0.004 CFM @ 9 "Hg Pitot LC: OK/OK

	Point	Time	Gas Meter Vol, Ft^3	Meter Temp, °F In	Meter Temp, °F Out	Stack Temp, °F	ΔP	ΔH	Meter ACFM	SQRT ΔP	Temp, °F Probe	Temp, °F Filter	Temp, °F Imp.	Vac., "Hg	Notes
Port 1	1	1343	175.105	88	88	275	1.20	0.873	0.512	1.095	287	278	58	4	280
	2	1348	180.65	88	88	278	1.60	1.160	0.587	1.265	289	281	58	5	280
	3	1353	183.60	98	88	276	1.35	0.983	0.543	1.162	287	278	58	4	279
	4	1358	186.30	91	88	273	1.45	1.061	0.564	1.204	284	275	59	5	280
	5	1403	189.10	91	88	270	1.05	0.771	0.482	1.025	282	276	59	4	280
2	1	1408	191.50	92	88	270	1.10	0.809	0.493	1.049	286	278	59	5	280
	2	1413	194.00	92	88	279	1.20	0.872	0.512	1.095	287	283	60	5	280
	3	1418	196.50	92	89	277	1.10	0.802	0.491	1.049	289	285	60	5	280
	4	1423	199.00	92	89	273	1.00	0.733	0.470	1.000	287	289	61	6	280
	5	1428	201.35	92	89	270	0.70	0.515	0.394	0.837	289	284	61	4	280
3	1	1433	203.30	91	89	273	0.93	0.681	0.453	0.964	291	282	61	6	280
	2	1438	205.60	93	89	283	1.00	0.724	0.467	1.000	290	280	61	8	280
	3	1443	207.80	90	89	279	0.88	0.639	0.438	0.938	285	278	62	9	280
	4	1448	210.05	90	89	277	0.70	0.509	0.392	0.837	285	279	61	7	280
	5	1453	212.05	87	87	272	0.48	0.350	0.324	0.693	286	280	62	5	280
Stop		1458	213.680												Stop

Moisture Data	Initial	Final	Net	Rinse
Impinger #1				
Impinger #2				
Impinger(s) #				
Impinger(s) #				
Silica Gel:				
Total Net / Rinse:				
Total Sample Volume:				

Field Calculations	
Sample Vol., dscf:	
% H_2O:	
MWs:	
MWd:	
Stack Vel, ft/s:	
Flow rate, acfm:	
Flow rate, dsfcm:	
% Isokinetics:	

Comments:

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Isokinetic Sampling Data Sheet (Method Cont. H_2O-Hg)

2 of 2

Facility: AES Hawaii **Date:** 0/12/99 **Run #:** 3 cont. **Personnel:** SB, JM

Facility Information		Equipment Information		Sampling Information	
Location:	B-Inlet	Meter #:	RAC #6	Pbar:	30.00
Port Dia.:	6"	Pitot #:	145	Pstatic:	-16
Depth:	36.5	Yd:	0.9852	% O_2:	8.0 8.0 Fyrite
Fitting:	–	Cp:	0.84	% CO_2:	11.7 11.7
Length:	–	ΔH@:	1.909	% H_2O:	8.5
Stack Dia:	109x125	Noz. #:	9A	Run Mins	150
Area:	95.61	Filter Box #:	9		
Upstream from disturbance:	>0.5	D_n:	0.180		
Downstream from disturbance:	>0.5	Filter #:	R3B		
		Mag. #:	–		
		Probe #:	145		
		Umb. #	–		
		Pyrometer #:	145		

Initial LC: 0.004 CFM @ 9 "Hg Final LC: 0.004 CFM @ 11 "Hg Pitot LC: OK/OK

	Point	Time	Gas Meter Vol, Ft³	Meter Temp, °F In	Meter Temp, °F Out	Stack Temp, °F	ΔP	ΔH	Meter ACFM	SQRT ΔP	Temp, °F Probe	Temp, °F Filter	Temp, °F Imp.	Vac., "Hg	Notes H.L.
Port 4	1	1517	213.866	85	85	275	1.15	0.832	0.498	1.072	289	290	60	4	280
	2	1522	216.35	88	86	280	1.15	0.830	0.498	1.072	290	286	59	4	280
	3	1527	218.74	88	86	275	0.84	0.610	0.427	0.917	287	284	59	4	280
	4	1532	220.90	89	86	273	0.80	0.583	0.418	0.894	288	288	58	4	280
	5	1537	223.05	90	86	272	0.80	0.585	0.419	0.894	289	287	58	4	280
5	1	1542	225.15	90	86	290	1.40	0.998	0.547	1.183	286	286	57	5	280
	2	1547	227.90	91	86	294	1.15	0.817	0.495	1.072	288	285	58	7	280
	3	1552	230.35	91	86	279	1.10	0.797	0.489	1.049	286	281	58	5	280
	4	1557	232.80	91	86	276	1.05	0.764	0.479	1.025	289	274	59	5	280
	5	1602	235.20	90	86	277	0.62	0.450	0.368	0.787	288	279	59	4	280
6	1	1607	237.05	90	86	284	1.45	1.042	0.559	1.204	287	283	60	9	280
	2	1612	239.85	90	80	290	1.35	0.956	0.535	1.158	285	279	60	10	280
	3	1617	242.50	87	86	295	1.05	0.740	0.470	1.025	285	279	61	9	280
	4	1622	244.85	87	86	292	1.10	0.780	0.483	1.049	289	280	62	8	280
	5	1627	247.30	89	86	290	0.82	0.584	0.419	0.906	289	284	62	9	280
Stop		1632	249.501												
			71.210	88.5		279.0		0.762		1.017					

Moisture Data	Initial	Final	Net	Rinse
Impinger #1				
Impinger #2				
Impinger(s) #				
Impinger(s) #				
Silica Gel:				
Total Net / Rinse:				
Total Sample Volume:				

Field Calculations	
Sample Vol., dscf:	68.048
% H_2O:	8.9
MWs:	29.11
MWd:	
Stack Vel, ft/s:	65.56
Flow rate, acfm:	397,007
Flow rate, dsfcm:	249,036
% Isokinetics:	99.5

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4.20

Comments:

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Isokinetic Sampling Data Sheet (Method Hg)

Facility: AES **Date:** 1-11-00 **Run #:** 1B Hg **Personnel:** GW, RC

Facility Information	Equipment Information	Sampling Information
Location: B-OUTLET	Meter #: RAC 5 Pitot #: 146	Pbar: 29.95
Port Dia.: 6" Depth:	Yd: 1.0081 Cp: 0.84	Pstatic: -19
Fitting: Flange Length:	ΔH@: 1.571 Noz. #: 3C	% O_2: 7.5 8.0 Fyrite
Stack Dia: 108x127 Area:	Filter Box #: 1 Dn: .242	% CO_2: 11.9 11.8 Fyrite
Upstream from disturbance:	Filter #: RUN 1B Hg Mag. #: INCLINE	% H_2O: 7
Downstream from disturbance:	Probe #: 146 Umb. #	Run Mins 150
	Pyrometer #: N.A	

Initial LC: <0.02 CFM @ 15 "Hg Final LC: <0.01 CFM @ 20 "Hg Pitot LC: ✓

5min/pt 30 pts

Point	Time	Gas Meter Vol, Ft³	Meter Temp, °F In	Meter Temp, °F Out	Stack Temp, °F	ΔP	ΔH	Meter ACFM	SQRT ΔP	Temp, °F Probe	Temp, °F Filter	Temp, °F Imp.	Vac., "Hg	Notes CYCL	ON LOW CONTROL LINE °F
1	1423	046.125	80	80	270	0.75	1.51	0.722	0.866	230	269	64	12	10°	270
2	1428	049.7	85	81	270	1.3	2.63	0.953	1.14	226	265	64	18	<5°	274
3	1433	054.5	83	81	270	1.1	2.22	0.876	1.05	244	263	68	17	0°	269
4	1438	58.7	83	80	271	0.95	1.915	0.813	0.975	248	249	66	15	0°	274
5	1443	62.9	85	81	273	0.55	1.108	0.621	0.742	249	252	66	9	+10°	275
1	1448	66.0	85	81	271	1.1	2.223	0.877	1.049	247	258	65	17	15°	275
2	1453	70.3	87	81	272	1.2	2.426	0.917	1.095	249	271	66	18	<5°	275
3	1458	74.9	83	81	273	1.2	2.424	0.913	1.095	251	276	66	18	0°	275
4	1503	79.5	83	81	273	1.0	2.01	0.834	1.000	252	264	66	16	10°	275
5	1508	83.6	87	81	272	0.85	1.7	0.773	0.922	248	268	67	14	10°	275
1	1513	87.6	91	82	271	1.1	2.23	0.883	1.049	254	291	67	20	+20°	275
2	1518	92.0	86	82	274	1.1	2.21	0.877	1.049	252	269	67	20	+20°	275
3	1523	96.4	86	82	274	1.1	2.218	0.877	1.049	254	254	67	20	<5°	275
4	1528	100.8	84	82	274	1.0	2.013	0.835	1.000	254	260	67	16	0°	275
5	1533	104.9	85	81	272	0.9	1.818	0.794	0.949	252	264	67	15	<5°	275
1	1537	108.6	79	79	271	1.1	2.207	0.871	1.049	251	253	59	18	<5°	274
2	1602	113.2	79	78	273	1.1	2.199	0.869	1.049	257	260	61	18	<5°	274
3	1607	117.7	81	78	274	1.1	2.20	0.870	1.049	258	257	62	18	<5°	274
4	1612	122.0	82	79	274	1.0	2.003	0.831	1.000	259	261	62	16	<5°	275
5	1617	126.1	82	79	274	0.80	1.603	0.744	0.894	257	250	62	13	+10°	275
1	1622	129.8	88	79	274	0.85	1.712	0.771	0.922	257	281	62	13	-10°	275
2	1627	133.7	88	79	274	0.82	1.652	0.757	0.906	260	273	62	13	-5°	275
3	1633	137.5	88	80	274	0.80	1.613	0.749	0.894	253	256	62	12	0°	275
4	1637	141.2	88	80	274	0.85	1.714	0.772	0.922	255	273	63	14	0°	275
5	1643	145.1	88	80	273	0.8	1.615	0.749	0.894	257	251	62	13	+5°	275
1	1647	148.9	87	80	273	0.82	1.654	0.758	0.906	253	271	62	13	0	275
2	1653	152.6	87	80	273	0.63	1.271	0.665	0.794	260	280	61	10	0	275
3	1657	155.9	90	81	273	0.40	0.810	0.532	0.632	258	267	61	7	0	275
4	1703	158.6	92	81	273	0.45	0.913	0.566	0.671	255	278	61	7	0	275
5	1707	161.45	93	81	273	0.55	1.117	0.626	0.742	261	263	62	8	<5°	275
	1713	164.610	83.0		272.7		1.832		0.945						

$\bar{x}$:170 σ:5.7

Vm = 118.485 Moisture Data SEE LAB LOG

	Initial	Final	Net	Rinse
Impinger #1	624	803	127	50
Impinger #2	718	765	47	
Impinger(s) #3	763	772	9	
Impinger(s) #4	728	732	4	
Silica Gel:	201	218	17	
Total Net / Rinse:			206	
Total Sample Volume:				

IMP#5 GAIN 4
IMP#6 GAIN 2
IMP#7 GAIN -4

est. 22°
Actual 206

Field Calculations $\bar{x}$=57	
Sample Vol., dscf:	116.79
% H_2O:	8.2
MWs:	29.10
MWd:	
Stack Vel, ft/s:	63.7
Flow rate, acfm:	364,232
Flow rate, dsfcm:	230,001
% Isokinetics:	101.0

Comments: 92 ml / 56 Vm = 1.9 ml/CF. Assumed for field calculation

STOPPED @ 1535 TO ALLOW INLET SAMPLING TEAM TO CHANGE

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BEST ENVIRONMENTAL, INC. San Leandro, CA (510)278-4011

Isokinetic Sampling Data Sheet (Method Hg)

Facility: AES **Date:** 1-12-00 **Run #:** 2B **Personnel:** GW / RC

Facility Information		Equipment Information		Sampling Information	
Location:	B-OUTLET	Meter #:	RAC 5	Pbar:	30.00
Port Dia.:	6"	Pitot #:	146	Pstatic:	-20
Depth:		Yd:	1.0081	Cp:	0.84
Fitting:	Flange	ΔH@:	1.571	% O_2:	8.0
Length:		Noz. #:	3C	% CO_2:	12.0
Stack Dia:	~~104x127~~ 109x127.5	Filter Box #:	1	% H_2O:	7.9
Area:		D_n:	0.242	Run Mins	150
Upstream from disturbance:		Filter #:	R2B-out-Hg		
Downstream from disturbance:		Mag. #:			
		Probe #:	146		
		Umb. #			
		Pyrometer #:			

Initial LC: 0.02 CFM @ 15 "Hg Final LC: 0.012 CFM @ 18 "Hg Pitot LC: ✓

Point	Time	Gas Meter Vol, Ft^3	Meter Temp, °F In	Meter Temp, °F Out	Stack Temp, °F	ΔP	ΔH	Meter ACFM	SQRT ΔP	Temp, °F Probe	Temp, °F Filter	Temp, °F Imp.	Vac., "Hg	Notes LINE °F
1	0914	167.550	75	75	274	1.1	2.176	0.858	1.049	254	257	63	13	274
2	0919	171.6	80	75	269	1.0	2.001	0.826	1.000	258	267	63	12	275
3	0924	175.75	83	76	271	1.1	2.204	0.867	1.049	257	254	65	14	274
4	0929	180.1	82	76	270	0.83	1.664	0.754	0.911	258	263	65	12	274
5	0934	184.1	86	75	269	0.65	1.308	0.67	0.806	256	264	65	9	275
1	0939	187.4	90	76	268	1.2	2.43	0.913	1.095	258	282	65	18	275
2	0944	192.0	84	78	273	1.2	2.40	0.907	1.095	257	276	65	18	275
3	0949	196.5	79	77	273	1.1	2.19	0.864	1.049	253	268	64	16	275
4	0954	200.9	83	77	273	0.98	1.96	0.819	0.990	259	266	63	14	275
5	0959	204.9	88	77	273	0.87	1.748	0.775	0.933	258	276	63	12	276
1	1004	208.8	90	77	273	1.2	2.415	0.911	1.095	256	273	64	18	274
2	1009	213.3	85	84	272	1.2	2.42	0.913	1.095	268	275	64	18	274
3	1014	217.9	85	85	272	1.2	2.425	0.914	1.095	263	281	64	18	275
4	1019	222.5	85	85	273	1.1	2.22	0.875	1.049	264	283	64	16	275
5	1024	226.9	92	87	273	0.9	1.83	0.799	0.949	264	281	64	12	275
1	1056	231.1	84	84	273	1.15	2.31	0.893	1.072	268	281	64	15	273
2	1101	235.4	86	84	273	1.2	2.42	0.913	1.095	258	284	61	18	273
3	1106	239.9	85	83	273	1.2	2.417	0.912	1.095	258	293	61	18	274
4	1111	244.5	86	83	273	1.1	2.218	0.874	1.049	260	270	60	15	275
5	1116	248.8	91	83	263	0.9	1.848	0.801	0.949	257	275	60	12	274
1	1121	252.8	95	83	271	0.9	1.835	0.799	0.949	260	285	60	10	277
2	1126	256.8	98	84	273	1.1	2.24	0.885	1.049	265	274	60	14	275
3	1131	261.1	98	86	273	1.0	2.044	0.845	1.000	266	286	62	14	275
4	1136	265.4	99	88	273	0.92	1.886	0.813	0.959	260	282	62	13	275
5	1141	269.5	98	88	273	0.75	1.536	0.734	0.866	261	276	64	11	276
1	1146	273.2	98	88	272	0.8	1.64	0.759	0.894	266	278	66	11	277
2	1151	277	99	88	271	0.55	1.13	0.631	0.742	260	269	65	8	275
3	1156	280.1	100	88	271	0.40	0.82	0.539	0.632	262	266	66	6	274
4	1201	282.8	100	88	271	0.50	1.029	0.602	0.707	264	294	66	7	275
5	1206	286.0	100	88	271	0.65	1.337	0.686	0.806	263	261	66	9	275
STOP	1211	289.300		85.8	271.7		1.938		0.971					

FC/029

FA = 121.750

Moisture Data

	Initial	Final	Net	Rinse
Impinger #1			103	50ml
Impinger #2			83	
Impinger(s) #3			6	
Impinger(s) #4			3	
Silica Gel: #8			12	
Total Net / Rinse:			207	
Total Sample Volume:				

GAIN
IMP 5 2
IMP 6 4
IMP 7 -6

Field Calculations

Sample Vol., dscf:	119.609
% H_2O:	7.5
MWs:	
MWd:	
Stack Vel, ft/s:	65.2
Flow rate, acfm:	377,570
Flow rate, dsfcm:	240,323
% Isokinetics:	100.3

Comments: est. 1.7ml/cF for H_2O. assumed 205

STOP FOR INLET LOCATION TO CHANGE OUT THEIR FILTER.

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BEST ENVIRONMENTAL, INC. San Leandro, CA (510)278-4011

Isokinetic Sampling Data Sheet (Method Hg)

Facility: AES **Date:** 1-12-06 **Run #:** 3B **Personnel:** GW/RC

Facility Information		Equipment Information		Sampling Information	
Location: B-OVCT		Meter #: RAC 5	Pitot #: 146	Pbar: 30.0"	
Port Dia.: 6	Depth:	Yd: 1.6081	Cp: 0.84	Pstatic: -20	
Fitting: Flange	Length:	ΔH@: 1.571	Noz. #: 7L	% O_2: 8	
Stack Dia: 109x127.5	Area: 96.51	Filter Box #: 1	D_n: 0.242	% CO_2: 12	
Upstream from disturbance:		Filter #: R3B-06-Hg	Mag. #:	% H_2O: 7	
Downstream from disturbance:		Probe #: 146	Umb. #:	Run Mins 150	
		Pyrometer #:			

Initial LC: 0.01 CFM @ 15 "Hg Final LC: <0.01 CFM @ 17 "Hg Pitot LC: ✓

1 → S
→ R
1-out

Point	Time	Gas Meter Vol, Ft^3	Meter Temp, °F In	Meter Temp, °F Out	Stack Temp, °F	ΔP	ΔH	Meter ACFM	SQRT ΔP	Temp, °F Probe	Temp, °F Filter	Temp, °F Imp.	Vac., "Hg	Notes LINE °F
1	1342	290.350	80	80	270	0.82	1.647	0.751	0.906	256	258	62	10	274
2	1347	293.8	87	81	273	1.2	2.417	0.912	1.095	255	261	56	14	272
3	1352	298.8	88	81	273	1.1	2.218	0.874	1.049	259	286	61	13	274
4	1357	302.9	90	81	273	0.95	1.919	0.815	0.975	258	260	61	12	275
5	1402	307.0	93	81	273	0.6	1.21	0.650	0.775	257	278	63	8	275
1	1407	310.3	95	83	273	1.20	2.44	0.92	1.095	259	280	63	14	275
2	1412	314.9	91	83	273	1.25	2.53	0.93	1.118	248	279	63	15	275
3	1417	319.5	88	83	274	1.2	2.42	0.91	1.095	263	271	64	15	275
4	1422	324.2	89	83	274	1.1	2.22	0.876	1.049	256	268	64	14	275
5	1427	328.6	89	83	274	0.85	1.716	0.771	0.922	259	285	64	10	275
1	1432	332.4	93	83	274	1.2	2.43	0.918	1.095	257	281	62	17	275
2	1437	337.1	87	83	273	1.2	2.42	0.913	1.095	257	272	62	17	275
3	1442	341.6	86	82	273	1.2	2.417	0.912	1.095	256	268	63	14	275
4	1447	346.2	87	81	273	1.1	2.2	0.873	1.049	255	262	62	13	275
5	1452	350.5	87	81	273	0.8	1.612	0.746	0.894	252	250	63	10	275
1	1516	354.2	80	79	273	1.1	2.198	0.866	1.049	267	285	63	14	275
2	1521	358.6	83	79	273	1.15	2.304	0.888	1.072	257	277	63	14	273
3	1526	363.1	84	79	273	1.2	2.406	0.908	1.095	256	281	64	15	274
4	1531	367.56	83	79	273	1.0	2.00	0.829	1.000	258	257	64	12	275
5	1536	371.7	87	79	273	1.0	2.011	0.832	1.000	258	256	64	12	275
1	1541	376.2	87	79	273	0.85	1.709	0.767	0.922	255	252	64	11	275
2	1546	380.0	86	79	273	0.85	1.708	0.767	0.922	256	278	65	11	274
3	1551	383.9	87	79	271	0.80	1.613	0.746	0.894	257	255	62	11	274
4	1556	387.6	89	79	272	0.88	1.775	0.783	0.938	257	273	62	10	275
5	1601	391.5	88	79	272	0.82	1.653	0.755	0.906	257	274	61	10	275
1	1614	395.3	88	79	272	0.70	1.41	0.698	0.837	255	276	61	9	275
2	1619	398.8	88	79	272	0.54	1.088	0.613	0.735	260	278	60	7	275
3	1624	401.8	91	80	272	0.44	0.89	0.556	0.663	261	272	60	7	275
4	1629	404.6	92	80	272	0.50	1.012	0.593	0.707	255	269	60	7	277
5	1634	407.6	91	80	272	0.85	1.719	0.771	0.922	255	274	60	11	275
	1639	411.445		84.2	272.7		1.912		0.966					

1 / 2 / 3 / 4 / 5 / 6

Pre 1457

mod to get 1/4 1549 1554 1559 1604

time pulled out of filter moment

Vm = 20.755 Moisture Data	Initial	Final	Net	Rinse
Impinger #1			114	50
Impinger #2			59	
Impinger(s) # 3			13	
Impinger(s) # 4			3	
Silica Gel:			31	
Total Net / Rinse:			226	
Total Sample Volume:				

stopped to check + re-seat filter @ 1541. restarted @ 1549

leak checked 375.86 to 376.20 @ 18 "Hg 0.340 CF

Field Calculations	
Sample Vol., dscf:	118.984
% H_2O:	~7.5
MWs:	29.32
MWd:	
Stack Vel, ft/s:	64.9
Flow rate, acfm:	375,829
Flow rate, dsfcm:	238,860
% Isokinetics:	100.3

Comments: assumed 204ml

	GAIN
IMP #5	1
IMP #6	3

PROBE HAS MOVED FROM PORT TO PORT WITHOUT SHUTTING OFF THE SAMPLE PUMP.

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Hg DETERMINATION SAMPLE RECOVERY DATA SHEET

Client: AES (Hawaii)
Location: Unit B Inlet R1
Sample Date: 1/11/00

Filter			98 gr net wt.	Container #1
Front ½ Rinse	Contents			Container #2
Impinger #1	Contents	Final Wt.	817	Container #3
		Initial Wt. g	674	
		Δ Weight	143 -Sud = 93	
Impinger #2	Contents	Final Wt.	742	
		Initial Wt.	727	
		Δ Weight	15	
Impinger #3	Contents	Final Wt.	713	
		Initial Wt.	712	
		Δ Weight	1	
Imkpinger #4	Contents	Final Wt.	725	Container #4
		Initial Wt.	722	
		Δ Weight	3	
Impinger #5	Contents	Final Wt.	733	Container #5
		Initial Wt.	730	
		Δ Weight	3	
Impinger #6	Contents	Final Wt.	726	
		Initial Wt.	724	
		Δ Weight	2	
Impinger #7	Contents	Final Wt.	721	
		Initial Wt.	722	
		Δ Weight	-1	
Impinger #8	Contents	Final Wt.	218	Container #6
		Initial Wt.	200	
		Δ Weight	18	
		Total Δ Weight	134	

Comments:

Hg DETERMINATION SAMPLE RECOVERY DATA SHEET

Client: AES
Location: Unit B Inlet R2
Sample Date: 1/12/00

Filter			91 gr net	Container #1
Front ½ Rinse	Contents			Container #2
Impinger #1	Contents	Final Wt.	820	Container #3
		Initial Wt.	675	
		Δ Weight	145 - Sod = 95	
Impinger #2	Contents	Final Wt.	742	
		Initial Wt.	724	
		Δ Weight	18	
Impinger #3	Contents	Final Wt.	710	
		Initial Wt.	710	
		Δ Weight	0	
Imkpinger #4	Contents	Final Wt.	721	Container #4
		Initial Wt.	719	
		Δ Weight	2	
Impinger #5	Contents	Final Wt.	730	Container #5
		Initial Wt.	728	
		Δ Weight	2	
Impinger #6	Contents	Final Wt.	732	
		Initial Wt.	730	
		Δ Weight	2	
Impinger #7	Contents	Final Wt.	720	
		Initial Wt.	722	
		Δ Weight	-2	
Impinger #8	Contents	Final Wt.	212	Container #6
		Initial Wt.	201	
		Δ Weight	11	
		Total Δ Weight	128	

Comments:

Hg DETERMINATION SAMPLE RECOVERY DATA SHEET

Client: AES
Location: Inlet Unit B R3
Sample Date: 1/12/00

Filter			89.9r.	Container #1
Front ½ Rinse	Contents		89.9r	Container #2
Impinger #1	Contents	Final Wt.	~~60~~ 759	Container #3
		Initial Wt.	610	
		Δ Weight	149 - Sol - 99	
Impinger #2	Contents	Final Wt.	729	
		Initial Wt.	704	
		Δ Weight	25	
Impinger #3	Contents	Final Wt.	735	
		Initial Wt.	731	
		Δ Weight	4	
Imkpinger #4	Contents	Final Wt.	724	Container #4
		Initial Wt.	723	
		Δ Weight	1	
Impinger #5	Contents	Final Wt.	736	Container #5
		Initial Wt.	733	
		Δ Weight	3	
Impinger #6	Contents	Final Wt.	756	
		Initial Wt.	753	
		Δ Weight	3	
Impinger #7	Contents	Final Wt.	735	
		Initial Wt.	737	
		Δ Weight	-2	
Impinger #8	Contents	Final Wt.	218	Container #6
		Initial Wt.	201	
		Δ Weight	17	
		Total Δ Weight	150ml	

Comments:

Hg DETERMINATION SAMPLE RECOVERY DATA SHEET

Client: AES (Hawaii)
Location: Unit B outlet R1
Sample Date: 1/11/00

Filter				Container #1
Front ½ Rinse	Contents		~~Sample~~	Container #2
Impinger #1	Contents	Final Wt.	817	Container #3
		Initial Wt.	674	
		Δ Weight	177 - Sample Rinse = 127	
Impinger #2	Contents	Final Wt.	765	
		Initial Wt.	718	
		Δ Weight	47 ~~Sample rinse~~	
Impinger #3	Contents	Final Wt.	772	
		Initial Wt.	763	
		Δ Weight	9.0	
Imkpinger #4	Contents	Final Wt.	732	Container #4
		Initial Wt.	728	
		Δ Weight	4	
Impinger #5	Contents	Final Wt.	749	Container #5
		Initial Wt.	745	
		Δ Weight	+ 4	
Impinger #6	Contents	Final Wt.	725	
		Initial Wt.	723	
		Δ Weight	2	
Impinger #7	Contents	Final Wt.	760	
		Initial Wt.	764	
		Δ Weight	−4	
Impinger #8	Contents	Final Wt.	218	Container #6
		Initial Wt.	201	
		Δ Weight	17	
		Total Δ Weight	206	

Comments:

Hg DETERMINATION SAMPLE RECOVERY DATA SHEET

Client: AES
Location: Unit B outlet R2
Sample Date: 1/12/06

Filter				Container #1
Front ½ Rinse	Contents			Container #2
Impinger #1	Contents	Final Wt.	822	Container #3
		Initial Wt.	669	
		Δ Weight	153 - 50 = 103	
Impinger #2	Contents	Final Wt.	798	
		Initial Wt.	715	
		Δ Weight	83	
Impinger #3	Contents	Final Wt.	699	
		Initial Wt.	693	
		Δ Weight	6	
Imkpinger #4	Contents	Final Wt.	729	Container #4
		Initial Wt.	726	
		Δ Weight	3	
Impinger #5	Contents	Final Wt.	731	Container #5
		Initial Wt.	729	
		Δ Weight	2	
Impinger #6	Contents	Final Wt.	755	
		Initial Wt.	751	
		Δ Weight	4	
Impinger #7	Contents	Final Wt.	762	
		Initial Wt.	768	
		Δ Weight	-6	
Impinger #8	Contents	Final Wt.	213	Container #6
		Initial Wt.	201	
		Δ Weight	12	
		Total Δ Weight	207	

Comments:

Hg DETERMINATION SAMPLE RECOVERY DATA SHEET

Client: AES
Location: Ontario Unit 8 R3
Sample Date: 1/12/00

Filter				Container #1
Front ½ Rinse	Contents			Container #2
Impinger #1	Contents	Final Wt.	855	Container #3
		Initial Wt.	691	
		Δ Weight	164 − Sol (114)	
Impinger #2	Contents	Final Wt.	779	
		Initial Wt.	720	
		Δ Weight	59	
Impinger #3	Contents	Final Wt.	705	
		Initial Wt.	692	
		Δ Weight	13	
Imkpinger #4	Contents	Final Wt.	743	Container #4
		Initial Wt.	740	
		Δ Weight	3	
Impinger #5	Contents	Final Wt.	688	Container #5
		Initial Wt.	687	
		Δ Weight	1	
Impinger #6	Contents	Final Wt.	721	
		Initial Wt.	718	
		Δ Weight	3	
Impinger #7	Contents	Final Wt.	726	
		Initial Wt.	728	
		Δ Weight	2	
Impinger #8	Contents	Final Wt.	232	Container #6
		Initial Wt.	201	
		Δ Weight	31	
		Total Δ Weight	226	

Comments:

BEST ENVIRONMENTAL, INC.

San Leandro, CA (510)278-4011

METER BOX POST TEST CALIBRATION

Date: 03/09/00,
Operator: B. Gallagher.
Signature B.G.
QAQC Officer:
Client: A.E.S.

Meter #: R.A.C.#5.
Meter Orifice ID: Box orifice
Standard Meter: Wet Gas Meter
Test Vacuum "Hg: 20"Hg
Bar. Pressure (Pb): 30.21
Leak Checked: 24"Hg

	Yd	ΔH@
Current	0.9939	1.507
Previous	1.0081	1.571

Average ΔH during test: 1.89
Highest Vacuum during test: 20"Hg

ΔH	ΔP	Yds	Standard Meter Gas Volume (ft³) Initial	Final	(Vds) Net	Meter Box Gas Volume (ft³) Initial	Final	(Vd) Net	Std. Meter Temp. (T_{ds}) Avg.	Meter Box Temperature (T_i) Inlet Init.	End	(T_o) Outlet Init.	End	(T_d) Avg.	Time (Min.) Ø	Q	Yd	ΔH@
1.90	-0.145	1.000	0.000	11.620	11.620	612.172	624.043	11.871	55.0	70	72	58	59	64.8	14.23	0.845	0.9924	1.511
1.90	-0.140	1.000	11.620	26.135	14.515	624.043	638.907	14.864	55.0	71	75	59	62	66.8	17.80	0.844	0.9939	1.510
1.90	-0.140	1.000	26.135	37.270	11.135	638.907	650.332	11.425	55.0	73	75	61	63	68.0	13.65	0.844	0.9943	1.505
1.90	-0.145	1.000	37.270	47.287	10.017	650.332	660.623	10.291	55.0	75	75	63	63	69.0	12.28	0.844	0.9949	1.502

Comments: Post test for A.E.S.

Variables:
- Q = Flow rate (cfm)
- ΔH = Orifice pressure differential (in. H_2O)
- ΔP = Inlet pressure differential standard meter (in. H_2O)
- Yds = Standard meter correction factor (Unitless)
- Yd = Meter box correction factor (Unitless)
- ΔH@ = Orifice pressure differential that gives 0.75 DSCFM of air at 68°F and 29.92 in. Hg (in. H_2O)

$$Yd = (Yds)\left(\frac{Vds}{Vd}\right)\left(\frac{Td+460}{Tds+460}\right)\left(\frac{Pb+\Delta P/13.6}{Pb+\Delta H/13.6}\right)$$

$$\Delta H@ = \frac{0.0317 \times \Delta H}{Pb(T_o+460)}\left[\frac{(Tds+460)\theta}{Vds \times Yds}\right]^2$$

$$Q = \frac{17.64 \times Vds \times Pb}{(Tds+460)\theta}$$

Yd Tolerence: (Yd_{AVG}-Yd) ±0.05 ref.Sec. 5.3.2 in EPA method 5

g:\cals\metercal\master1

BEST ENVIRONMENTAL, INC.

San Leandro, CA (510)278-4011

METER BOX FULL TEST CALIBRATION

Meter #: RAC#5,
Meter Orifice ID: boxes orifice
Standard Meter: Wet Gas Meter
Test Vacuum "Hg: 0"Hg
Bar. Pressure (Pb): 30.02
Leak Checked: Yes at 17"Hg

Date: 09/20/99,
Operator: Bob Gallagher
Signature BG
QAQC Officer: CT

	Yd	ΔH@
Current	1.0081	1.571
Previous	1.0338	1.577

ΔH	ΔP	Yds	Standard Meter Gas Volume (ft³) Initial	Final	(Vds) Net	Meter Box Gas Volume (ft³) Initial	Final	(Vd) Net	Std. Meter Temp. (T_{ds}) Avg.	Meter Box Temperature (T_i) Inlet Init.	End	(T_o) Outlet Init.	End	(T_d) Avg.	Time (Min.) θ	Q	Yd	ΔH@
0.50	-0.090	1.000	0.000	6.040	6.040	324.062	330.257	6.195	72.0	95	96	77	79	86.8	14.68	0.410	1.0006	1.614
0.50	-0.095	1.000	6.040	12.060	6.020	330.257	336.452	6.195	73.0	96	101	79	80	89.0	14.68	0.408	0.9995	1.625
0.50	-0.090	1.000	12.060	17.440	5.380	336.452	341.986	5.534	73.0	100	100	81	83	91.0	13.13	0.407	1.0036	1.621
1.50	-0.125	1.000	0.000	10.090	10.090	351.491	361.954	10.463	73.0	115	118	87	89	102.3	13.95	0.719	1.0132	1.530
1.50	-0.120	1.000	10.090	21.400	11.310	361.954	373.727	11.773	73.0	114	118	90	91	103.3	15.63	0.719	1.0112	1.526
1.50	-0.125	1.000	0.000	11.210	11.210	393.543	405.067	11.524	75.0	111	116	85	87	99.8	15.43	0.719	1.0137	1.535
3.00	-0.150	1.000	0.000	13.680	13.680	405.713	419.794	14.081	75.0	114	120	87	90	102.8	13.40	1.011	1.0141	1.546
3.00	-0.155	1.000	13.680	39.485	25.805	419.794	446.620	26.826	76.0	117	125	90	96	107.0	25.56	0.998	1.0098	1.574
3.00	-0.150	1.000	39.485	49.630	10.145	446.620	457.237	10.617	76.0	121	124	96	97	109.5	10.05	0.998	1.0075	1.568

Comments:

Variables:

- Q = Flow rate (cfm)
- ΔH = Orifice pressure differential (in. H_2O)
- ΔP = Inlet pressure differential standard meter (in. H_2O)
- Yds = Standard meter correction factor (Unitless)
- Yd = Meter box correction factor (Unitless)
- ΔH@ = Orifice pressure differential that gives 0.75 DSCFM of air at 68°F and 29.92 in. Hg (in. H_2O)

$$Yd = (Yds)\left(\frac{Vds}{Vd}\right)\left(\frac{Td+460}{Tds+460}\right)\left(\frac{Pb+\Delta P/13.6}{Pb+\Delta H/13.6}\right)$$

$$\Delta H@ = \frac{0.0317 \times \Delta H}{Pb(T_c+460)}\left[\frac{(Tds+460)\theta}{Vds \times Yds}\right]^2$$

$$Q = \frac{17.64 \times Vds \times Pb}{(Tds+460)\theta}$$

1. Yd Tolerence: (Yd_{AVG}-Yd) ±0.02 ref. Fig 5.6 in EPA method 5
2. ΔH@ Tolerence: ($\Delta H@_{AVG}$-ΔH@) ± 0.20 ref. fig 5.6 in EPA method 5.

R.A.C #5

Type K Thermocouple Calibration

Pitot #: _____ Meter # RAC #5

Probe #: _____ Heater Box # _____

Probe Type: _____ Other: Temp Readout

Calibration Date	Thermocouple ID	Reference Temp. (°F)	Test T/C Temp. (°F)	Temp. Difference < 400 °F	% Difference > 400 °F	Notes Pass / Fail
7-6-99	Read out					
	1-STACK	200 °F	202 °F	+2 °F		PASS
	2-PROBE	300 °F	301 °F	+1 °F		PASS
	3-OVEN	200 °F	202 °F	+2 °F		PASS
	4-EXTRA	100 °F	98 °F	-2 °F		PASS
	5-METER IN	71 °F	72 °F	+1 °F		PASS
	6-METER OUT	71 °F	72 °F	+1 °F		PASS

NIST Pyrometer: T134449 Calibrated By: Suhail Asfour

NIST Thermocouple: 910006 Calibration Frequency: *6 Months*

ASTM Mercury in Glass Thermometer #: 61134-125

Comments: T/C SIMULATOR, OMEGA CL-300-2100°F S/N 912

Method Reference: Code of Federal Regulations, 40 CFR 60, Appendix A, Method 2, Revised as of July 1, 1992.

Tolerance Limits: +/-4.0 °F For Temp <400°F.

Tolerance Limits: +/-1.5% For Temp >400°F.

BEST ENVIRONMENTAL, INC.

San Leandro, CA (510)278-4011

METER BOX POST TEST CALIBRATION

Meter #: R.A.C.#6

Date: 03/08/00,
Operator: B. Gallagher.
Signature: B.G.
QAQC Officer:
Client: A.E.S.

Meter Orifice ID: Box orifice
Standard Meter: Wet Gas Meter
Test Vacuum "Hg: 10"Hg
Bar. Pressure (Pb): 29.80
Leak Checked: 16"

	Yd	ΔH@
Current	0.9320	2.103
Previous	0.9882	1.909

Average ΔH during test: 0.75
Highest Vacuum during test: 10"Hg

ΔH	ΔP	Yds	Standard Meter Gas Volume (ft³) Initial	Final	(Vds) Net	Meter Box Gas Volume (ft³) Initial	Final	(Vd) Net	Std. Meter Temp. (T_{ds}) Avg.	Meter Box Temperature (T_i) Inlet Init.	End	(T_o) Outlet Init.	End	(T_d) Avg.	Time (Min.) Θ	Q	Yd	ΔH@
0.75	-0.135	1.000	0.000	6.620	6.620	267.924	275.101	7.177	55.0	61	63	62	63	62.3	15.02	0.450	0.9333	2.086
0.75	-0.140	1.000	6.620	13.239	6.619	275.101	282.298	7.197	55.0	63	63	63	63	63.0	15.07	0.448	0.9319	2.097
0.75	-0.135	1.000	13.239	19.640	6.401	282.298	289.260	6.962	55.0	62	62	63	63	62.5	14.62	0.447	0.9308	2.113
0.75	-0.135	1.000	19.640	26.970	7.330	289.260	297.223	7.963	55.0	62	63	62	63	62.5	16.75	0.447	0.9319	2.115

Comments: Post test for A.E.S.

Variables:

- Q = Flow rate (cfm)
- ΔH = Orifice pressure differential (in. H_2O)
- ΔP = Inlet pressure differential standard meter (in. H_2O)
- Yds = Standard meter correction factor (Unitless)
- Yd = Meter box correction factor (Unitless)
- ΔH@ = Orifice pressure differential that gives 0.75 DSCFM of air at 68°F and 29.92 in. Hg (in. H_2O)

$$Yd = (Yds)\left(\frac{Vds}{Vd}\right)\left(\frac{Td + 460}{Tds + 460}\right)\left(\frac{Pb + \Delta P/13.6}{Pb + \Delta H/13.6}\right)$$

$$\Delta H@ = \frac{0.0317 \times \Delta H}{Pb(T_o + 460)}\left[\frac{(Tds + 460)\theta}{Vds \times Yds}\right]^2$$

$$Q = \frac{17.64 \times Vds \times Pb}{(Tds + 460)\theta}$$

Yd Tolerence (Yd_{AVG}-Yd) ±0.05 ref.Sec. 5.3.2 in EPA method 5

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BEST ENVIRONMENTAL, INC.

San Leandro, CA (510)278-4011

METER BOX FULL TEST CALIBRATION

Meter #: RAC#6,
Meter Orifice ID: boxes orifice
Standard Meter: Wet Gas Meter
Test Vacuum "Hg: 0"Hg
Bar. Pressure (Pb): 29.70
Leak Checked: Yes at 17"Hg

Date: 08/24/99,
Operator: Bob Gallagher
Signature BG
QAQC Officer: CT

	Yd	ΔH@
Current	0.9882	1.909
Previous	0.9603	1.938

ΔH	ΔP	Yds	Standard Meter Gas Volume (ft³) Initial	Final	(Vds) Net	Meter Box Gas Volume (ft³) Initial	Final	(Vd) Net	Std. Meter Temp. (T_{ds}) Avg.	Meter Box Temperature (T_i) Inlet Init.	End	(T_o) Outlet Init.	End	(T_d) Avg.	Time (Min.) Θ	Q	Yd	ΔH@
0.50	-0.085	1.000	0.000	5.060	5.060	374.507	379.680	5.173	84.0	94	98	84	86	90.5	12.95	0.376	0.9884	1.879
0.50	-0.085	1.000	5.060	10.130	5.070	379.680	384.849	5.169	84.0	98	100	86	91	93.8	13.03	0.375	0.9970	1.884
0.50	-0.090	1.000	10.130	15.910	5.780	384.849	390.765	5.916	84.0	100	101	91	93	96.3	14.88	0.374	0.9976	1.882
1.50	-0.105	1.000	0.000	10.050	10.050	291.943	302.307	10.364	85.0	89	102	89	93	93.3	14.98	0.645	0.9805	1.910
1.50	-0.105	1.000	10.050	22.375	12.325	302.307	315.100	12.793	86.0	102	111	93	95	100.3	18.55	0.638	0.9846	1.930
1.50	-0.100	1.000	0.000	11.595	11.595	326.798	338.615	11.817	75.0	93	98	76	81	87.0	17.37	0.654	0.9993	1.880
3.00	-0.125	1.000	0.000	11.455	11.455	243.200	255.062	11.862	80.0	91	105	83	87	91.5	12.28	0.905	0.9787	1.946
3.00	-0.130	1.000	11.455	28.630	17.175	255.062	273.004	17.942	80.0	105	113	87	93	99.5	18.48	0.902	0.9842	1.932
3.00	-0.130	1.000	28.630	46.263	17.633	273.004	291.577	18.573	80.0	110	115	92	98	103.8	19.07	0.897	0.9835	1.937

Comments:

Variables:

Q = Flow rate (cfm)
ΔH = Orifice pressure differential (in. H_2O)
ΔP = Inlet pressure differential standard meter (in. H_2O)
Yds = Standard meter correction factor (Unitless)
Yd = Meter box correction factor (Unitless)
ΔH@ = Orifice pressure differential that gives 0.75 DSCFM of air at 68°F and 29.92 in. Hg (in. H_2O)

$$Yd = (Yds)\left(\frac{Vds}{Vd}\right)\left(\frac{Td+460}{Tds+460}\right)\left(\frac{Pb+\Delta P/13.6}{Pb+\Delta H/13.6}\right)$$

$$\Delta H@ = \frac{0.0317 \times \Delta H}{Pb(T_o+460)}\left[\frac{(Tds+460)\theta}{Vds \times Yds}\right]^2$$

$$Q = \frac{17.64 \times Vds \times Pb}{(Tds+460)\theta}$$

1. Yd Tolerence: (Yd_{AVG}-Yd) ±0.02 ref. Fig 5.6 in EPA method 5
2. ΔH@ Tolerence: ($\Delta H@_{AVG}$-ΔH@) ± 0.20 ref. fig 5.6 in EPA method 5.

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Type K Thermocouple Calibration

Pitot #: _____ Meter # RAC #6

Probe #: _____ Heater Box # _____

Probe Type: _____ Other: Thermo Couple Readout

Calibration Date	Thermocouple ID	Reference Temp. (°F)	Test T/C Temp. (°F)	Temp. Difference < 400 °F	% Difference > 400 °F	Notes Pass / Fail
5-29-99						
1	STACK	400°F	397°F	-3°F		PASS
2	Probe	300°F	299°F	-1°F		PASS
3	OVEN	300°F	299°F	-1°F		PASS
4	Extra	600°F	598°F	-2°F		PASS
5	Meter in	60°F	59°F	-1°F		PASS
6	Meter out	60°F	60°F	-0		PASS

NIST Pyrometer: T134449 Calibrated By: [signature]

NIST Thermocouple: G10006 Calibration Frequency: 6 Months

ASTM Mercury in Glass Thermometer #: 61134-125

Comments: Also used Omega Thermocouple Simulator # CL3002100F SN 912

Method Reference: Code of Federal Regulations, 40 CFR 60, Appendix A, Method 2, Revised as of July 1, 1992.

Tolerance Limits: +/-4.0 °F For Temp <400°F.

Tolerance Limits: +/-1.5% For Temp >400°F.

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PR146

Type K Thermocouple Calibration

Pitot #: _____ Meter # _____

Probe #: PR 146 Heater Box # _____

Probe Type: M5 Other: _____

Calibration Date	Thermocouple ID	Reference Temp. (°F)	Test T/C Temp. (°F)	Temp. Difference < 400 °F	% Difference > 400 °F	Notes Pass / Fail
7-13-99						
	stack T/C	80.1	77.4	-2.7		PASS
	STACK T/C	288.5	287.7	+0.8		PASS
	STACK T/C	31.0	32.4	+1.4		PASS

NIST Pyrometer: T134449 Calibrated By: Suhail Asfour

NIST Thermocouple: 910006 Calibration Frequency: *6 Months*

ASTM Mercury in Glass Thermometer #: _____

Comments: Also USED Pyrometer # T134449

Method Reference: Code of Federal Regulations, 40 CFR 60, Appendix A, Method 2, Revised as of July 1, 1992.

Tolerance Limits: +/-4.0 °F For Temp <400°F.

Tolerance Limits: +/-1.5% For Temp >400°F.

BEST ENVIRONMENTAL, INC.

Type–S Pitot Tube Geometric Calibration Data Sheet

Technician: Robert Gallagher

Date: 7-14-99

Pitot No.:

Pitot length:

Probe No: PR145

Probe Length: 146"

Probe Type: MS

Level Pitot Assembly

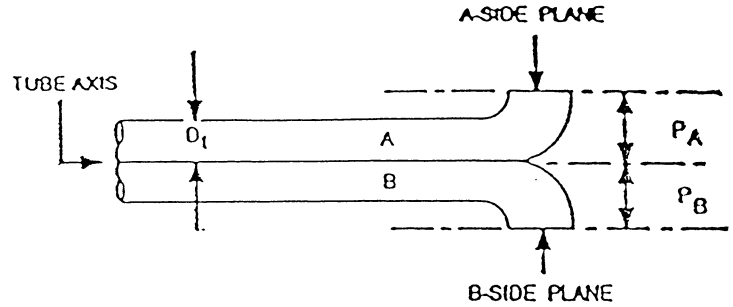
D_t .375 (in.)

P_A .448 (in.)

P_B .448 (in.)

$P = (P_A + P_B)/2$

P/D_t = 1.195 (in.) ($1.05 \le P/D_t \le 1.50$)



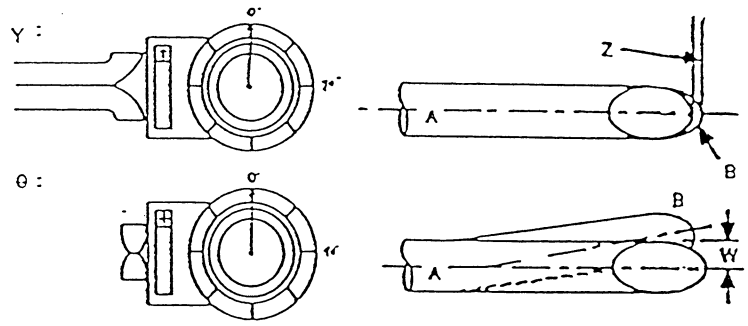
$A = P_A + P_B$ = .896 (in.)

Y = Θ °

Z = A sin Y = Θ (in.) (< 0.125 in.)

θ = Θ °

W = A sin θ = Θ (in.) (< 0.031 in.)

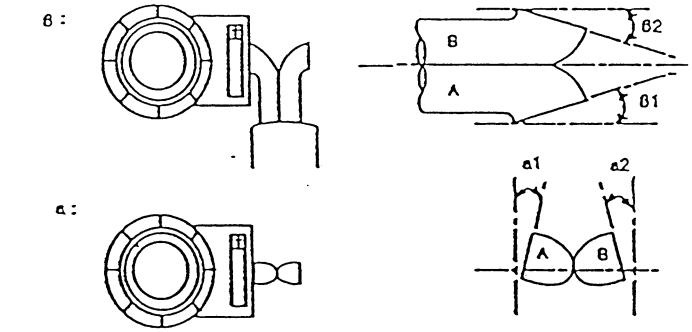


β1 = Θ °(<5°)

β2 = Θ °(<5°)

a1 = Θ °(<10°)

a2 = Θ °(<10°)



Comments: Pitot condition?: good/poor/ need repair/ beyond repair.

New Apex Probe 3-99

Next Cal. Due: (frequency = 6 months)

Tolerance limits from: 1. Standard of Performance for New Stationary Sources, Federal Register 34 (247) December 23, 1971.

2. Vollaro, R.F., "The Effects of Impact Opening Misalignment on the Value of the Type–S Pitot Coefficient." U.S.E.P.A. Emission Measurement Branch, Research Triangle Park, N.C., October 1976.

pitot

BEST ENVIRONMENTAL, INC.

Type–S Pitot Tube Geometric Calibration Data Sheet

Technician: Bob Gallagh

Date: 7-14-99

Pitot No.:

Pitot length:

Probe No: PR146

Probe Length: 146" LONG

Probe Type: M5

Level Pitot Assembly

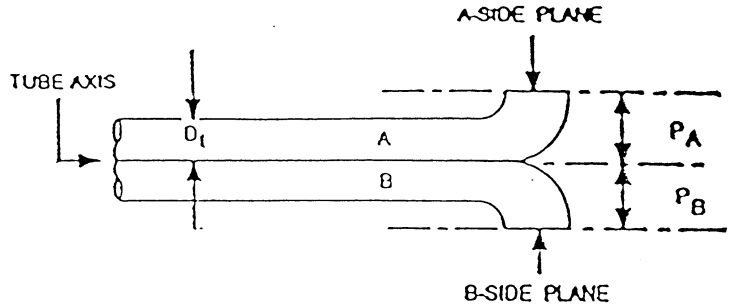
D_t .375 (in.)

P_A .448 (in.)

P_B .448 (in.)

$P = (P_A + P_B)/2$

P/D_t = 1.193 (in.) ($1.05 \le P/D_t \le 1.50$)



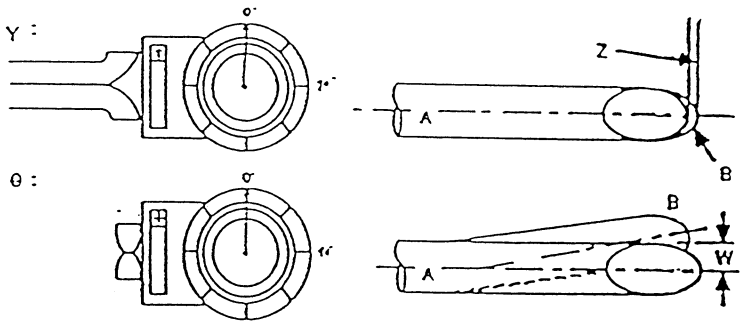
$A = P_A + P_B$ = .896 (in.)

Y = Θ °

Z = A sin Y = Θ (in.) (< 0.125 in.)

θ = Θ °

W = A sin θ = Θ (in.) (< 0.031 in.)

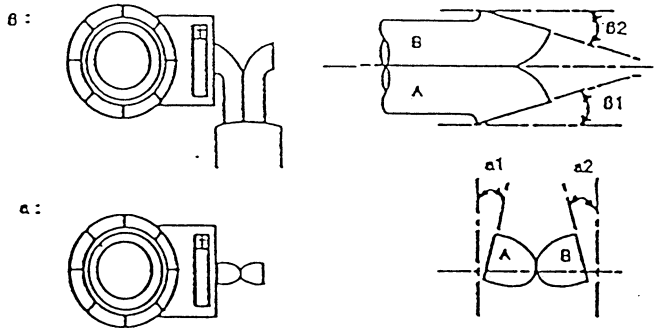


β1 = Θ °(<5°)

β2 = Θ °(<5°)

a1 = Θ °(<10°)

a2 = Θ °(<10°)



Comments: Pitot condition?: (good)/poor/ need repair/ beyond repair.

NEW PROBE - Apex 3-99

Next Cal. Due: (frequency = 6 months)

Tolerance limits from: 1. Standard of Performance for New Stationary Sources, Federal Register 36 (247) December 23, 1971.

2. Vollaro, R.F., "The Effects of Impact Opening Misalignment on the Value of the Type–S Pitot Coefficient." U.S.E.P.A. Emission Measurement Branch, Research Triangle Park, N.C., October 1976.

pitot

PR 145

Type K Thermocouple Calibration

Pitot #: _____ Meter # _____

Probe #: PR 145 Heater Box # _____

Probe Type: M5 Other: 145" Long

Calibration Date	Thermocouple ID	Reference Temp. (°F)	Test T/C Temp. (°F)	Temp. Difference < 400 °F	% Difference > 400 °F	Notes Pass / Fail
7-12-99						
	STACK T/C	89.9 °F	91.9 °F	+ .2 °F		PASS
	STACK T/C	226.2 °F	225.8 °F	-0.4 °F		PASS
	STACK T/C	36.0 °F	37.4 °F	+ 1.4 °F		PASS

NIST Pyrometer: T134449 Calibrated By: Suhail Asfour

NIST Thermocouple: 910006 Calibration Frequency: *6 Months*

ASTM Mercury in Glass Thermometer #: 61134-125

Comments: Also Used pyrometer #3

"NEW PROBE"

Method Reference: Code of Federal Regulations, 40 CFR 60, Appendix A, Method 2, Revised as of July 1, 1992.

Tolerance Limits: +/-4.0 °F For Temp <400°F.

Tolerance Limits: +/-1.5% For Temp >400°F.

R.A.C #5

Type K Thermocouple Calibration

Pitot #: _____ Meter # RAC #5

Probe #: _____ Heater Box # _____

Probe Type: _____ Other: Temp Read out

Calibration Date	Thermocouple ID	Reference Temp. (°F)	Test T/C Temp. (°F)	Temp. Difference < 400 °F	% Difference > 400 °F	Notes Pass / Fail
7-6-99	Read out					
	1-STACK	200 °F	202 °F	+2 °F		PASS
	2-PROBE	300 °F	301 °F	+1 °F		PASS
	3-OVEN	200 °F	202 °F	+2 °F		PASS
	4-EXTRA	100 °F	98 °F	-2 °F		PASS
	5-METER IN	71 °F	72 °F	+1 °F		PASS
	6-METER OUT	71 °F	72 °F	+1 °F		PASS

NIST Pyrometer: T134449 Calibrated By: Suhail Asfour

NIST Thermocouple: 910006 Calibration Frequency: *6 Months*

ASTM Mercury in Glass Thermometer #: 61134-125

Comments: T/C SIMULATOR, OMEGA CL-300-2100°F S/N 912

Method Reference: Code of Federal Regulations, 40 CFR 60, Appendix A, Method 2, Revised as of July 1, 1992.

Tolerance Limits: +/-4.0 °F For Temp <400°F.

Tolerance Limits: +/-1.5% For Temp >400°F.

Type K Thermocouple Calibration

Pitot #: _____ Meter # RAC #6

Probe #: _____ Heater Box # _____

Probe Type: _____ Other: Thermo Couple Readout

Calibration Date	Thermocouple ID	Reference Temp. (°F)	Test T/C Temp. (°F)	Temp. Difference < 400 °F	% Difference > 400 °F	Notes Pass / Fail
5-29-99						
1	STACK	400°F	397°F	-3°F		PASS
2	PROBE	300°F	299°F	-1°F		PASS
3	OVEN	300°F	299°F	-1°F		PASS
4	EXTRA	600°F	598°F	-2°F		PASS
5	METER IN	60°F	59°F	-1°F		PASS
6	METER OUT	60°F	60°F	-0		PASS

NIST Pyrometer: T134449 Calibrated By: [signature]

NIST Thermocouple: 910006 Calibration Frequency: 6 Months

ASTM Mercury in Glass Thermometer #: 61134-125

Comments: ALSO USED Omega T'couple Simulator # CL3002100F SN 912

Method Reference: Code of Federal Regulations, 40 CFR 60, Appendix A, Method 2, Revised as of July 1, 1992.

Tolerance Limits: +/-4.0 °F For Temp <400°F.

Tolerance Limits: +/-1.5% For Temp >400°F.

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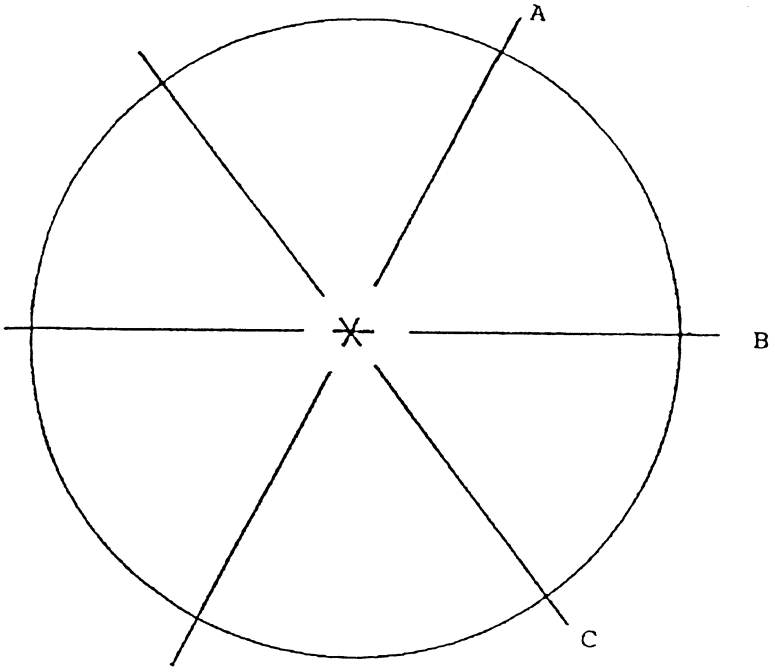
NOZZLE CALIBRATION FORM

ID# A11



Diameter Dimension

0.179
0.180
0.180

Average

0.180

Range

0.001

Nozzle type:

Glass:	A11 MS
Quartz:	
Stainless Steel:	
Other:	

Date: 6/11/99

Recorded By: Michael J. Wiley

Next Cal. due: 6/11/00

Reference Method: EPA 5 (section 5.1)

Acceptance Limits: < 0.004" range of 3 measurements

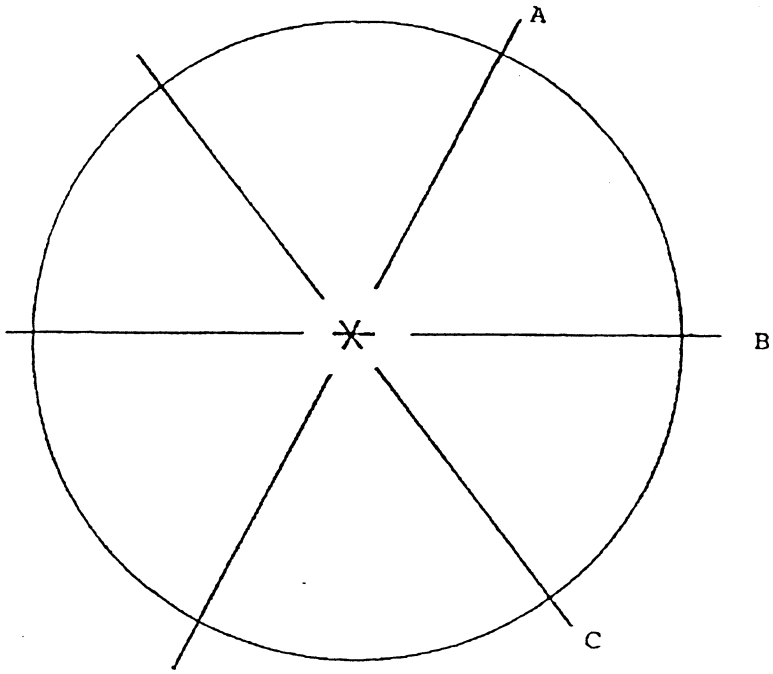
Calibration Frequency: 12 Months

Comments:

AAMSnozcal

NOZZLE CALIBRATION FORM

ID# 3 C



Diameter Dimension
.241
.243
.243

Average
.242

Range
.002

Nozzle type:

Glass: ✓ MS
Quartz:
Stainless Steel:
Other:

Date: 5/25/99

Recorded By: M. Wiley

Next Cal. due: 5/25/00

Reference Method: EPA 5 (section 5.1)

Acceptance Limits: < 0.004" range of 3 measurements

Calibration Frequency: 12 Months

Comments: 2

AAM5nozcal

APPENDIX

C - Sampling Log and Chain-of-Custody Records

BEST ENVIRONMENTAL, INC.
15890 Foothill Boulevard
San Leandro, California 94578
(510) 278-4011 FAX (510) 278-4018

FIELD LOG

AES Hawaii, Kapolei, HI

11/11/00

Samples Collected

Inlet - Ontario H_2O Hg - Run 1
Inlet - M3 O_2 & CO_2 - Run 1

Outlet - Ontario H_2O Hg - Run 1
Outlet - M3 O_2 & CO_2 - Run 1

11/12/00

Inlet - Ontario H_2O Hg - Run 2
Inlet - M3 O_2 & CO_2 - Run 2

Outlet - Ontario H_2O Hg - Run 2
Outlet - M3 O_2 & CO_2 - Run 2

Inlet - Ontario H_2O Hg - Run 3
Inlet - M3 lost

Outlet - Ontario H_2O Hg - Run 3
Outlet - ~~Ontario~~ M3 O_2 & CO_2 - Run 3

BEST ENVIRONMENTAL, INC

Ph (510) 278 4011; Fx (510) 278 4018

Project ID: AES - Inlet Unit B

Analytical Lab: Method - Source - Run - Fraction

SAMPLE CHAIN OF CUSTODY

1 of 4

#	DATE	TIME	SAMPLE ID ~~Source/Run#/Method/Fraction~~	CONTAINER ~~size Type~~ #	Volume	Storage Temp °F	SAMPLE DESCRIPTION	ANALYSIS	TAT
1	1/11/00	✓	Out.Hydro-Binlet-R1-Filter	#1 [illegible]			Quarz fiber filter		
2	1/12/00	✓	Out.Hydro-Binlet R2-Filter	#1 "			Quarz fiber filter		
3	1/12/00	✓	Out.Hydro-Binlet R3 Filter	#1 "			Quarz fiber filter		
4	1/11/00	✓	Out.Hydro-trainBK-R4-Filter	#1 "			Quarz fiber filter		
5									
6	1/11/00	✓	Out.Hydro-Binlet-R1-F/H rinse	#2 250			0.1N HNO_3-Probe/Nozzle rinse		
7	1/12/00	✓	Out.Hydro-Binlet-R2 F/H rinse	#2 "			0.1N HNO_3-Probe/Nozzle rinse		
8	1/12/00	✓	Out.Hydro-Binlet-R3 F/H rinse	#2 "			0.1N HNO_3-Probe/Nozzle rinse		
9	1/11/00	✓	Out Hydro-~~train~~ BK-R4-F/H rinse	#2 "			0.1N HNO_3-Probe/Nozzle rinse		
10									
11	1/11/00	✓	Out Hydro-Binlet-R1-KCl	#3 950cc			1N KCl-Impinger Solution		
12	1/12/00	✓	Out.Hydro-Binlet-R2-KCl	#3 950cc			1N KCl-Impinger Solution		
13	1/12/00	✓	Out.Hydro-Binlet-R3-KCl	#3 950cc			1N KCl-Impinger Solution		
14	1/11/00	✓	Out.Hydro-train BK-R4-KCl	#3 950cc			1N KCl-Impinger Solution		
15									
16	1/11/00	✓	Out.Hydro-Binlet-R1-H_2O_2/HNO_3	#4 250			10% H_2O_2/5% HNO_3 Impinger Sol.		
17	1/12/00	✓	Out.Hydro-Binlet-R2-H_2O_2/HNO_3	#4 "			10% H_2O_2/5% HNO_3 Impinger Sol.		
18	1/12/00	✓	Out.Hydro-Binlet-R3-H_2O_2/HNO_3	#4 "			10% H_2O_2/5% HNO_3 Impinger Sol		
19	1/11/00	✓	Out.Hydro.-train BK-R4-H_2O_2/HNO_3	#4 "			10% H_2O_2/5% HNO_3 Impinger Sol.		
20									
21									

SPECIAL INSTRUCTIONS: Record & Report all liquid sample volumes.

All $KMnO_4$ samples are all in one cooler; All other samples are in 2nd cooler.

Submit Results to: Attn: SCOTT CHESNUT

Best Environmental Inc, 15890 Foothill Blvd., San Leandro, CA 94578

Relinquished by: [signature] Received by: FedEx 814799991875 Date: 1-14-00 Time:

Relinquished by: Received by: Date: Time:

Relinquished by: Received by: Date: Time:

SAMPLE CONDITION AS RECEIVED: OK or not OK

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BEST ENVIRONMENTAL, INC Ph (510) 278 4011; Fx (510) 278 4018

Project ID: AES Inlet Unit B

Analytical Lab:

SAMPLE CHAIN OF CUSTODY

2 of 4

#	DATE	TIME	SAMPLE ID Source/Run#/Method/Fraction	CONTAINER ~~size/type~~ #	Volume	Storage Temp °F	SAMPLE DESCRIPTION	ANALYSIS	TAT
1	1/11/00	✓	Ont.Hydro-Binlet-R1-KMnO4	#5 soil			4% KMnO4/10% H2SO4 imp Sol	Ont Hydro	Normal
2	1/12/00	✓	Ont.Hydro-Binlet-R2-KMnO4	#5 soil			4% KMnO4/10% H2SO4 imp. Sol	Ont.Hydro	Normal
3	1/12/00	✓	Ont.Hydro-Binlet R3-KMnO4	#5 soil			4% KMnO4/10% H2SO4 imp Sol	Ont. Hydro	Normal
4	1/11/00	✓	Ont.Hydro-~~Binlet~~ BK R4 KMnO4	#5 soil			4% KMnO4/10% H2SO4 imp Sol.	Ont. Hydro	Normal
5									
6	1/12/00	✓	Ont.Hydro-Reagent BK-F/H rinse	#7 250cc			0.1N HNO3 reagent Blank		
7	1/12/00	✓	Ont.Hydro-Reagent BK-KCl	#8 "			1N KCl reagent Blank		
8	1/12/00	✓	Ont Hydro-Reagent BK-H2O2/HNO3	#9 "			10% H2O2/5% HNO3 reagent BK.		
9	1/12/00	✓	Ont Hydro-Reagent BK-KMnO4	#10 "			4% KMnO4/10% H2SO4 reagent BK		
10	1/12/00	✓	Ont Hydro-Reagent BK-OH NH2-SO4	#11 "			10% Hydroxylamine sulfate-R BK		
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									

SPECIAL INSTRUCTIONS: Record & Report all liquid sample volumes.

Submit Results to: Attn: SCOTT CHESNUT Best Environmental Inc, 15890 Foothill Blvd., San Leandro, CA 94578

Relinquished by: [signature] Received by: Date: 1-14-00 Time:

Relinquished by: Received by: Date: Time:

Relinquished by: Received by: Date: Time:

SAMPLE CONDITION AS RECEIVED: OK or not OK

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BEST ENVIRONMENTAL, INC Ph (510) 278 4011; Fx (510) 278 4018

Project ID: AES - outlet B

Analytical Lab:

SAMPLE CHAIN OF CUSTODY

3 of 4

#	DATE	TIME	SAMPLE ID Source/Run#/Method/Fraction	CONTAINER size / type	Volume	Storage Temp °F	SAMPLE DESCRIPTION	ANALYSIS	TAT
1	1/11/00	✓	Out. Hydro - Bottlet - R1 - Filter	#1 8oz wide			Quartz fiber filter	Out. Hydro	Normal
2	1/12/00	✓	Out. Hydro - Bottlet - R2 - Filter	#1 "			Quartz fiber filter	Out. Hydro	Normal
3	1/12/00	✓	Out Hydro - Bottlet - R3 - Filter	#1 "			Quartz fiber filter	Out. Hydro	Normal
4	~~1/11/00~~		~~Out. Hydro - Bottlet - R~~				~~Quartz~~		
5	~~1/11/00~~		~~Out Hydro - Trip Blk - R4 - Filter~~	~~#1~~			~~Quartz fiber filter~~	~~Out. Hydro~~	~~Normal~~
6									
7	1/11/00	✓	Out. Hydro - Bottlet - R1 - F/H rinse	#2 250cc			0.1N HNO_3 Probe/nozzle rinse	Out. Hydro	Normal
8	1/12/00	✓	Out. Hydro - Bottlet - R2 - F/H rinse	#2 250cc			0.1N HNO_3 - Probe/Nozzle rinse	Out. Hydro	Normal
9	1/12/00	✓	Out. Hydro - Bottlet - R3 - F/H rinse	#2 250cc			0.1N HNO_3 - Probe/Nozzle rinse	Out. Hydro	Normal
10	~~1/11/00~~		~~Out Hydro - Bottlet Trip Blk - R4 - F/H rinse~~	~~#2~~			~~0.1N HNO_3 - Probe/Nozzle rinse~~	~~Out. Hydro~~	~~Normal~~
11									
12	1/11/00	✓	Out. Hydro - Bottlet - R1 - KCl	#3 950cc			1N KCl - Impinger Solution	Out. Hydro	Normal
13	1/12/00	✓	Out. Hydro - Bottlet - R2 - KCl	#3 950cc			1N KCl - Impinger Solution	Out. Hydro	Normal
14	1/12/00	✓	Out. Hydro - Bottlet - R3 - KCl	#3 950cc			1N KCl - Impinger Solution	Out. Hydro	Normal
15	~~1/11/00~~		~~Out. Hydro - Bottlet trip Blk - R4 - KCl~~	~~#3~~			~~1N KCl - Impinger Solution~~	~~Out. Hydro~~	~~Normal~~
16									
17	1/11/00	✓	Out. Hydro - Bottlet - R1 - H_2O_2/HNO_3	#4 250cc			10% H_2O_2/5% HNO_3 Impinger Sol.	Out. Hydro	Normal
18	1/12/00	✓	Out. Hydro - Bottlet - R2 - H_2O_2/HNO_3	#4 "			10% H_2O_2/5% HNO_3 Impinger Sol.	Out. Hydro	Normal
19	1/12/00	✓	Out. Hydro - Bottlet - R3 - H_2O_2/HNO_3	#4 "			10% H_2O_2/5% HNO_3 Impinger Sol.	Out. Hydro	Normal
20	~~1/11/00~~		~~Out. Hydro - trip Blk - R4 - H_2O_2/HNO_3~~	~~#4~~			~~10% H_2O_2/5% HNO_3 Impinger Sol.~~	~~Out. Hydro~~	~~Normal~~
21									

SPECIAL INSTRUCTIONS: Record & Report all liquid sample volumes.

Submit Results to: Attn: SCOTT CHESNOT **Best Environmental Inc, 15890 Foothill Blvd., San Leandro, CA 94578**

Relinquished by: [signature] Received by: _____ Date: 1-14-00 Time: _____

Relinquished by: _____ Received by: _____ Date: _____ Time: _____

Relinquished by: _____ Received by: _____ Date: _____ Time: _____

SAMPLE CONDITION AS RECEIVED: OK or not OK

BEST ENVIRONMENTAL, INC

Ph (510) 278 4011, Fx (510) 278 4018

Project ID: AES-outlet B

Analytical Lab:

SAMPLE CHAIN OF CUSTODY

4 of 4

#	DATE	TIME	SAMPLE ID (Source/Run#/Method/Fraction)	CONTAINER size / type	Volume	Storage Temp °F	SAMPLE DESCRIPTION	ANALYSIS	TAT
1	1/11/00	✓	Out. Hydro - Bottle - R1 KMnO4	#5			4% KMnO4/10% H2SO4 imp. Sol.	Out Hydro	Normal
2	1/12/00	✓	Out. Hydro - Bottle - R2 KMnO4	#5			4% KMnO4/10% H2SO4 imp. Sol.	Out. Hydro	Normal
3	1/12/00	✓	Out. Hydro - Bottle - R3 KMnO4	#5			4% KMnO4/10% H2SO4 imp. Sol.	Out. Hydro	Normal
4	1/11/00		~~Out. Hydro trap BK - R4 KMnO4~~	#5			4% KMnO4/10% H2SO4 imp. Sol.	Out. Hydro	Normal
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									

SPECIAL INSTRUCTIONS: Record & Report all liquid sample volumes.

Submit Results to: Attn: SCOTT CHESNUT

Best Environmental Inc, 15890 Foothill Blvd., San Leandro, CA 94578

Relinquished by: [signature] Received by: _____ Date: 1-14-00 Time: _____

Relinquished by: _____ Received by: _____ Date: _____ Time: _____

Relinquished by: _____ Received by: _____ Date: _____ Time: _____

SAMPLE CONDITION AS RECEIVED: OK or not OK

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BEST ENVIRONMENTAL, INC. PH (510) 278-4011 FX (510) 278-4018

Project ID: AES Hawaii
Analytical Lab: Standard Laboratory

SAMPLE CHAIN OF CUSTODY

#	DATE	TIME	SAMPLE ID Source/Run#/Method/Fraction	CONTAINER size / type	Volume	Storage Temp °F	SAMPLE DESCRIPTION	ANALYSIS	TAT
1	1/11/00	1423-1713	~~Run~~ Fuel Analysis, - Inlet - Run 1	Plastic Bag	1 gal	Amb.	Coal Fuel	Ash, Sulfur, Moisture, Btu Volatile, C, H, N, Cl + Hg	Normal
2	1/12/00	914-1211	Fuel Analysis, Inlet - Run 2	"	"	"	"	"	"
3	"	1342-1639	Fuel Analysis, Inlet - Run 3	"	"	"	"	"	"
4									
5	—	—	Coal Fly Ash - Audit	125ml Jar	~3 lg	Amb.	Coal Fly Ash	Hg	"
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									

SPECIAL INSTRUCTIONS: Record & Report all liquid sample volumes.

Submit Results to: Attn: Scott Chesnut Best Environmental Inc. 15890 Foothill Blvd., San Leandro, CA 94578

Relinquished by: [signature] Received by: ENTRY 1 UPS 1Z 8E6 879 01 1002 192 5 Date: 1/19/00 Time: 2:00 p.m.

Relinquished by: _____ Received by: _____ Date: _____ Time: _____

Relinquished by: _____ Received by: _____ Date: _____ Time: _____

SAMPLE CONDITION AS RECEIVED: OK or not OK

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APPENDIX

D - Analytical Data Sheets

INORGANIC DATA PACKAGE
FOR
BEST ENVIRONMENTAL INC.

Philip Analytical Services Corporation
5555 North Service Road
Burlington, Ontario L7L 5H7

Submission #0A0501

Prepared by: Shari Typer – CSR Initial : _____
Approved by : Dr. Ron McLeod - Principal Scientist Initial : _____

1. CASE NARRATIVE

PROJECT NARRATIVE

PHILIP Analytical Services (Burlington ON)
Philip Project: AN990603
Philip Submission #:0A0501

Client: Best Environmental Inc.
Client Project: AES, Stack Emissions

I. SAMPLE RECEIPT/ANALYSIS

a) Sample Listing

Philip ID	Client Sample ID	Date Sampled	Date Received	Date Prepped	Run Date
Mercury via SW846 Method 7471					
002622 00	NIST 1633b Coal Ash	00/01/20	00/01/20	00/02/11	00/02/11
002887 00	Method Blank	00/01/21	00/01/21	00/02/11	00/02/11
002888 00	Coal Fly Ash Audit-B	00/01/21	00/01/21	00/02/11	00/02/11
Draft ASTM Mercury Speciation Method (October 27, 1999 Revision)- Front Half					
002592 00	Method Blank	00/01/11	00/01/19	00/02/11	00/02/11
002594 00	OH-Train Blank	00/01/11	00/01/19	00/02/11	00/02/11
002595 00	OH-Unit B Outlet-R1	00/01/11	00/01/19	00/02/11	00/02/11
002596 00	OH-Unit B Outlet-R2	00/01/12	00/01/19	00/02/11	00/02/11
002597 00	OH-Unit B Outlet-R3	00/01/12	00/01/19	00/02/11	00/02/11
002598 00	OH-Unit B Inlet-R1	00/01/11	00/01/19	00/02/11	00/02/11
002599 00	OH-Unit B Inlet-R2	00/01/12	00/01/19	00/02/11	00/02/11
002600 00	H-U	00/01/12	00/01/19	00/02/11	00/02/11
Draft ASTM Mercury Speciation Method (October 27, 1999 Revision)- Hydroxylamine					
002592 00	Method Blank	00/01/11	00/01/19	00/01/28	00/01/28
002593 00	OH-Reagent Blank	00/01/11	00/01/19	00/01/28	00/01/28
Draft ASTM Mercury Speciation Method (October 27, 1999 Revision)- KCl Impingers/Rinses					
002592 00	Method Blank	00/01/11	00/01/19	00/02/08	00/02/08
002593 00	OH-Reagent Blank	00/01/11	00/01/19	00/02/08	00/02/08
002594 00	OH-Train Blank	00/01/11	00/01/19	00/02/08	00/02/08
002595 00	OH-Unit B Outlet-R1	00/01/11	00/01/19	00/02/08	00/02/08
002596 00	OH-Unit B Outlet-R2	00/01/12	00/01/19	00/02/08	00/02/08
002597 00	OH-Unit B Outlet-R3	00/01/12	00/01/19	00/02/08	00/02/08
002598 00	OH-Unit B Inlet-R1	00/01/11	00/01/19	00/02/08	00/02/08
002599 00	OH-Unit B Inlet-R2	00/01/12	00/01/19	00/02/08	00/02/08
002600 00	H-U	00/01/12	00/01/19	00/02/08	00/02/08

Draft ASTM Mercury Speciation Method (October 27, 1999 Revision)- KMNO4 Impingers/Rinses

002592 00	Method Blank	00/01/11	00/01/19	00/02/03	00/02/03
002593 00	OH-Reagent Blank	00/01/11	00/01/19	00/02/03	00/02/03
002594 00	OH-Train Blank	00/01/11	00/01/19	00/02/03	00/02/03
002595 00	OH-Unit B Outlet-R1	00/01/11	00/01/19	00/02/03	00/02/03
002596 00	OH-Unit B Outlet-R2	00/01/12	00/01/19	00/02/03	00/02/03
002597 00	OH-Unit B Outlet-R3	00/01/12	00/01/19	00/02/03	00/02/03
002598 00	OH-Unit B Inlet-R1	00/01/11	00/01/19	00/02/03	00/02/03
002599 00	OH-Unit B Inlet-R2	00/01/12	00/01/19	00/02/03	00/02/03
002600 00	H-U	00/01/12	00/01/19	00/02/03	00/02/03

Draft ASTM Mercury Speciation Method (October 27, 1999 Revision)- HNO3/H202 Impingers/Rinses

002592 00	Method Blank	00/01/11	00/01/19	00/01/28	00/01/28
002593 00	OH-Reagent Blank	00/01/11	00/01/19	00/01/28	00/01/28
002594 00	OH-Train Blank	00/01/11	00/01/19	00/01/28	00/01/28
002595 00	OH-Unit B Outlet-R1	00/01/11	00/01/19	00/01/28	00/01/28
002596 00	OH-Unit B Outlet-R2	00/01/12	00/01/19	00/01/28	00/01/28
002597 00	OH-Unit B Outlet-R3	00/01/12	00/01/19	00/01/28	00/01/28
002598 00	OH-Unit B Inlet-R1	00/01/11	00/01/19	00/01/28	00/01/28
002599 00	OH-Unit B Inlet-R2	00/01/12	00/01/19	00/01/28	00/01/28
002600 00	H-U	00/01/12	00/01/19	00/01/28	00/01/28

Draft ASTM Mercury Speciation Method (October 27, 1999 Revision)- Probe Rinses

002593 00	OH-Reagent Blank	00/01/11	00/01/19	00/02/11	00/02/11
002598 00	OH-Unit B Inlet-R1	00/01/11	00/01/19	00/02/11	00/02/11
002599 00	OH-Unit B Inlet-R2	00/01/12	00/01/19	00/02/11	00/02/11
002600 00	H-U	00/01/12	00/01/19	00/02/11	00/02/11

Run Date is defined as the date of injection of the last calibration standard (12 hour or less) prior to the samples analyzed within that run sequence. Therefore the time of calibration injection that defines the run date is always within 12 hours of the time of sample injection.

b) Shipping Problems: none encountered

c) Documentation Problems: none encountered

II. SAMPLE PREP:

No problems encountered

III. SAMPLE ANALYSIS:

See also comments within the appropriate Certificate of Analysis.

a) Hold Times: all within recommended hold times

b) Instrument Calibration: all within control limits

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above.
In addition, I certify, that to the best of my knowledge and belief, the data as reported are true and accurate.
Release of the data contained in this data package has been authorized by the cognizant laboratory official or his/her designee, as verified by this signature.

Ronald A. McLeod, Principal Sci., Ph.D.,C.Chem.

Date

2. ANALYTICAL DATA REPORT

Certificate of Analysis

CLIENT INFORMATION		LABORATORY INFORMATION	
Attention:	Scott Chestnut	**Contact:**	Ron McLeod
Client Name:	Best Environmental Inc.	**Project:**	AN990603
Project:	AES	**Date Received:**	00/01/19
Project Desc:	Stack Emissions	**Date Reported:**	00/02/14
Address:	15890 Foothill Blvd San Leandro,CA CA 94578	**Submission No.:**	0A0501
		Sample No.:	002592-002600
Fax Number:	510 278 4018		
Phone Number:	510 278 4011		

NOTES: ***"-" = not analysed '<' = less than Method Detection Limit (MDL) 'NA' = no data available***
LOQ can by determined for all analytes by multiplying the appropriate MDL X 3.33
Solids data is based on dry weight except for biota analyses.
Organic analyses are not corrected for extraction recovery standards except for isotope dilution methods, (i.e. CARB 429 PAH, all PCDD/F and DBD/DBF analyses)

Methods used by PASC are based upon those found in 'Standard Methods for the Examination of Water and Wastewater', Nineteenth Edition. Other methods are based on the principles of MISA or EPA methodologies. New York State: ELAP Identification Number 10756.

All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies, quality assurance and quality control procedures except where otherwise agreed to by the client and testing company in writing. Any and all use of these test results shall be limited to the actual cost of the pertinent analysis done. There is no other warranty expressed or implied. Your samples will be retained at PASC for a period of three weeks from receipt of data or as per contract.

COMMENTS:

* Probe rinses were analyzed separately on the inlets but combined with the filters on the outlets.

Certified by: _____

PASC - Certificate of Analysis

	Client ID:		Method Blank	Blank Spike #1	Blank Spike #1	Blank Spike #2	Blank Spike #2	OH-Reagent Blank	OH-Train Blank	OH-Unit B Outlet-R1
	Lab No.:		002592 00	002592 00	002592 00	002592 00	002592 00	002593 00	002594 00	002595 00
	Date Sampled:		00/01/11	00/01/11	00/01/11	00/01/11	00/01/11	00/01/11	00/01/11	00/01/11
Component	**MDL**	**Units**			% Recoveries		% Recoveries			
Mercury - filter*	0.010	ug	<	0.10	100	0.10	100	-	0.012	<
Mercury - hydroxylamine	0.010	"	<	0.10	100	0.10	100	<	-	-
Mercury - KCl	0.030	"	<	0.30	100	0.30	100	<0.10	<0.10	<0.10
Mercury - KMnO4	0.030	"	<	0.30	99	0.29	97	0.20	0.78	1.6
Mercury - H202	0.010	"	<0.25	0.10	100	0.10	100	0.056	0.11	<0.25
Mercury - probe rinse*	0.010	"	-	-	-	-	-	<	-	-

00006

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PASC - Certificate of Analysis

	Client ID:		OH-Unit B Outlet-R1	OH-Unit B Outlet-R1	OH-Unit B Outlet-R1	OH-Unit B Outlet-R1	OH-Unit B Outlet-R1	OH-Unit B Outlet-R2	OH-Unit B Outlet-R3	OH-Unit B Inlet-R1	OH-Unit B Inlet-R2
	Lab No.:		002595 00	002595 00	002595 00	002595 00	002595 00	002596 00	002597 00	002598 00	002599 00
	Date Sampled:		00/01/11	00/01/11	00/01/11	00/01/11	00/01/11	00/01/12	00/01/12	00/01/11	00/01/12
Component	**MDL**	**Units**	Duplicate	M. Spike	MS % Rec.	MS Dup	MSD % Rec.				
Mercury - filter*	0.010	ug	<	0.11	100	0.11	100	<	<	0.10	0.12
Mercury - hydroxylamine	0.010	"	-	-	-	-	-	-	-	-	-
Mercury - KCl	0.030	"	<0.10	0.99	99	1.00	100	<0.10	<0.10	<0.10	0.21
Mercury - KMnO4	0.030	"	1.6	3.5	94	3.5	94	2.2	1.3	1.6	1.9
Mercury - H202	0.010	"	<0.25	2.5	100	2.6	100	<0.25	<0.25	<0.25	<0.25
Mercury - probe rinse*	0.010	"	-	-	-	-	-	-	-	0.23	0.33

00007

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PASC - Certificate of Analysis

Inlet A3

Client ID:		H-U
Lab No.:		002600 00
Date Sampled:		00/01/12
Component	**MDL**	**Units**
Mercury - filter*	0.010	ug
Mercury - hydroxylamine	0.010	"
Mercury - KCl	0.030	"
Mercury - KMnO4	0.030	"
Mercury - H202	0.010	"
Mercury - probe rinse*	0.010	"

00008

PASC - Certificate of Analysis

	Client ID:		Method Blank	Blank Spike #1	Blank Spike #1	Blank Spike #2	Blank Spike #2	Coal Fly Ash Audit-B	NIST 1633b Coal Ash	NIST 1633b Coal Ash
	Lab No.:		002887 00	002887 00	002887 00	002887 00	002887 00	002888 00	002622 00	002622 00
	Date Sampled:		00/01/21	00/01/21	00/01/21	00/01/21	00/01/21	00/01/21	00/01/20	00/01/20
Component	**MDL**	**Units**			% Recoveries		% Recoveries			Design
Mercury	0.04	mg/kg	<	1.0	103	1.0	102	0.150	0.150	0.141

00009

Batch Code:	**02111NFT**
Mercury - filter Outlet	002592 00
	002594 00
	002595 00
	002596 00
	002597 00
Run Date	00/02/11
Date of Sample Prep.	00/02/11

Batch Code:	**02111NFT**
Mercury - filter Inlet	002598 00
	002599 00
	002600 00
Run Date	00/02/11
Date of Sample Prep.	00/02/11

Batch Code:	**01281GPO**
Mercury - hydroxylamine	002592 00
	002593 00
Run Date	00/01/28
Date of Sample Prep.	00/01/28

Batch Code:	**02081NKC**
Mercury - KCl	002592 00
	002593 00
	002594 00
	002595 00
	002596 00
	002597 00
	002598 00
	002599 00
	002600 00
Run Date	00/02/08
Date of Sample Prep.	00/02/08

Batch Code:	**02031NM4**
Mercury - KMnO4	002592 00
	002593 00
	002594 00
	002595 00
	002596 00
	002597 00
	002598 00
	002599 00
	002600 00
Run Date	00/02/03
Date of Sample Prep.	00/02/03

Batch Code:	**01281GPO**	
Mercury - H202	002592 00	
	002593 00	
	002594 00	
	002595 00	
	002596 00	
	002597 00	
	002598 00	
	002599 00	
	002600 00	
Run Date	00/01/28	
Date of Sample Prep.	00/01/28	

Batch Code:	**02112NPR**	
Mercury - probe rinse	002593 00	
	002598 00	
	002599 00	
	002600 00	
Run Date	00/02/11	
Date of Sample Prep.	00/02/11	

Batch Code:	**02111NFT**	**02081NFT**
Mercury	002622 00	002887 00
	002888 00	
Run Date	00/02/11	00/02/11
Date of Sample Prep.	00/02/11	00/02/08

3. RAW DATA

Zenon Number	Client	Client ID	Parameter	TS	Result	Dup.	Spike	% Rec.	Dup. Spk	% Rec.	Batch Date	Batch Code	Run Date	Run Code	Day Old	Day In	Analyst's Comments
002622	BESTENV	NIST 1633b Coal Ash	Mercury	PV	0.15						00/02/11	1NFT	00/02/11	MG01	22.	22.	
002887	BESTENV	MB R456	Mercury	PV	-0.04	-99999.0	1.03	103.	1.02	102.	00/02/11	1NFT	00/02/11	MG01	21.	21.	
002888	BESTENV	Coal Fly Ash Audit-B	Mercury	PV	0.15						00/02/11	1NFT	00/02/11	MG01	21.	21.	
BL0211	INTERNAL		Mercury	PV	-0.04	-99999.0	1.03	103.	1.02	102.	00/02/11	1NFT	00/02/11	MG01	$$$	$$$	

4 Tests for 7471HG-S with an MDL of 0.04 mg/kg Validated By CMB Control Chart Updated N/A IO Requirements met N/A

00013

Zenon Number	Client	Client ID	Parameter	TS	Result	Dup.	Spike	% Rec.	Dup. Spk	% Rec.	Batch Date	Batch Code	Run Date	Run Code	Day Old	Day In	Analyst's Comments
002592	BESTENV	MB R456	Mercury -	PV	-0.010	-99999.0	0.103	103.	0.102	102.	00/02/11	1NFT	00/02/11	MG01	31.	23.	*BLKIM*
002594	BESTENV	OH-Train Blank	Mercury -	PV	0.012						00/02/11	1NFT	00/02/11	MG01	31.	23.	
002595	BESTENV	OH-Unit B Outlet-R1	Mercury -	PV	-0.010	-0.010	0.106	101.	0.107	101.	00/02/11	1NFT	00/02/11	MG01	31.	23.	*PDS*
002596	BESTENV	OH-Unit B Outlet-R2	Mercury -	PV	-0.010						00/02/11	1NFT	00/02/11	MG01	30.	23.	
002597	BESTENV	OH-Unit B Outlet-R3	Mercury -	PV	-0.010						00/02/11	1NFT	00/02/11	MG01	30.	23.	
BL0211	INTERNAL		Mercury -	PV	-0.010	-99999.0	0.103	103.	0.102	102.	00/02/11	1NFT	00/02/11	MG01	$$$	$$$	*BLKIMP*

6 Tests for OHFLT with an MDL of 0.010 ug Validated By CMB Control Chart Updated N/A IO Requirements met N/A

00014

Zenon Number	Client	Client ID	Parameter	TS	Result	Dup.	Spike	% Rec.	Dup. Spk	% Rec.	Batch Date	Batch Code	Run Date	Run Code	Day Old	Day In	Analyst's Comments
002598	BESTENV	OH-Unit B Inlet-R1	Mercury -	PV	0.100						00/02/11	1NFT	00/02/11	MG01	31.	23.	
002599	BESTENV	OH-Unit B Inlet-R2	Mercury -	PV	0.121						00/02/11	1NFT	00/02/11	MG01	30.	23.	
002600	BESTENV	H-U	Mercury -	PV	0.118						00/02/11	1NFT	00/02/11	MG01	30.	23.	
BL0211	INTERNAL		Mercury -	PV	-0.010	-99999.0	0.103	103.	0.102	102.	00/02/11	1NFT	00/02/11	MG01	$$$	$$$	*BLKIMP*

4 Tests for OHFLTB with an MDL of 0.010 ug Validated By CMB Control Chart Updated N/A IO Requirements met N/A

00015

Zenon Number	Client	Client ID	Parameter	TS	Result	Dup.	Spike	% Rec.	Dup. Spk	% Rec.	Batch Date	Batch Code	Run Date	Run Code	Day Old	Day In	Analyst's Comments
002593	BESTENV	OH-Reagent Blank	Mercury -	PV	-0.010						00/02/11	2NPR	00/02/11	MG01	31.	23.	
002598	BESTENV	OH-Unit B Inlet-R1	Mercury -	PV	0.227						00/02/11	2NPR	00/02/11	MG01	31.	23.	
002599	BESTENV	OH-Unit B Inlet-R2	Mercury -	PV	0.332						00/02/11	2NPR	00/02/11	MG01	30.	23.	
002600	BESTENV	H-U	Mercury -	PV	0.358						00/02/11	2NPR	00/02/11	MG01	30.	23.	
BL0211	INTERNAL		Mercury -	PV	-0.010	-99999.0	0.100	100.	0.103	103.	00/02/11	2NPR	00/02/11	MG01	$$$	$$$	*BLKIMP*

5 Tests for OHPROBE with an MDL of 0.010 ug Validated By CMB Control Chart Updated N/A IO Requirements met N/A

LDC AUTOSAMPLER RUN LOG (MERCURY)

Date: 00.02.11 (W) Run Code: M601 Matrix: IMP

Analyst: MG Units: ~~ug/l~~ (see comments) MDL: 0.01

Cup	Dig. F.	Dil. F.	Zenon ID	Init. Conc.	F. Conc.	% R
1			Primer (ICV)			
2			Dummy (Blk)			
3			Std 1 (S1)	0.0		
4			Std 2 (S2)	0.6		
5			Std 3 (S3)	1.0		
6			Std 4 (S4)	1.6		
7			Std 5 (S5)	2.0		
8			Std 6 (S6)	2.6		
9			ICV			
10			B (Std 1)			
11			D4 (Std 4)			
12			BL0211	INFT.		
13			"			
14			BL0211 S			
15			"			
16			BL0211 DS			
17			"			
18			2595			
19			"			
20			2595 D			
21			"			
22			2595 S			
23			"			
24			2595 DS			
25			"			
26			2592			
27			"			
28			2594			
29			"			
30			2596			
31			"			
32			CCV			
33			B			
34			D4			
35			2597			
36			"			
37			2598			
38			"			
39			2599			
40			"			

Cup	Dig. F.	Dil. F.	Zenon ID	Init. Conc.	F. Conc.	% R
41			2600			
42			"			
43			BL0211	2NPR		
44			"			
45			BL0211 S			
46			"			
47			BL0211 DS			
48			"			
49			2592			
50			"			
51			2593			
52			"			
53			2598			
54			"			
55			CCV			
56			B			
57			D4			
58		½	2599			
59		↓	"			
60			2600			
61			"			
62			2622			
63			"			
64			2888			
65			"			
66			CCV			
67			B			
68			D4			
69						
70						
71						
72						
73						
74						
75						
76						
77						
78						
79						
80						

Comments: *** "HG-347" and "MISA12" units are expressed in mg/L not ug/L

ICV = 1.5 ug/L, CCV = 1.0 ug/L, Blank Spike = 1.0 ug/L for liquid samples.

Blank Spike = 1.0 mg/kg for solid samples.

EPA 7470 WATER PREPARATION LOG - MERCURY

000118

DG7470HG
DGHGLEACH, DG29HG***

Calibration Solutions:

#	I.D.	*Conc.	Spike	**Conc. Entered
1	Blank/Dummy	0 ppb	None	0.0
2	Standard 1	0 ppb	None	0.0
3	Standard 2	0.33	200 ul of 0.05 ppm IV working standard	0.5
4	Standard 3	0.67	400 ul of 0.05 ppm IV working standard	1.0
5	Standard 4	1.0	600 ul of 0.05 ppm IV working standard	1.5
6	Standard 4	1.0	600 ul of 0.05 ppm IV working standard	1.5
7	Standard 5	1.33	800 ul of 0.05 ppm IV working standard	2.0
7	Standard 6	1.67	1000 ul of 0.05 ppm IV working standard	2.5

Check List
- ✓ Digest Code/labels
- ✓ Samples poured out
- ✓ Acids added
- ✓ Reagents added
- ✓ Samples spiked
- ✓ Bath at 95 degrees C
- ✓ Samples digested
- ✓ Hydroxylamine HCl added
- ✓ Samples bulked and mixed
- ✓ Rack order checked

	#	Sample I.D.	B.Code	Init.Vol.	F. Vol.	Dil	Comment
	9	ICV (Init. Calib. Verif.)	INPT	20 ml	30 ml	1 X	1.5 ppb = 600 ul. of 0.05 ppm HP MESS-ZENO 30/QCA Std.
	10	BL 0211	"	"	"	"	(Processed Blank)
	11	BL 0211 S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	12	2595	"	"	"	"	FINALVOL 100 mls
1	13	2595 D	"	"	"	"	(Duplicate sample)
1	14	S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	15	DS	"	"	"	"	(Duplicate Spiked sample)
2	16	2592	"	"	"	"	
3	17	2594	"	"	"	"	
4	18	2596	"	"	"	"	
5	19	2597	"	"	"	"	
6	20	2598	"	"	"	"	0.500 g SUB-SAMPLE FOR DIGEST
7	21	2599	"	"	"	"	
8	22	2600	"	"	"	"	
9	23	2622	"	0.5009	100 ml	200X	
10	24	2888	"	0.5009	100 ml	200X	

	#						
	25	CCV (Cont. Calib. Verif.)	2NPR	20 ml	30 ml	1 X	1.0 ppb = 400 ul. of 0.05 ppm HP MESS-ZENO 30/QCA Std.
	26	BL 0211	"	"	"	"	(Processed Blank)
	27	BL 0211 S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	28		"	"	"	"	
1	29	D	"	"	"	"	(Duplicate sample)
1	30	S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	31	DS	"	"	"	"	(Duplicate Spiked sample)
2	32	2592	"	"	"	"	FINALVOL 100 mls
3	33	2593	"	"	"	"	
4	34	2598	"	"	"	"	
5	35	2599	"	"	"	"	
6	36	2600	"	"	"	"	
7	37		"	"	"	"	
8	38		"	"	"	"	
9	39		"	"	"	"	
10	40		"	"	"	"	

Notes: Other Applicable Test Codes: DG29HG-1B, DG29HG-2B, DG29HG-3A, DG29HG-3B, DG29HG-3C
DG29HGI, DG29HGF, DG101AA1, DG101AA2

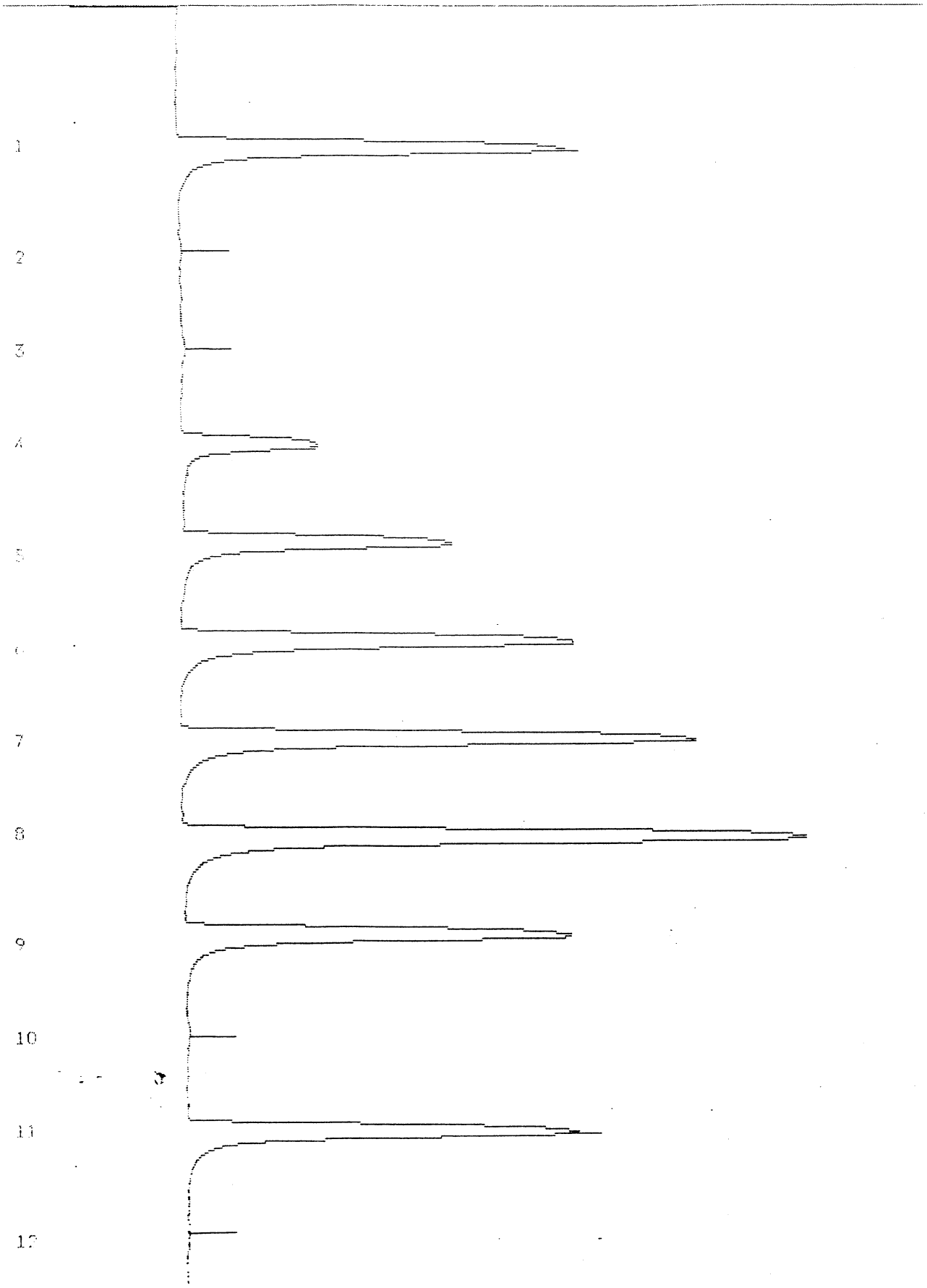
Include External Reference Material (EPA WS 378 or SPEX CertiPrep TM - WS) per run

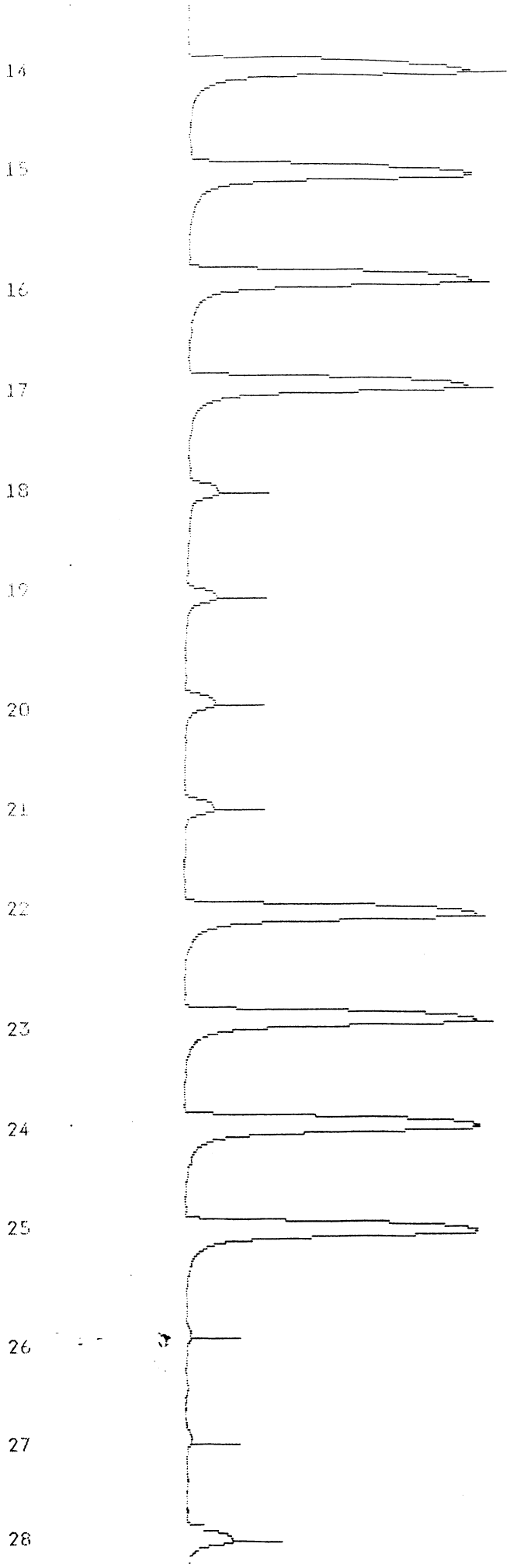
Prepare 0.05 ppm standards daily

HNO3 Lot. No. 119091	H2SO4 Lot. No. 319020	Bath Temps. 1 195°C

Prepared By: M Shipuro Date: 000211 Checked by: M Shipuro

RUN DATE: 02-11-2000 CHART DATE: 02-11-2000
CHART SPEED: 30
DATA FILE NAME: C:\DP4\DATA\0002LLW.DAT

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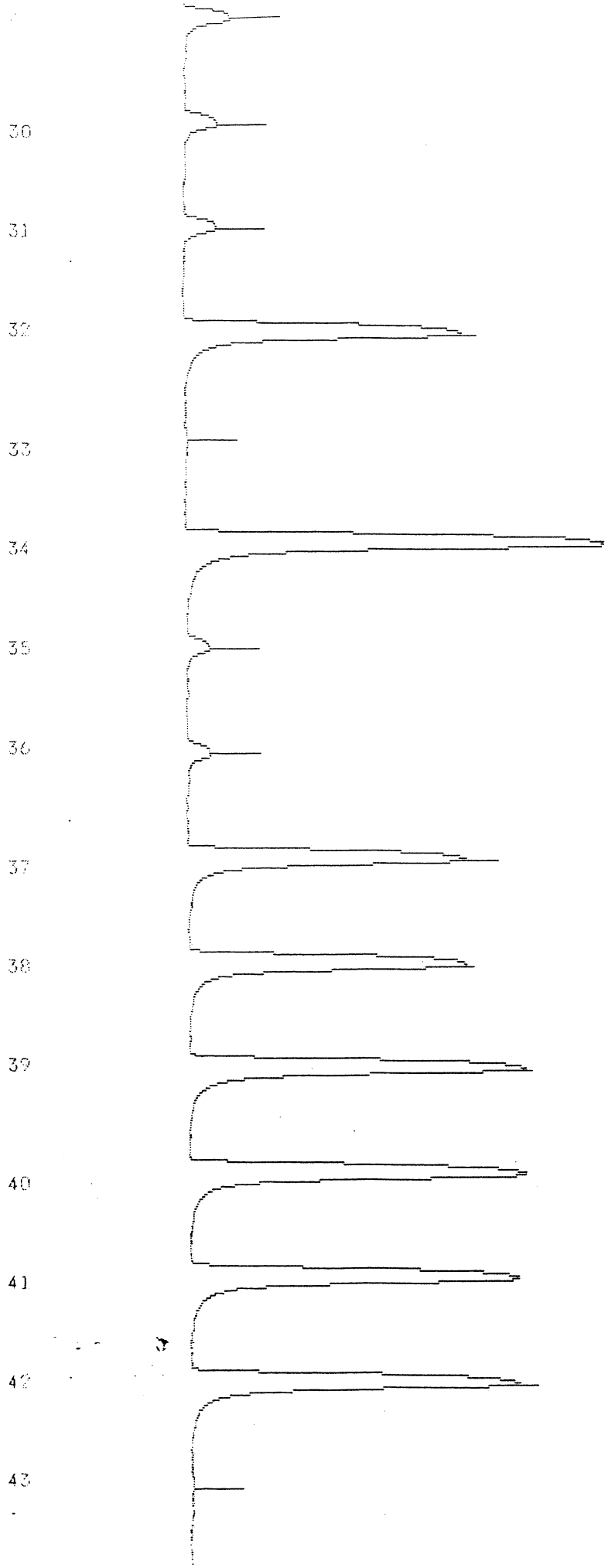
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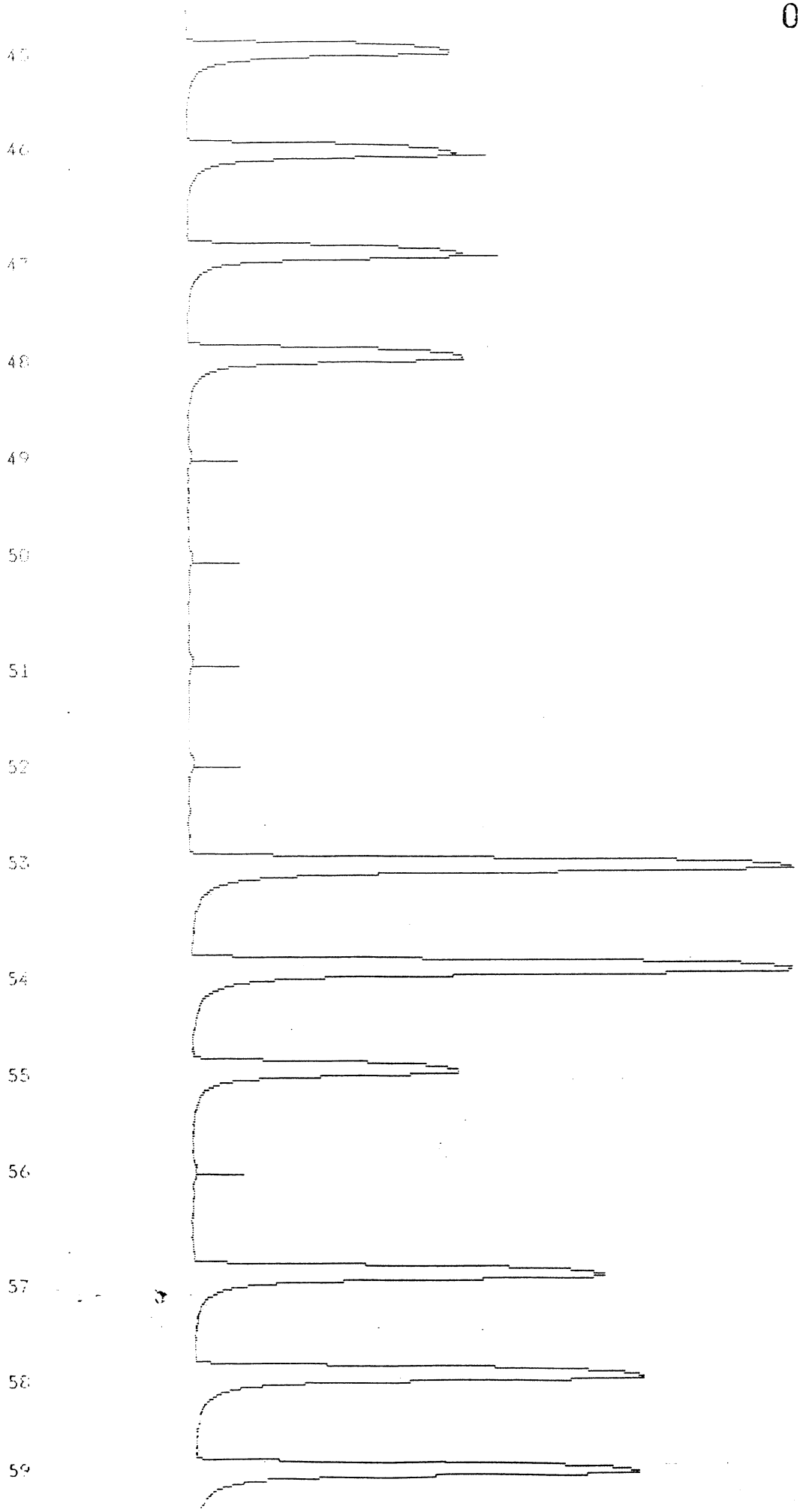
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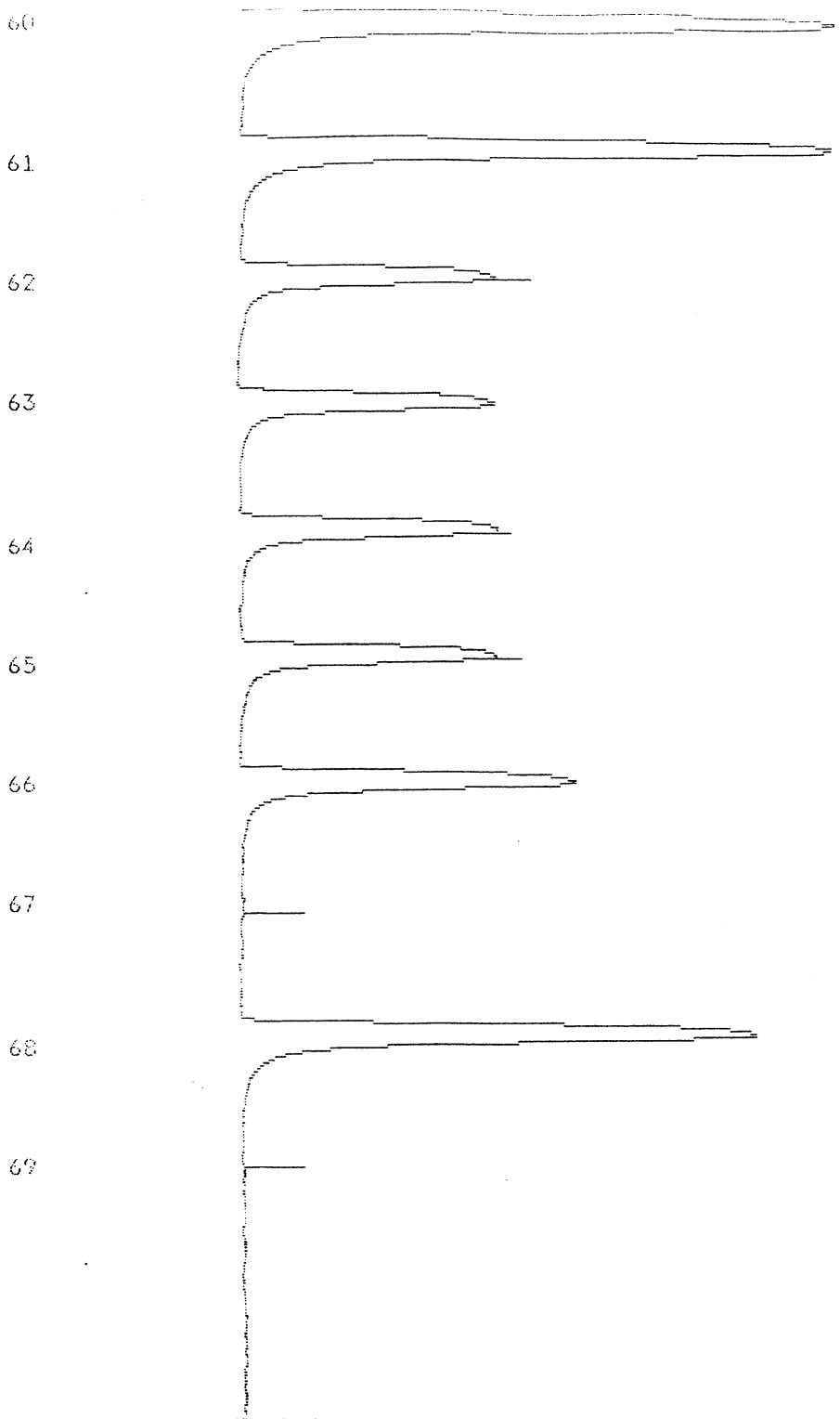
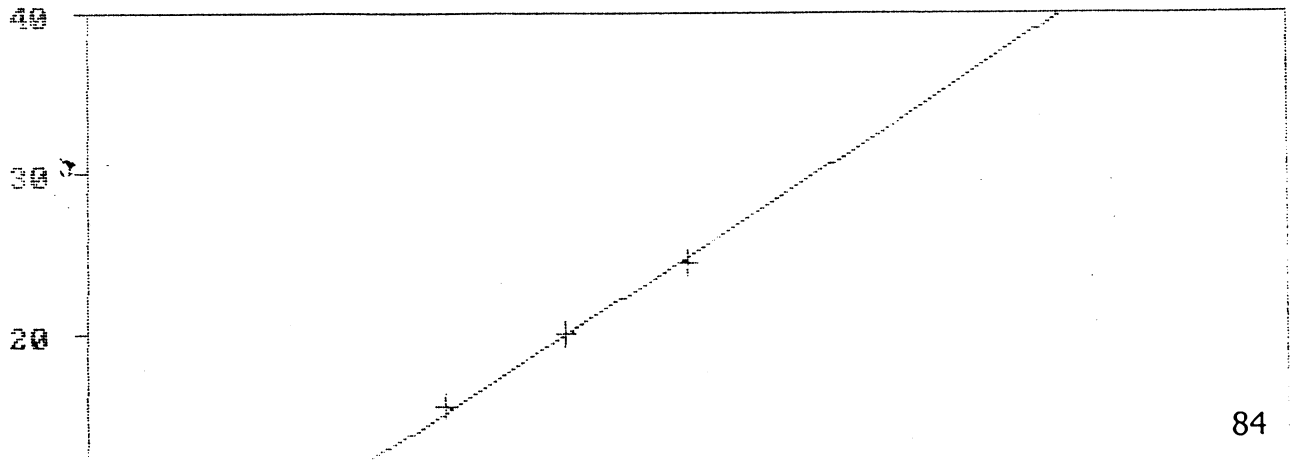
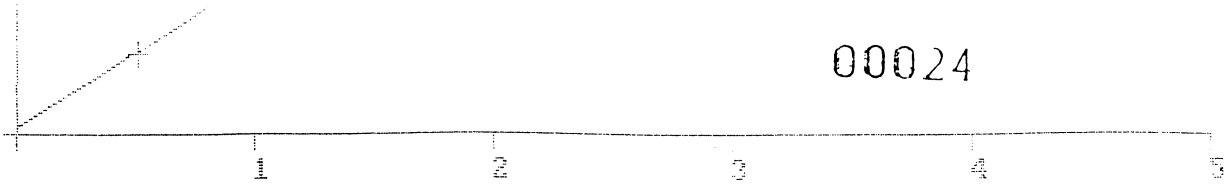


CHANNEL NAME: LDC
RUN NAME: 000211W





DATA TYPE: FIA CALIBRATION ORDER: 1
INTERCEPT = 0.38 SLOPE = 0.756845

CORRELATION: .999377

CHANNEL NAME: LDC
RUN DATE: 02-11-2000
SAMPLE TABLE NAME: 000211W
METHOD NAME: HG-W-20

CUP#	SAMPLE ID	DIL	WGT	HEIGHT/AREA	TUG	CONCENTRATION (PPB)	EF
1	PRIMER	1	1	15.2		1.515	s
2	DUMMY	1	1	0.0		-0.039	I
3	S1: 0	1	1	0.1		-0.031	I
4	S2: .5	1	1	5.2		0.492	
5	S3: 1	1	1	10.5		1.037	
6	S4: 1.5	1	1	15.4		1.535	
7	S5: 2	1	1	20.0		2.008	
8	S6: 2.5	1	1	24.4		2.459	
9	ICV	1	1	15.1		1.510	101%
10	B	1	1	0.0		-0.039	b
11	D4	1	1	15.4		1.535	d
12	BL0211-1NFT 2592, 2887	1	1	0.0	<0.01	-0.039	I
13	BL0211-1NFT	1	1	0.0		-0.039	I
14	BL0211S	1	1	10.4	0.103	1.030	103%
15	BL0211S	1	1	10.4		1.025	
16	BL0211DS	1	1	10.4	0.102	1.027	102%
17	BL0211DS	1	1	10.3		1.015	
18	2595	1	1	0.9	<0.01	0.054	
19	2595	1	1	0.9		0.049	
20	2595D	1	1	0.9	<0.01	0.051	
21	2595D	1	1	0.9		0.054	
22	2595S	1	1	10.7	0.106	1.062	101%
23	2595S	1	1	10.7		1.060	
24	2595DS	1	1	10.8	0.107	1.067	101%
25	2595DS	1	1	10.7		1.062	
26	2592	1	1	0.0	<0.100	-0.036	I
27	2592	1	1	0.1		-0.031	I
28	2594	1	1	1.5	0.012	0.116	
29	2594	1	1	1.5		0.114	
30	2596	1	1	1.1	<0.01	0.069	
31	2596	1	1	1.1		0.071	s
32	CCV	1	1	10.1		1.000	100%
33	B	1	1	0.0		-0.039	b
34	D4	1	1	15.4		1.535	d
35	2597	1	1	0.7	<0.01	0.029	I
36	2597	1	1	0.7		0.031	
37	2598	1	1	10.1	0.0999	1.000	~~100%~~ MD
38	2598	1	1	10.1		0.997	
39	2599	1	1	12.2	0.121	1.212	
40	2599	1	1	12.2		1.207	
41	2600	1	1	11.9	0.118	1.182	
42	2600	1	1	11.9		1.185	
43	BL0211-2NPR	1	1	0.0	<0.01	-0.039	I
44	BL0211-2NPR	1	1	0.0		-0.039	I

[illegible]	[illegible]	1	1	10.4	0.103	0.023	103%	
[illegible]	[illegible]	1	1	10.4		1.024		
49	2592	1	1	0.0	<0.01	-0.039		I
50	2592	1	1	0.0		-0.034		I
51	2593	1	1	0.0	<0.01	-0.034		I
52	2593	1	1	0.0		-0.034		I
53	2598	1	1	22.4	0.227	2.261		
54	2598	1	1	22.6		2.279		
55	CCV	1	1	10.0		0.990	99%	
56	B	1	1	0.0		-0.039		b
57	D4	1	1	15.4		1.535		d
58	2599	2	1	16.7	0.332	3.351		
59	2599	2	1	16.5		3.296		
60	2600	2	1	17.9	0.358	3.591		
61	2600	2	1	17.8		3.566		s
62	* 2622	1	1	7.7	0.150	0.747		
63	2622	1	1	7.7		0.749		
64	* 2888	1	1	7.8	0.150	0.759		
65	2888	1	1	7.6		0.744		
66	CCV	1	1	10.1		0.995	100%	
67	B	1	1	0.0		-0.039		b
68	D4	1	1	15.4		1.535		d

INTERCEPT: 0.38 LINEAR COEF: 9.756845
CORRELATION COEF: .999377

*① $0.748 \frac{\mu g}{L} \times \frac{0.1 L}{0.5 g} = 0.1496 \frac{\mu g}{g}$

*② $0.752 \frac{\mu g}{L} \times \frac{0.1 L}{0.5 g} = 0.1503 \frac{\mu g}{g}$

Zenon Number	Client	Client ID	Parameter	TS	Result	Dup.	Spike	% Rec.	Dup. Spk	% Rec.	Batch Date	Batch Code	Run Date	Run Code	Day Old	Day In	Analyst's Comments
002592	BESTENV	MB R456	Mercury -	PV	-0.030	-99999.0	0.299	100.	0.299	100.	00/02/08	1NKC	00/02/08	MG01	28.	20.	
002593	BESTENV	OH-Reagent Blank	Mercury -	PV	-0.100						00/02/08	1NKC	00/02/08	MG01	28.	20.	
002594	BESTENV	OH-Train Blank	Mercury -	PV	-0.100						00/02/08	1NKC	00/02/08	MG01	28.	20.	
002595	BESTENV	OH-Unit B Outlet-R1	Mercury -	PV	-0.100	-0.100	0.994	99.	0.997	100.	00/02/08	1NKC	00/02/08	MG01	28.	20.	
002596	BESTENV	OH-Unit B Outlet-R2	Mercury -	PV	-0.100						00/02/08	1NKC	00/02/08	MG01	27.	20.	
002597	BESTENV	OH-Unit B Outlet-R3	Mercury -	PV	-0.100						00/02/08	1NKC	00/02/08	MG01	27.	20.	
002598	BESTENV	OH-Unit B Inlet-R1	Mercury -	PV	-0.100						00/02/08	1NKC	00/02/08	MG01	28.	20.	
002599	BESTENV	OH-Unit B Inlet-R2	Mercury -	PV	0.206						00/02/08	1NKC	00/02/08	MG01	27.	20.	
002600	BESTENV	OH-Unit B Inlet-R3	Mercury -	PV	0.136						00/02/08	1NKC	00/02/08	MG01	27.	20.	
BL0208	INTERNAL		Mercury -	PV	-0.030	-99999.0	0.299	100.	0.299	100.	00/02/08	1NKC	00/02/08	MG01	$$$	$$$	

10 Tests for OHKCL with an MDL of 0.030 ug Validated By CMB Control Chart Updated N/A IO Requirements met N/A

LDC AUTOSAMPLER RUN LOG (MERCURY)

Date: 00-02-08 Run Code: MG01 Matrix: _____

Analyst: MG Units: _____ (see comments) MDL: _____

Cup	Dig. F.	Dil. F.	Zenon ID	Init. Conc.	F. Conc.	% R
1			Primer (ICV)			
2			Dummy (Blk)			
3			Std 1 (S1)	0.0		
4			Std 2 (S2)	0.6		
5			Std 3 (S3)	1.0		
6			Std 4 (S4)	1.6		
7			Std 5 (S5)	2.0		
8			Std 6 (S6)	2.6		
9			ICV			
10			B (Std 1)			
11			D4 (Std 4)			
12			WS 378			
13			ORG. REF			
14			BL0208	INKC		
15			"			
16			BL0208S			
17			"			
18			BL0208 DS			
19			"			
20			2595			
21			"			
22			2595 D			
23			"			
24			2595 S			
25			"			
26			2595 DS			
27			"			
28			2593			
29			"			
30			2594			
31			"			
32			2596			
33			"			
34			CCV			
35			B			
36			D4			
37			2597			
38			"			
39			2598			
40			"			

Cup	Dig. F.	Dil. F.	Zenon ID	Init. Conc.	F. Conc.	% R
41			2599			
42			"			
43			2600			
44			"			
45			BL0208	1B2.B		
46			"			
47			BL0208S			
48			"			
49			BL0208DS			
50			"			
51	10		4446			
52			"			
53			4446 D			
54			"			
55			4446 S			
56			"			
57			CCV			
58			B			
59			D4 - 4446 DS			
60	10		4447			
61			"			
62			4448			
63			"			
64		1/4	4449			
65			"			
66			4450			
67			"			
68			4451			
69			"			
70		1/40	3824			
71			"			
72		1/5	3437			
73			"			
74			CCV			
75			B			
76			D4			
77			BL0208			
78			BL0208S			
79		1/10	5054			
80			54D			

Comments: *** "HG-347" and "MISA12" units are expressed in mg/L not ug/L

ICV = 1.5 ug/L, CCV = 1.0 ug/L, Blank Spike = 1.0 ug/L for liquid samples.

[illegible] ug/kg for solid samples.

00028

EPA 7470 WATER PREPARATION LOG - MERCURY

DG7470HG
DGHGLEACH, DG29HG***

Calibration Solutions:

#	I.D.	*Conc.	Spike	**Conc. Entered
1	Blank/Dummy	0 ppb	None	0.0
2	Standard 1	0 ppb	None	0.0
3	Standard 2	0.33	200 ul of 0.05 ppm IV working standard	0.5
4	Standard 3	0.67	400 ul of 0.05 ppm IV working standard	1.0
5	Standard 4	1.0	600 ul of 0.05 ppm IV working standard	1.5
6	Standard 4	1.0	600 ul of 0.05 ppm IV working standard	1.5
7	Standard 5	1.33	800 ul of 0.05 ppm IV working standard	2.0
7	Standard 6	1.67	1000 ul of 0.05 ppm IV working standard	2.5

Check List

- ✓ Digest Code/labels
- ✓ Samples poured out
- ✓ Acids added
- ✓ Reagents added
- ✓ Samples spiked
- ✓ Bath at 95 degrees C
- ✓ Samples digested
- ✓ Hydroxylamine HCl added
- ✓ Samples bulked and mixed
- ✓ Rack order checked

	#	Sample I.D.	B.Code	Init.Vol.	F. Vol.	Dil	Comment
	9	ICV (Init. Calib. Verif.)	INKC	20 ml	30 ml	1 X	1.5 ppb = 600 ul. of 0.05 ppm HP MESS-ZENO 30/QCA Std.
	10	BL 0208	"	"	"	"	(Processed Blank)
	11	BL 0208 S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	12	2595	"	"	"	"	IMPKCL 1000mls
1	13	D	"	"	"	"	(Duplicate sample)
1	14	S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	15	DS	"	"	"	"	(Duplicate Spiked sample)
2	16	2593	"	"	"	"	1000mL
3	17	2594	"	"	"	"	1000 mls
4	18	2596	"	"	"	"	
5	19	2597	"	"	"	"	
6	20	2598	"	"	"	"	
7	21	2599	"	"	"	"	
8	22	2600	"	"	"	"	
9	23		"	"	"	"	
10	24		"	"	"	"	
	25	CCV (Cont. Calib. Verif.)		20 ml	30 ml	1 X	1.0 ppb = 400 ul. of 0.05 ppm HP MESS-ZENO 30/QCA Std.
	26	BL	"	"	"	"	(Processed Blank)
	27	BL S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	28		"	"	"	"	
1	29	D	"	"	"	"	(Duplicate sample)
1	30	S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	31	DS	"	"	"	"	(Duplicate Spiked sample)
2	32		"	"	"	"	
3	33		"	"	"	"	
4	34		"	"	"	"	
5	35		"	"	"	"	
6	36		"	"	"	"	
7	37		"	"	"	"	
8	38		"	"	"	"	
9	39		"	"	"	"	
10	40		"	"	"	"	

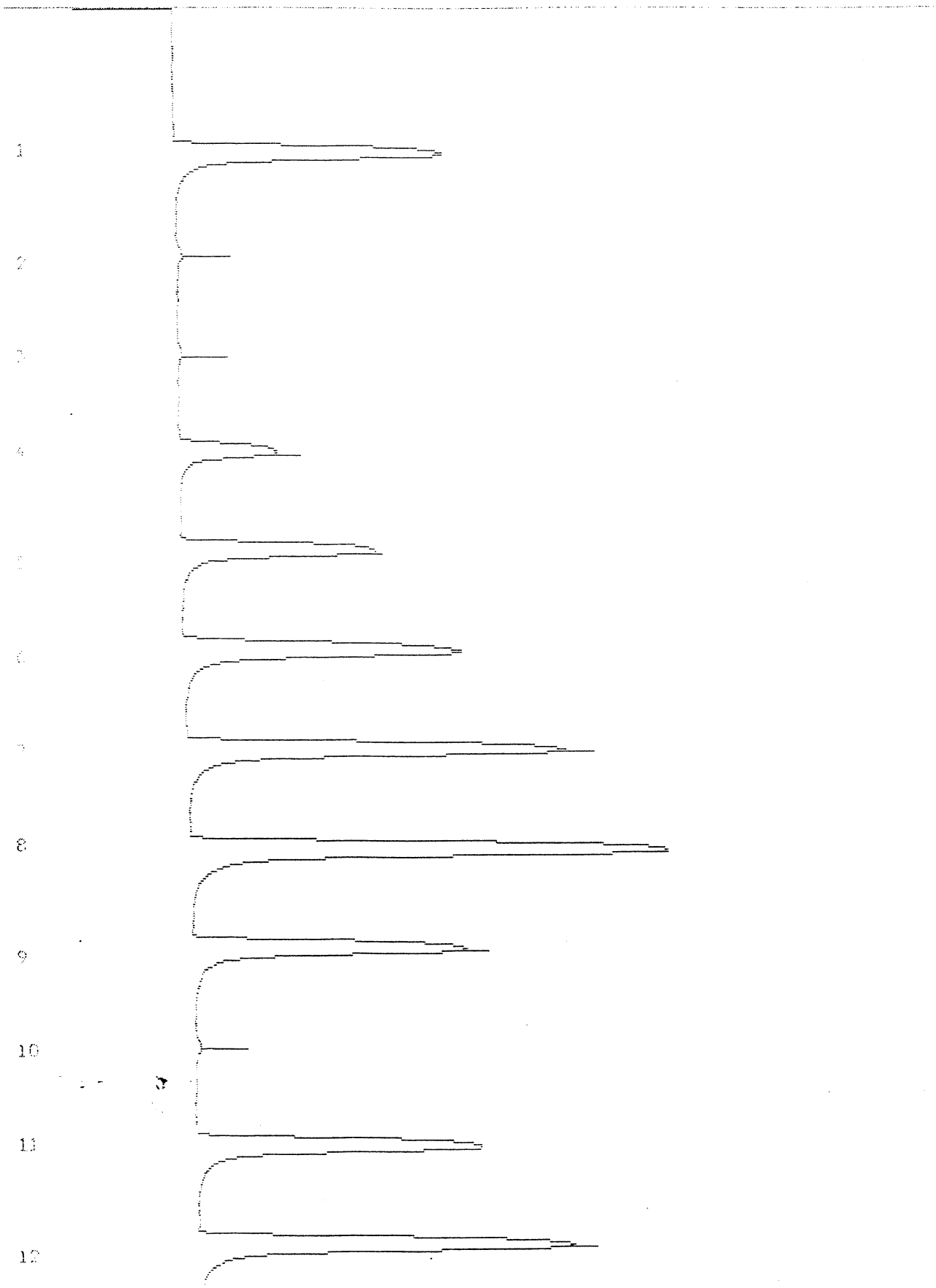
Notes: Other Applicable Test Codes: DG29HG-1B, DG29HG-2B, DG29HG-3A, DG29HG-3B, DG29HG-3C
DG29HGI, DG29HGF, DG101AA1, DG101AA2

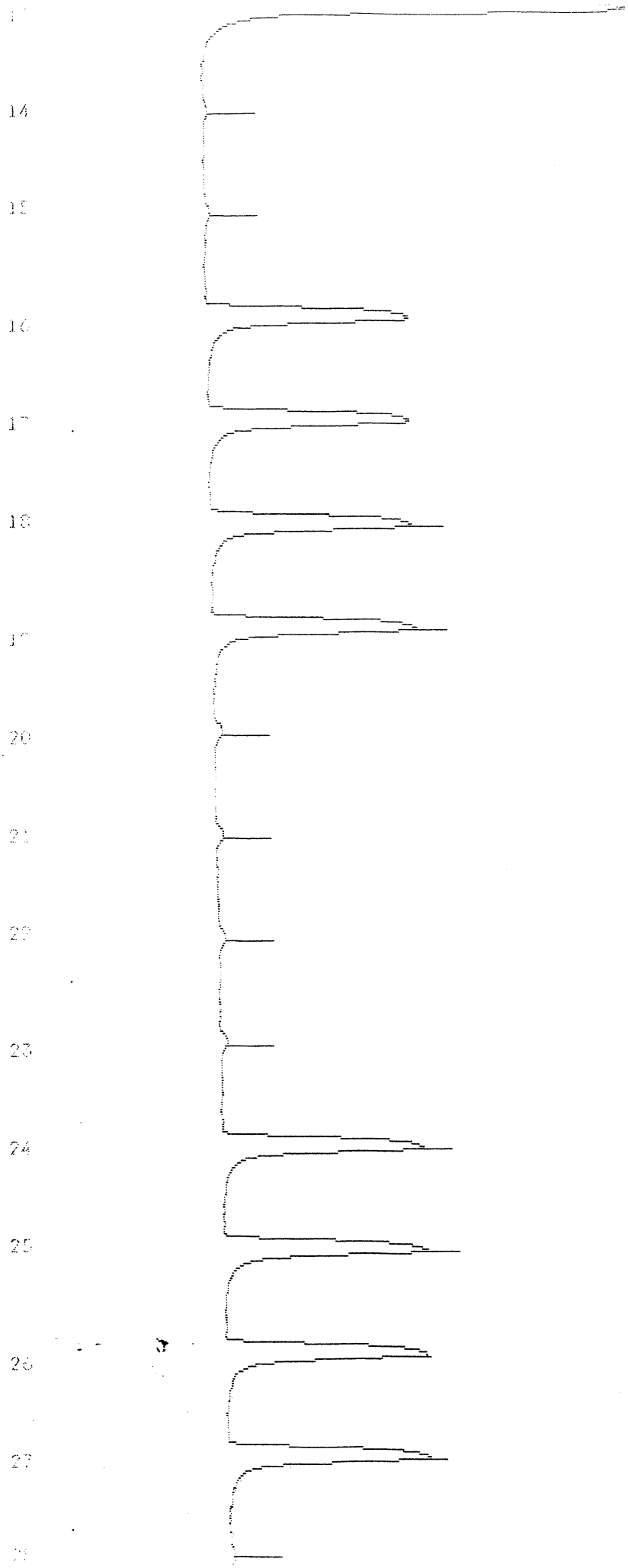
Include External Reference Material (EPA WS 378 or SPEX CertiPrep TM - WS) per run — Prepare 0.05 ppm standards daily

HNO3 Lot. No. 119091 | H2SO4 Lot. No. 317020 | Bath Temps 1 195 °C

Prepared By: M Alsperos Date: 000208 Checked by: M Alsperos

RUN DATE: 02-08-2000 CHART DATE: 02-09-2000
CHART SPEED: 30
DATA FILE NAME: C:\DP4\DATA\000208W.DAT

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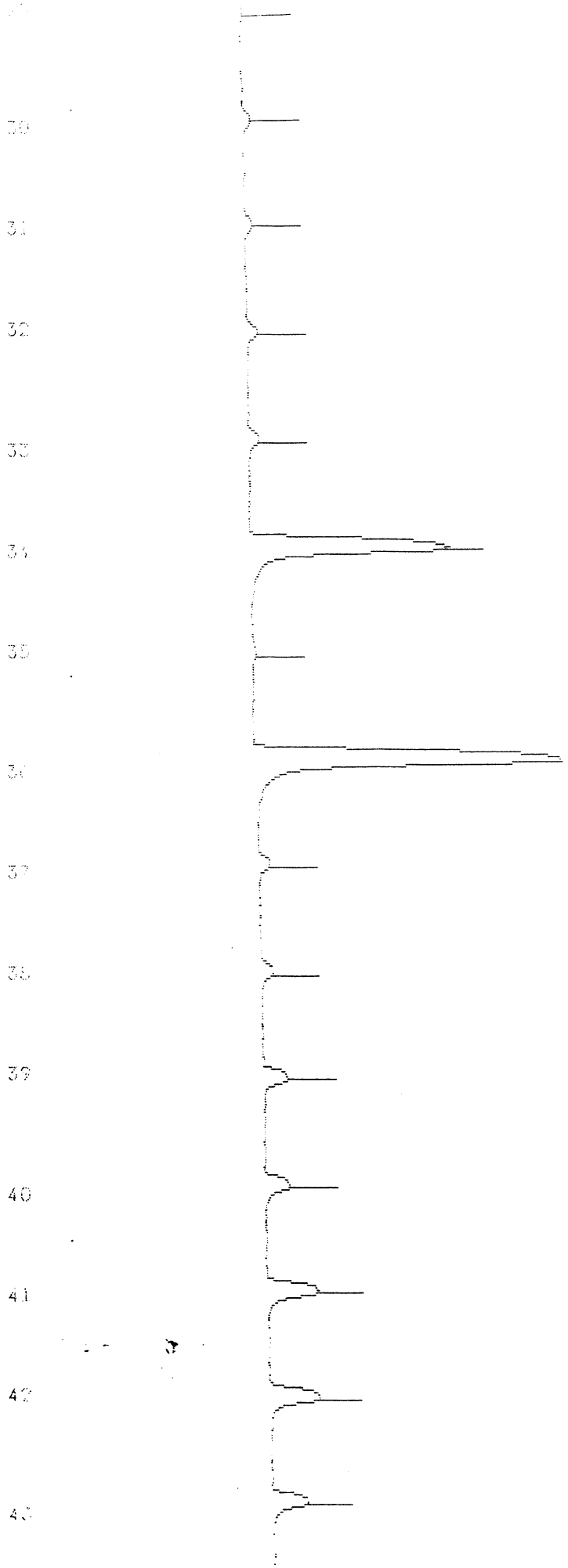
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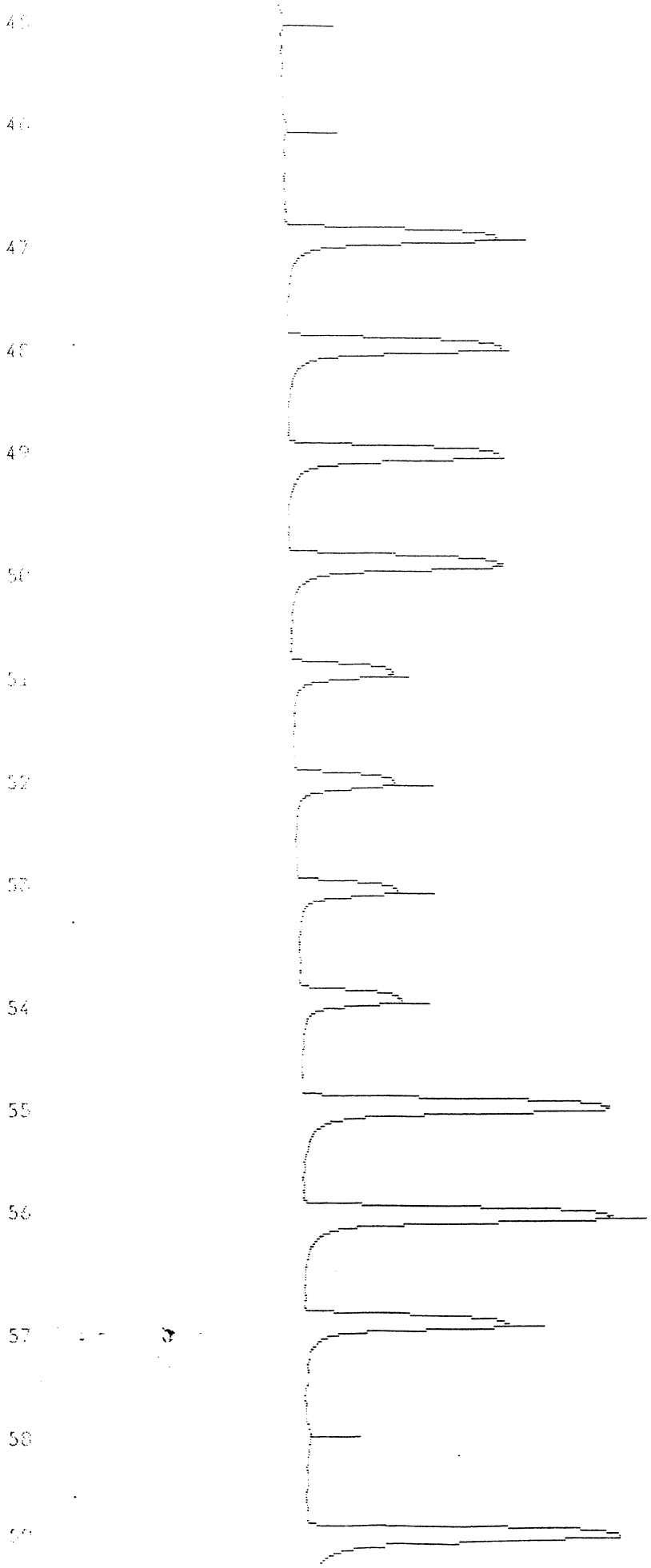
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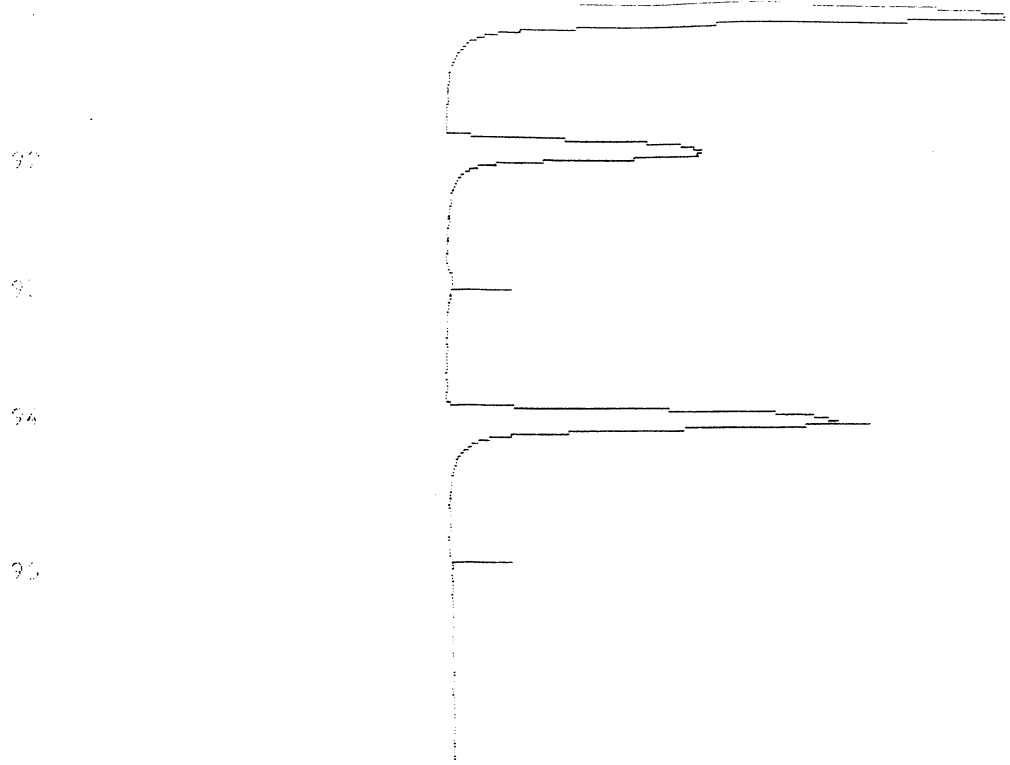
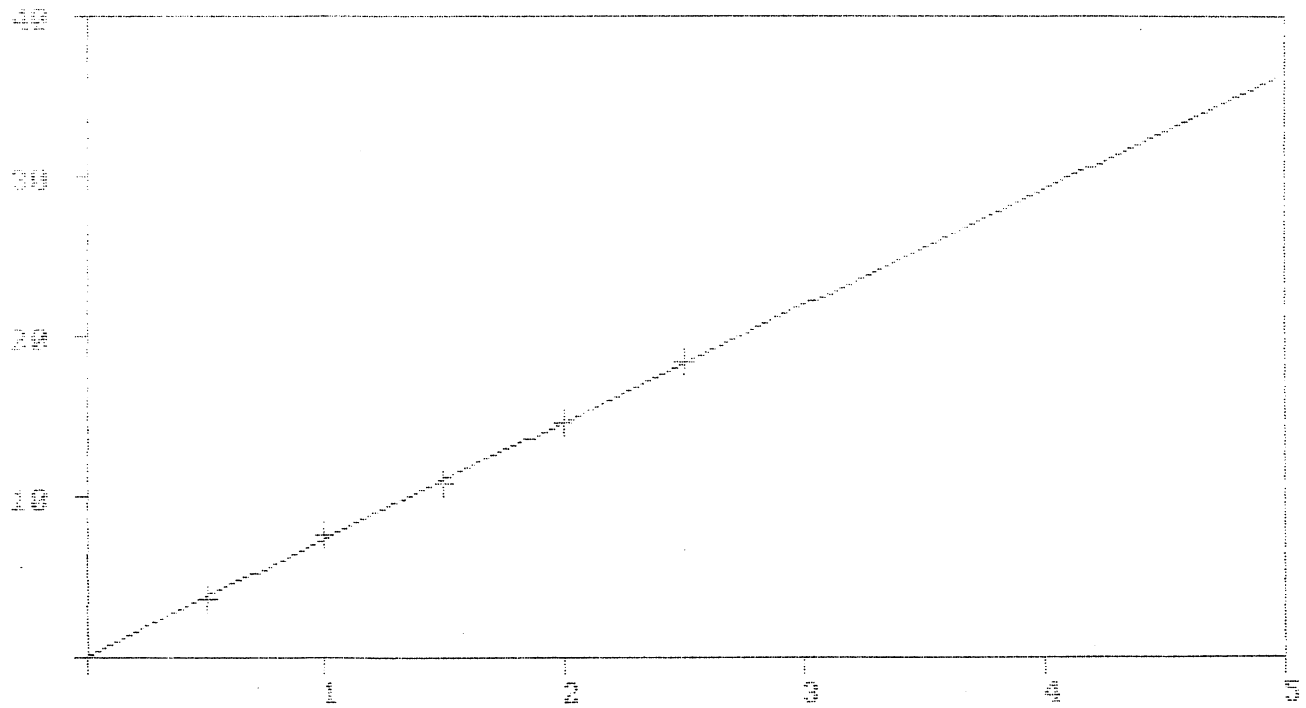


CHANNEL NAME: LDC
RUN NAME: 000208W



DATA TYPE: FIA CALIBRATION ORDER: 1
INTERCEPT = -7.21 SLOPE = 7.256236

CORRELATION: .9997831

CHANNEL NAME: LDC
RUN DATE: 02-08-2001
SAMPLE TABLE NAME: 000208W
METHOD NAME: HGWATER

ppb

[illegible]	SAMPLE ID	SIG	WGT	HEIGHT/AREA	CONCENTRATION	CF
[illegible]	[illegible]	1	1	10.4	1.423	8

00034

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	7.5		[illegible]	[illegible]	
6	S4: 1.5	1	1	10.3		[illegible]	[illegible]	
7	S5: 2	1	1	14.5		1.992		
8	S6: 2.5	1	1	18.3		2.513		
9	ICV	1	1	10.3		1.413	94%	
10	B	1	1	0.0		-0.011	b	
11	D4	1	1	10.8		1.473	d	
12	WS 578	1	1	14.2	TLG	1.941	97%	
13	ORG REF	1	1	15.5		2.129	107%	
14	BL0208-1BBC 2592	1	1	0.0	<0.03	0.011	I	
15	BL0208-1NKC	1	1	0.0		-0.011	I	
16	BL0208S	1	1	7.3	0.299	0.999	100%	
17	BL0208S	1	1	7.3		0.992		
18	BL0208SD	1	1	7.3	0.299	0.989	100%	
19	BL0208DC	1	1	7.4		1.005		
20	2595	1	1	0.1	<0.100	0.003	I	
21	2595	1	1	0.0		-0.004	I	
22	25950	1	1	0.1	<0.100	0.003	I	
23	25950	1	1	0.0		-0.004	I	
24	25950	1	1	7.3	0.994	0.989	99%	
25	25950	1	1	7.3		0.999		
26	25950D	1	1	7.3	0.997	0.995	100%	
27	25950D	1	1	7.3		0.999		
28	2596	1	1	0.0	<0.100	-0.011	I	
29	2596	1	1	0.0		-0.011	I	
30	2596	1	1	0.1	<0.100	0.001	I	
31	2596	1	1	0.1		-0.001	I	
32	2596	1	1	0.2	<0.100	0.019	I	
33	2596	1	1	0.2		0.013	I	
34	CCV	1	1	7.1		[illegible]	97%	
35	B	1	1	0.0		-0.011	b	
36	D4	1	1	10.8		1.473	d	
37	2597	1	1	0.2	<0.100	0.019	I	
38	2597	1	1	0.2		0.013	I	
39	2598	1	1	0.7	<0.100	0.004	I	
40	2598	1	1	0.6		0.003	I	
41	2599	1	1	[illegible]	0.206	[illegible]		
42	2599	1	1	[illegible]		[illegible]		
43	2600	1	1	[illegible]	0.136	[illegible]		
44	2600	1	1	[illegible]		[illegible]		
45	BL0208-1B2C	1	1	0.0	<0.01	[illegible]		
46	BL0208-1B2B	1	1	0.0		-0.011	I	
47	BL0208S	1	1	7.3	0.099	0.989	99%	
48	BL0208S	1	1	7.2		0.999		
49	BL0208SD	1	1	7.3	0.100	0.995	100%	
50	BL0208SD	1	1	7.3		0.999		
51	4446	10	1	5.4	2.376	[illegible]		
52	4446	10	1	[illegible]		[illegible]		
53	4446D	10	1	[illegible]	2.359	[illegible]		
54	4446D	10	1	[illegible]		[illegible]		
55	4446S	10	1	[illegible]	7.573	[illegible]	100%	
56	4446S	10	1	[illegible]		[illegible]		
57	CCV		1	[illegible]		[illegible]		
58	B		[illegible]			-0.011	b	
59	D4		[illegible]			1.473	d	
60	4446DS		[illegible]		7.562	[illegible]	100%	
61	4446DS	1	[illegible]			[illegible]		
62	4447	[illegible]	[illegible]		3.440	[illegible]		
63	4447	[illegible]	[illegible]			[illegible]		
64	4447	[illegible]	[illegible]		4.426	[illegible]		
[illegible]	[illegible]					[illegible]		
[illegible]	[illegible]				24.045	[illegible]		

Zenon Number	Client	Client ID	Parameter	TS	Result	Dup.	Spike	% Rec.	Dup. Spk	% Rec.	Batch Date	Batch Code	Run Date	Run Code	Day Old	Day In	Analyst's Comments
002592	BESTENV	MB R456	Mercury -	PV	-0.030	-99999.0	0.296	99.	0.292	97.	00/02/03	1NM4	00/02/03	MG01	23.	15.	
002593	BESTENV	OH-Reagent Blank	Mercury -	PV	0.196						00/02/03	1NM4	00/02/03	MG01	23.	15.	
002594	BESTENV	OH-Train Blank	Mercury -	PV	0.783						00/02/03	1NM4	00/02/03	MG01	23.	15.	
002595	BESTENV	OH-Unit B Outlet-R1	Mercury -	PV	1.618	1.589	3.488	94.	3.488	94.	00/02/03	1NM4	00/02/03	MG01	23.	15.	*POST SPIKE*
002596	BESTENV	OH-Unit B Outlet-R2	Mercury -	PV	2.217						00/02/03	1NM4	00/02/03	MG01	22.	15.	
002597	BESTENV	OH-Unit B Outlet-R3	Mercury -	PV	1.304						00/02/03	1NM4	00/02/03	MG01	22.	15.	
002598	BESTENV	OH-Unit B Inlet-R1	Mercury -	PV	1.618						00/02/03	1NM4	00/02/03	MG01	23.	15.	
002599	BESTENV	OH-Unit B Inlet-R2	Mercury -	PV	1.931						00/02/03	1NM4	00/02/03	MG01	22.	15.	
002600	BESTENV	OH-Unit B Inlet-R3	Mercury -	PV	1.544						00/02/03	1NM4	00/02/03	MG01	22.	15.	
BL0203	INTERNAL		Mercury -	PV	-0.030	-99999.0	0.296	94.	0.292	97.	00/02/03	1NM4	00/02/03	MG01	$$$	$$$	

10 Tests for OHMN4 with an MDL of 0.030 ug Validated By CMB Control Chart Updated N/A IO Requirements met NA

00035

LDC AUTOSAMPLER RUN LOG (MERCURY)

Date: 00.02-03 (W) Run Code: MG01 Matrix: IMP

Analyst: MG Units: µg (see comments) MDL: 0.03

Cup	Dig. F.	Dil. F.	Zenon ID	Init. Conc.	F. Conc.	% R
1			Primer (ICV)			
2			Dummy (Blk)			
3			Std 1 (S1)	0.0		
4			Std 2 (S2)	0.5		
5			Std 3 (S3)	1.0		
6			Std 4 (S4)	1.5		
7			Std 5 (S5)	2.0		
8			Std 6 (S6)	2.5		
9			ICV			
10			B (Std 1)			
11			D4 (Std 4)			
12			BL0203	INM4.		
13			"			
14			BL0203 S			
15			"			
16			BL0203 DS			
17			"			
18		1/4	2595			
19			"			
20			2595 D			
21			"			
22			2595 S			
23			"			
24			2595 DS			
25			"			
26			2593			
27			"			
28			2594			
29			"			
30		1/4	2596			
31			"			
32			CCV			
33			B			
34			D4			
35		1/2	2597			
36			"			
37			2598			
38			"			
39			2599			
40			"			

Cup	Dig. F.	Dil. F.	Zenon ID	Init. Conc.	F. Conc.	% R
41		1/2	2600			
42			"			
43			CCV			
44			B			
45			D4			
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Comments: *** "HG-347" and "MISA12" units are expressed in mg/L not ug/L

ICV = 1.5 ug/L, CCV = 1.0 ug/L, Blank Spike = 1.0 ug/L for liquid samples.

[illegible] Spike = 1.0 mg/kg for solid samples.

00037

EPA 7470 WATER PREPARATION LOG - MERCURY

DG7470HG
DGHGLEACH, DG29HG***

Calibration Solutions:

#	I.D.	*Conc.	Spike	**Conc. Entered
1	Blank/Dummy	0 ppb	None	0.0
2	Standard 1	0 ppb	None	0.0
3	Standard 2	0.33	200 ul of 0.05 ppm IV working standard	0.5
4	Standard 3	0.67	400 ul of 0.05 ppm IV working standard	1.0
5	Standard 4	1.0	600 ul of 0.05 ppm IV working standard	1.5
6	Standard 4	1.0	600 ul of 0.05 ppm IV working standard	1.5
7	Standard 5	1.33	800 ul of 0.05 ppm IV working standard	2.0
7	Standard 6	1.67	1000 ul of 0.05 ppm IV working standard	2.5

Check List
- ✓ Digest Code/labels
- ✓ Samples poured out
- ~~Acids added~~
- ~~Reagents added~~
- ~~Samples spiked~~
- ~~Bath at 95 degrees C~~
- ~~Samples digested~~
- ~~Hydroxylamine HCl added~~
- ~~Samples bulked and mixed~~
- ✓ Rack order checked

	#	Sample I.D.	B.Code	Init.Vol.	F. Vol.	Dil	Comment
	9	ICV (Init. Calib. Verif.)	#JM4	20 ml	30 ml	1 X	1.5 ppb = 600 ul. of 0.05 ppm HP MESS-ZENO 30/QCA Std.
	10	BL 0203	"	"	"	"	(Processed Blank)
	11	BL 0203 S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	12	2596	"	"	"	"	500 mLs
1	13	D	"	"	"	"	(Duplicate sample)
1	14	S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	15	DS	"	"	"	"	(Duplicate Spiked sample)
2	16	2573	"	"	"	"	500mls
3	17	94	"	"	"	"	500 mls
4	18	95	"	"	"	"	
5	19	97	"	"	"	"	
6	20	98	"	"	"	"	
7	21	99	"	"	"	"	
8	22	2600	"	"	"	"	
9	23		"	"	"	"	
10	24		"	"	"	"	
	25	CCV (Cont. Calib. Verif.)		20 ml	30 ml	1 X	1.0 ppb = 400 ul. of 0.05 ppm HP MESS-ZENO 30/QCA Std.
	26	BL	"	"	"	"	(Processed Blank)
	27	BL S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	28		"	"	"	"	
1	29	D	"	"	"	"	(Duplicate sample)
1	30	S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	31	DS	"	"	"	"	(Duplicate Spiked sample)
2	32		"	"	"	"	
3	33		"	"	"	"	
4	34		"	"	"	"	
5	35		"	"	"	"	
6	36		"	"	"	"	
7	37		"	"	"	"	
8	38		"	"	"	"	
9	39		"	"	"	"	
10	40		"	"	"	"	

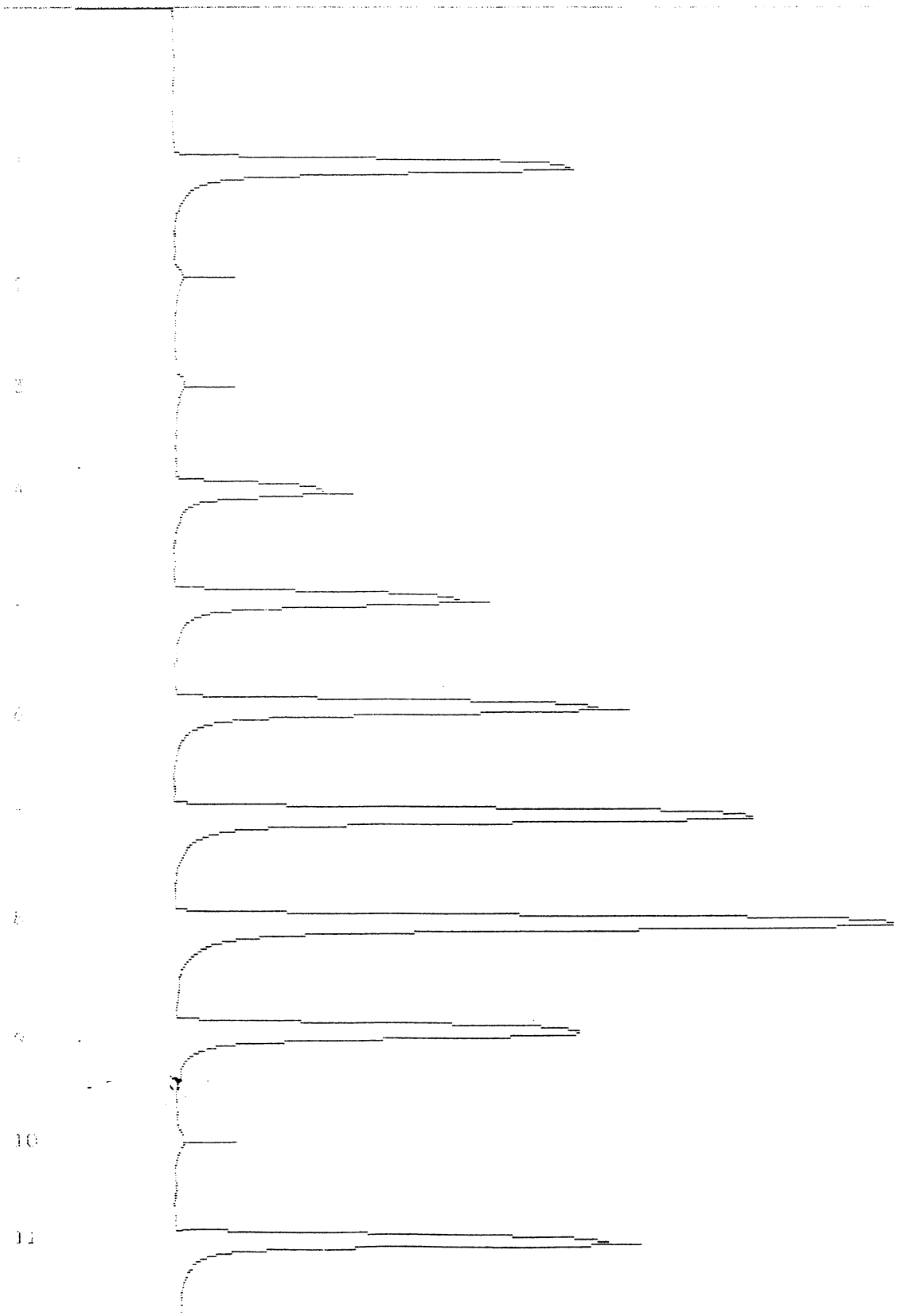
Notes: Other Applicable Test Codes: DG29HG-1B, DG29HG-2B, DG29HG-3A, DG29HG-3B, DG29HG-3C
DG29HGI, DG29HGF, DG101AA1, DG101AA2

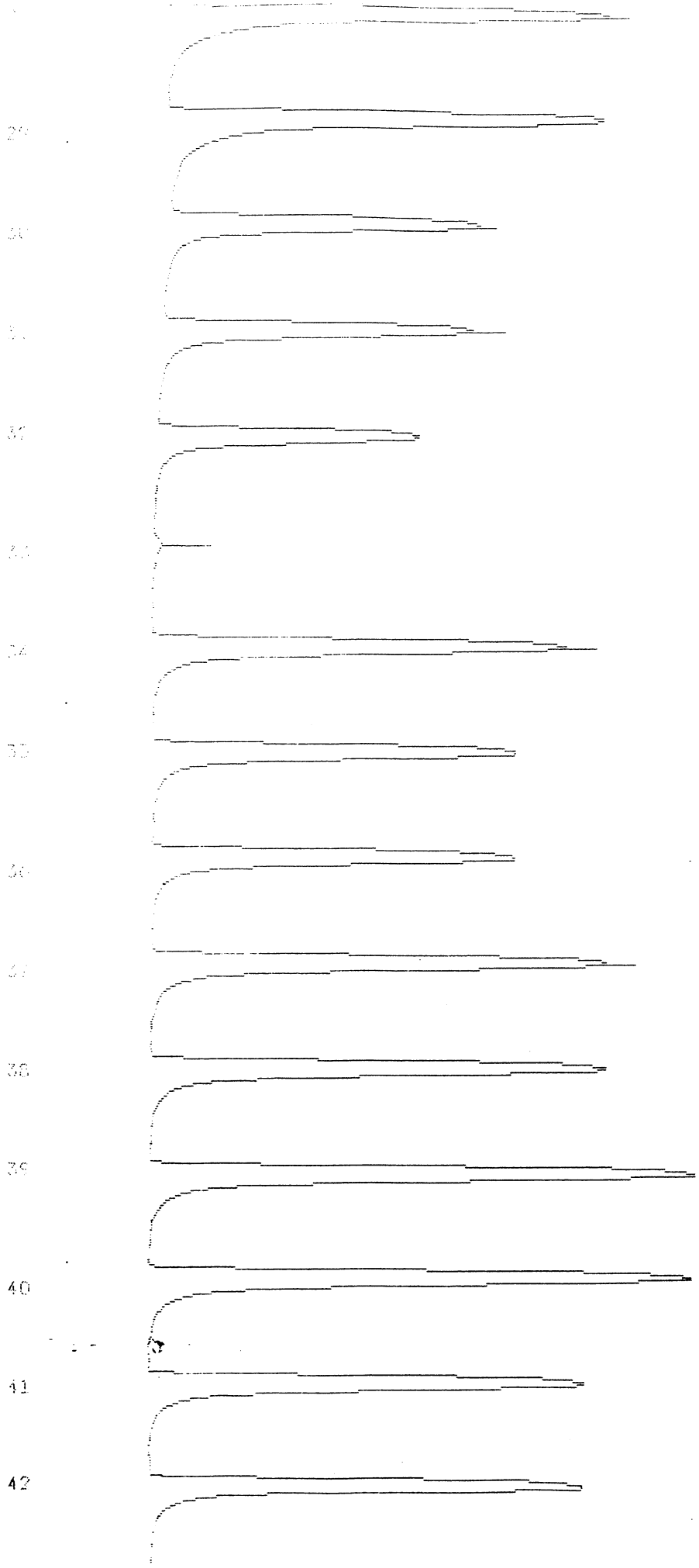
Include External Reference Material (EPA WS 378 or SPEX CertiPrep TM - WS) per run — Prepare 0.05 ppm standards daily

HNO3 Lot. No.	H2SO4 Lot. No.	Bath Temps. / / °C

Prepared By: M Mispiros Date: 00 6 203 Checked by: M Mispiros

RUN DATE: 02-03-2000 CHART DATE: 02-03-2000
CHART SPEED: 30
DATA FILE NAME: C:\DP4\DATA\000203A.DAT

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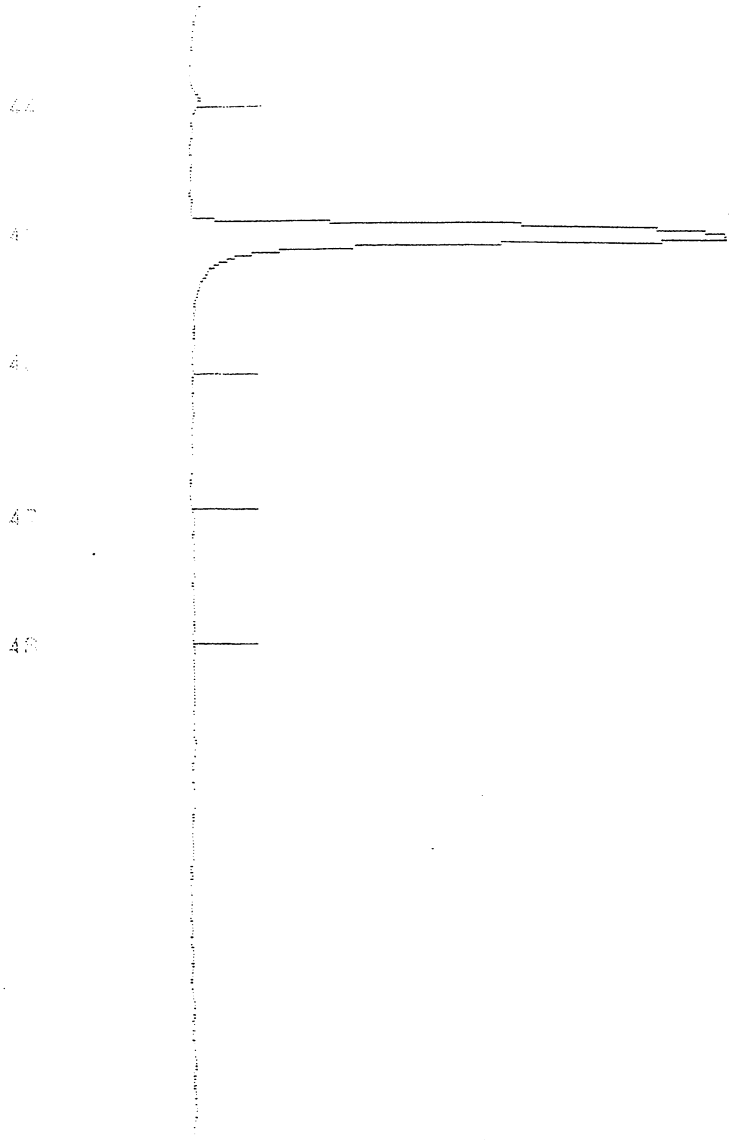
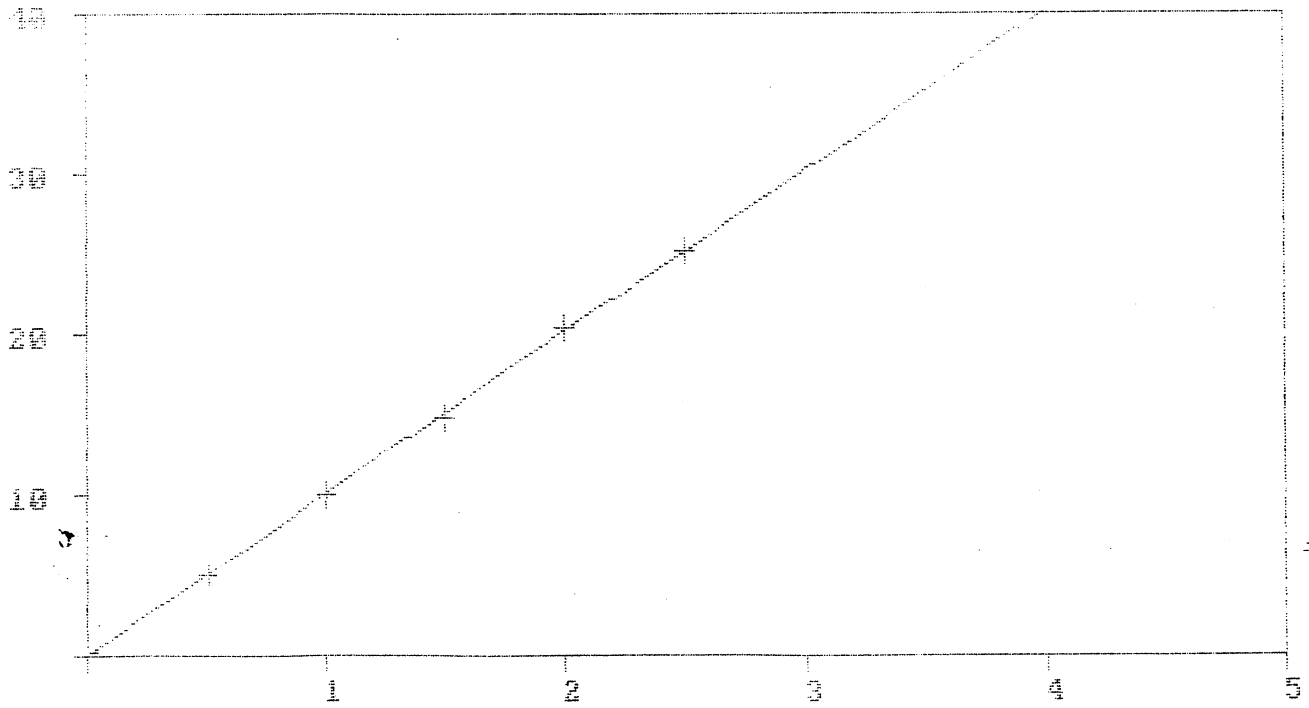


CHANNEL NAME: LOC
RUN NAME: 000203W



DATA TYPE: FIA
INTERCEPT = -2.91

CALIBRATION ORDER: 1
SLOPE = 10.0443

CHANNEL NAME: LOC
RUN DATE: 02-03-2000
SAMPLE TABLE NAME: 000203W
METHOD NAME: HG-W-20

CUP#	SAMPLE ID	DIL	WGT	HEIGHT/AREA		CONCENTRATION (ppb)	EF
1	PRIMER	1	1	14.1		1.405	s
2	DUMMY	1	1	0.2		0.014	I
3	S1: 0	1	1	0.1		0.012	I
4	S2: .5	1	1	5.0		0.498	
5	S3: 1	1	1	10.0		0.989	
6	S4: 1.5	1	1	14.9		1.478	
7	S5: 2	1	1	20.4		2.027	
8	S6: 2.5	1	1	25.1		2.496	
9	ICV	1	1	14.0		1.393	93%
10	B	1	1	0.0	TUG	-0.003	b
11	D4	1	1	14.9		1.478	d
12	BL0202-1NM4 2592	1	1	0.0	<0.03	-0.003	I
13	BL0202-1NM4	1	1	0.0		-0.003	I
14	BL0202S	1	1	9.8	0.296	0.977	99%
15	BL0202S	1	1	10.1		0.999	
16	BL020202S	1	1	9.8	0.292	0.972	97%
17	BL020202S	1	1	9.8		0.972	
18	2595	4	1	8.1	1.618	3.217	
19	2595	4	1	8.2		3.256	
20	2595D	4	1	7.9	1.589	3.149	
21	2595D	4	1	8.1		3.207	
22	2595S	4	1	17.4	3.488	6.932	94%
23	2595S	4	1	17.7		7.020	
24	2595DS	4	1	17.5	3.488	6.971	94%
25	2595DS	4	1	17.6		6.981	
26	2593	1	1	1.0	0.196	0.391	
27	2593	1	1	4.0		0.391	
28	2594	1	1	15.9	0.783	1.585	
29	2594	1	1	15.6		1.548	
30	2596	4	1	11.2	2.217	4.433	
31	2596	4	1	11.2		4.433	s
32	CCV	1	1	9.4		0.936	94%
33	B	1	1	0.0		-0.003	b
34	D4	1	1	14.9		1.478	d
35	2597	2	1	13.1	1.304	2.600	
36	2597	2	1	13.2		2.615	
37	2598	2	1	16.3	1.618	3.233	
38	2598	2	1	16.3		3.237	
39	2599	2	1	19.5	1.931	3.879	
40	2599	2	1	19.3		3.845	
41	2600	2	1	15.6	1.544	3.092	
42	2600	2	1	15.5		3.082	
43	CCV	1	1	9.5		0.938	94%
44	B	1	1	0.0		-0.003	b
45	D4	1	1	14.9		1.478	d
46	0	1	1	0.0		-0.003	s
47	0	1	1	0.0		-0.003	I

INTERCEPT 0.03 LINEAR COEF: 10.0443
CORRELATION COEF: .9998276

Zenon Number	Client	Client ID	Parameter	TS	Result	Dup.	Spike	% Rec.	Dup. Spk	% Rec.	Batch Date	Batch Code	Run Date	Run Code	Day Old	Day In	Analyst's Comments
002592	BESTENV	MB R456	Mercury -	PV	-0.2500	-99999.0	0.1010	101.	0.1010	101.	00/01/28	1GPO	00/01/28	MG01	17.	9.	*BLKIMP*
002593	BESTENV	OH-Reagent Blank	Mercury -	PV	0.0560						00/01/28	1GPO	00/01/28	MG01	17.	9.	*DDL*
002594	BESTENV	OH-Train Blank	Mercury -	PV	0.1060						00/01/28	1GPO	00/01/28	MG01	17.	9.	*DDL*
002595	BESTENV	OH-Unit B Outlet-R1	Mercury -	PV	-0.2500	-0.2500	2.5300	101.	2.5610	102.	00/01/28	1GPO	00/01/28	MG01	17.	9.	*DDL*
002596	BESTENV	OH-Unit B Outlet-R2	Mercury -	PV	-0.2500						00/01/28	1GPO	00/01/28	MG01	16.	9.	*DDL*
002597	BESTENV	OH-Unit B Outlet-R3	Mercury -	PV	-0.2500						00/01/28	1GPO	00/01/28	MG01	16.	9.	*DDL*
002598	BESTENV	OH-Unit B Inlet-R1	Mercury -	PV	-0.2500						00/01/28	1GPO	00/01/28	MG01	17.	9.	*DDL*
002599	BESTENV	OH-Unit B Inlet-R2	Mercury -	PV	-0.2500						00/01/28	1GPO	00/01/28	MG01	16.	9.	*DDL*
002600	BESTENV	OH-Unit B Inlet-R3	Mercury -	PV	-0.2500						00/01/28	1GPO	00/01/28	MG01	16.	9.	*DDL*
BL0128	INTERNAL		Mercury -	PV	-0.2500	-99999.0	0.1010	101.	0.1010	101.	00/01/28	1GPO	00/01/28	MG01	$$$	$$$	*BLKIMP*

10 Tests for OHPOX with an MDL of 0.010 ug Validated By CMB Control Chart Updated N/A IO Requirements met N/A

00043

Zenon Number	Client	Client ID	Parameter	TS	Result	Dup.	Spike	% Rec.	Dup. Spk	% Rec.	Batch Date	Batch Code	Run Date	Run Code	Day Old	Day In	Analyst's Comments
002592	BESTENV	MB R456	Mercury -	PV	-0.010	-99999.0	0.101	101.	0.101	101.	00/01/28	1GPO	00/01/28	MG01	17.	9.	*BLKIMP*
002593	BESTENV	OH-Reagent Blank	Mercury -	PV	-0.010						00/01/28	1GPO	00/01/28	MG01	17.	9.	
BL0128	INTERNAL		Mercury -	PV	-0.010	-99999.0	0.101	101.	0.101	101.	00/01/28	1GPO	00/01/28	MG01	$$$	$$$	*BLKIMP*

3 Tests for OHHYX with an MDL of 0.010 ug Validated By CMB Control Chart Updated N/A IO Requirements met N/A

00044

LDC AUTOSAMPLER RUN LOG (MERCURY)

Date: 00.01.28 Run Code: MG01 Matrix: IMP./WATER

Analyst: MG Units: _____ (see comments) MDL: _____

Cup	Dig. F.	Dil. F.	Zenon ID	Init. Conc.	F. Conc.	% R
1			Primer (ICV)			
2			Dummy (Blk)			
3			Std 1 (S1)	0.0		
4			Std 2 (S2)	0.6		
5			Std 3 (S3)	1.0		
6			Std 4 (S4)	1.6		
7			Std 6 (S5)	2.0		
8			Std 6 (S6)	2.6		
9			ICV			
10			B (Std 1)			
11			D4 (Std 4)			
12			WS 378			
13			ORG. REF			
14			BL0128	IGPO.		
15			"			
16			BL0128 S			
17			"			
18			BL0128 DS			
19			"			
20	10		2595			
21			"			
22			2595 D			
23			"			
24			2595 S			
25			"			
26			2595 DS			
27			"			
28			2593			
29			"			
30			2594			
31			"			
32			2596			
33			"			
34			CCV			
35			B			
36			D4			
37	10		2597			
38			"			
39			2598			
40			"			

Cup	Dig. F.	Dil. F.	Zenon ID	Init. Conc.	F. Conc.	% R
41	10		2599			
42			"			
43			2600			
44			"			
45			2593	HYX		
46			"			
47		1/20	Check-1			
48			Check-2			
49			CCV			
50			B			
51			D4			
52			BL0128	STA1		
53			BL0128 S			
54			3559			
55			59 D			
56			59 S			
57			3522			
58			3207			
59	10		3217			
60			3835			
61			3220			
62			3479			
63			3481			
64			3483			
65			LEACH BLK			
66			CCV			
67			B			
68			D4			
69			BL0128			
70			BL0128 S	STA2		
71			3324			
72			24 D			
73			24 S			
74	10		3027			
75			TCLP BLK			
76		1/20	3150			
77			3150 D			
78			3150 S			
79			WS 378			
80			ORG. REF			

Comments: *** "HG-347" and "MISA12" units are expressed in mg/L not ug/L

ICV = 1.5 ug/L, CCV = 1.0 ug/L, Blank Spike = 1.0 ug/L for liquid samples.

Spike = 1.0 mg/kg for solid samples.

EPA 7470 WATER PREPARATION LOG - MERCURY

00046
DG7470HG
DGHGLEACH, DG29HG***

Calibration Solutions:

#	I.D.	*Conc.	Spike	**Conc. Entered
1	Blank/Dummy	0 ppb	None	0.0
2	Standard 1	0 ppb	None	0.0
3	Standard 2	0.33	200 ul of 0.05 ppm IV working standard	0.5
4	Standard 3	0.67	400 ul of 0.05 ppm IV working standard	1.0
5	Standard 4	1.0	600 ul of 0.05 ppm IV working standard	1.5
6	Standard 4	1.0	600 ul of 0.05 ppm IV working standard	1.5
7	Standard 5	1.33	800 ul of 0.05 ppm IV working standard	2.0
7	Standard 6	1.67	1000 ul of 0.05 ppm IV working standard	2.5

Check List
- ✓ Digest Code/labels
- ✓ Samples poured out
- ✓ Acids added
- ✓ Reagents added
- ✓ Samples spiked
- ✓ Bath at 95 degrees C
- ✓ Samples digested
- ✓ Hydroxylamine HCl added
- ✓ Samples bulked and mixed
- ✓ Rack order checked

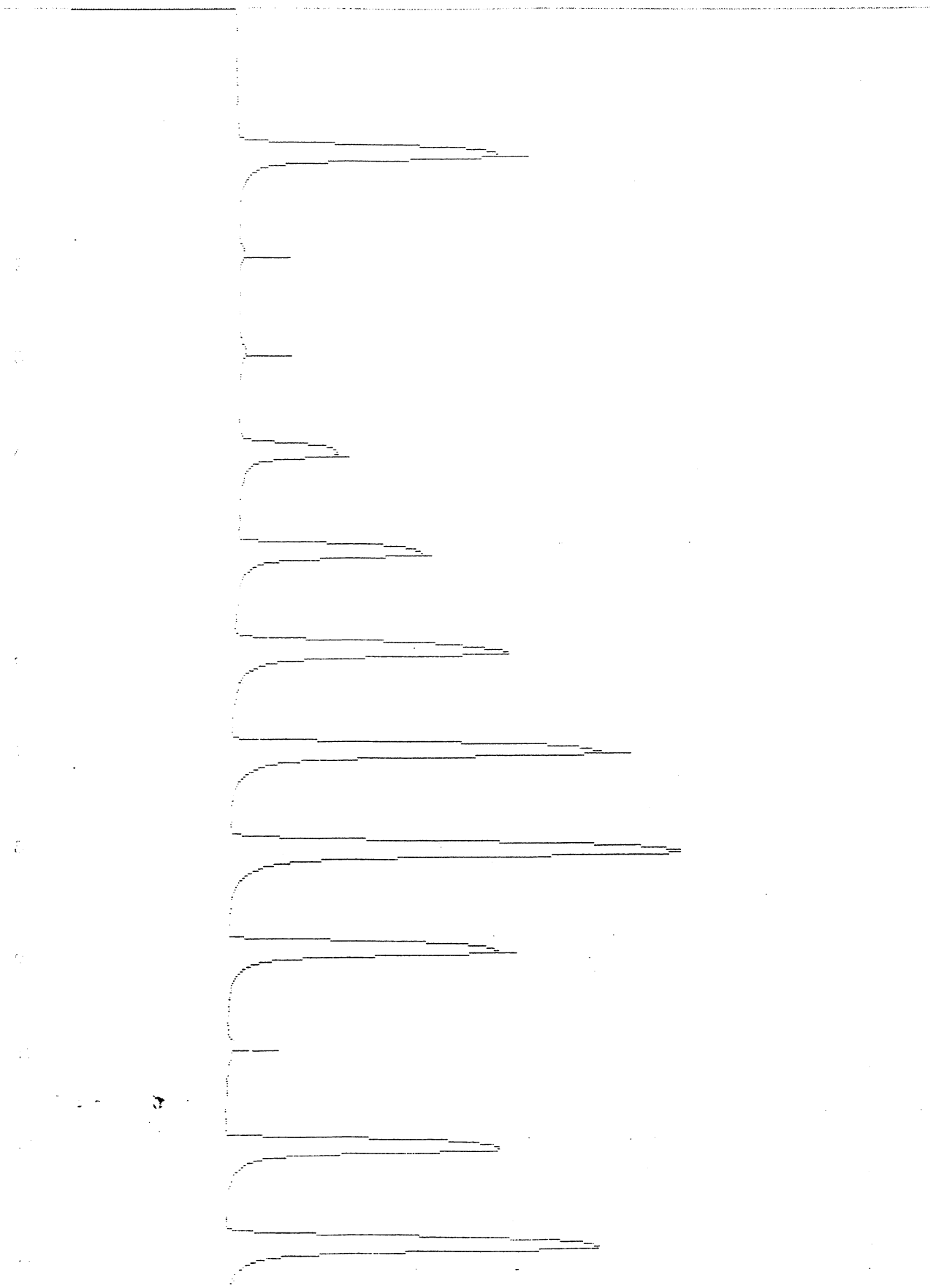
	#	Sample I.D.	B.Code	Init.Vol.	F. Vol.	Dil	Comment
	9	ICV (Init. Calib. Verif.)	16PO	20 ml	30 ml	1 X	1.5 ppb = 600 ul. of 0.05 ppm HP MESS-ZENO 30/QCA Std.
	10	BL 0128	"	"	"	"	(Processed Blank)
	11	BL 0128 S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	12	2595	"	1 ml	15 ml	10X	F. VOLUME : 250 ml
1	13	D	"	↓	↓	↓	(Duplicate sample)
1	14	S	"	↓	↓	↓	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	15	DS	"	↓	↓	↓	(Duplicate Spiked sample)
2	16	2593	"	↓	↓	↓	56 ml
3	17	2594	"	↓	↓	↓	106 ml
4	18	2596	"	↓	↓	↓	250 ml
5	19	2597	"	↓	↓	↓	↓
6	20	2598	"	↓	↓	↓	↓
7	21	2599	"	↓	↓	↓	↓
8	22	2600	"	↓	↓	↓	↓
9	23	2593	"	"	"	"	HYDROXYLAMINE SULFATE 10% w/v 100 ml
10	24		"	"	"	"	
	25	CCV (Cont. Calib. Verif.)		20 ml	30 ml	1 X	1.0 ppb = 400 ul. of 0.05 ppm HP MESS-ZENO 30/QCA Std.
	26	BL	"	"	"	"	(Processed Blank)
	27	BL S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	28		"	"	"	"	
1	29	D	"	"	"	"	(Duplicate sample)
1	30	S	"	"	"	"	1 ppb = 400 ul. of 0.05 ppm Inorganic Ventures Std Interm.
1	31	DS	"	"	"	"	(Duplicate Spiked sample)
2	32		"	"	"	"	
3	33		"	"	"	"	
4	34		"	"	"	"	
5	35		"	"	"	"	
6	36		"	"	"	"	
7	37		"	"	"	"	
8	38		"	"	"	"	
9	39		"	"	"	"	
10	40		"	"	"	"	

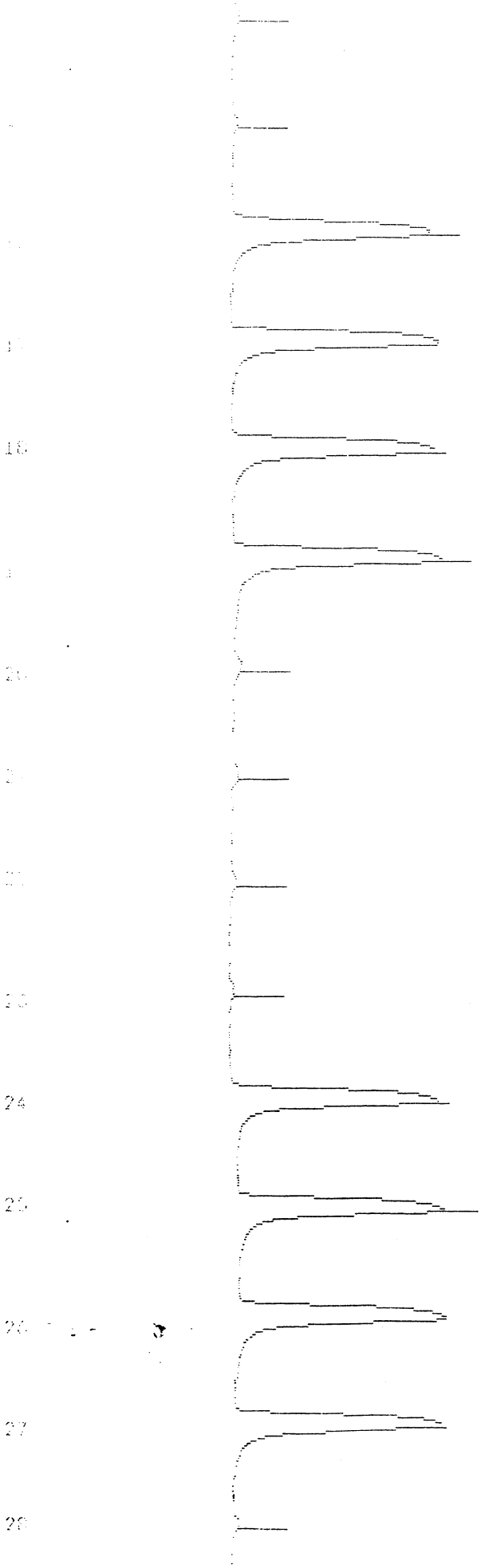
Notes: Other Applicable Test Codes: DG29HG-1B, DG29HG-2B, DG29HG-3A, DG29HG-3B, DG29HG-3C
DG29HGI, DG29HGF, DG101AA1, DG101AA2

Include External Reference Material (EPA WS 378 or SPEX CertiPrep TM - WS) per run — Prepare 0.05 ppm standards daily

HNO3 Lot. No. 119091	H2SO4 Lot. No. 319020	Bath Temps. 195 °C
Prepared By: [illegible]	Date: 00/01/28	Checked by: [illegible]

RUN DATE: 01-31-00 CHART DATE: 01-31-2000
CHART SPEED: 50
DATA FILE NAME: C:\PPA\DATA\P00128W.DAT




24
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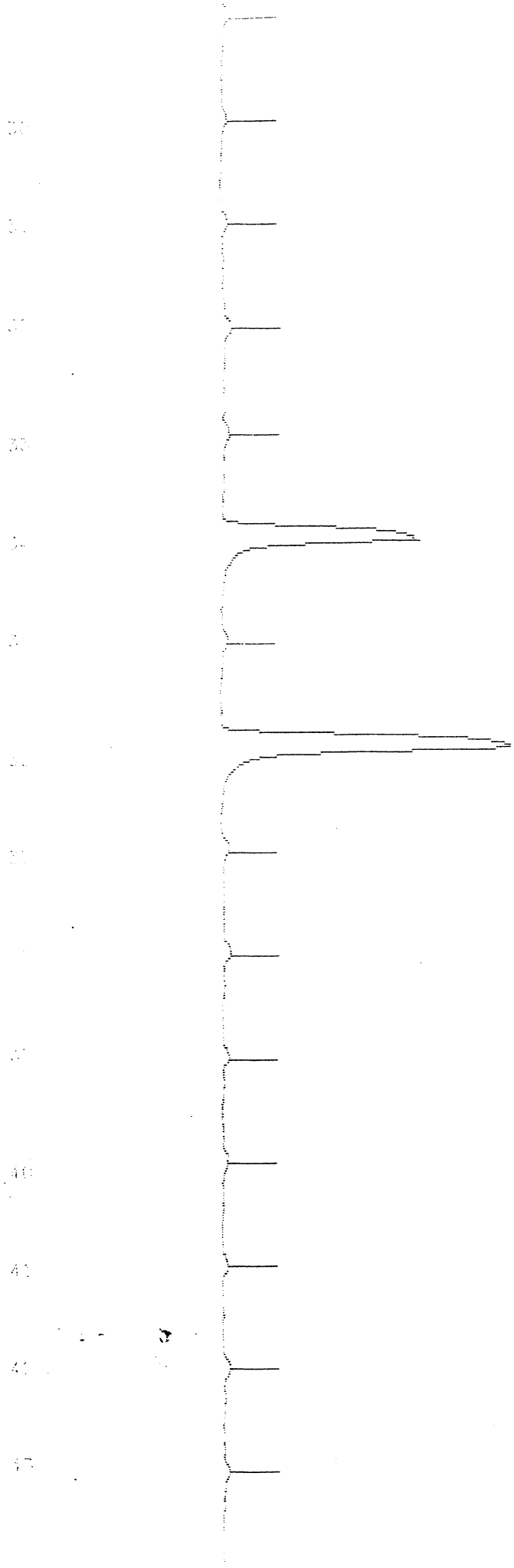
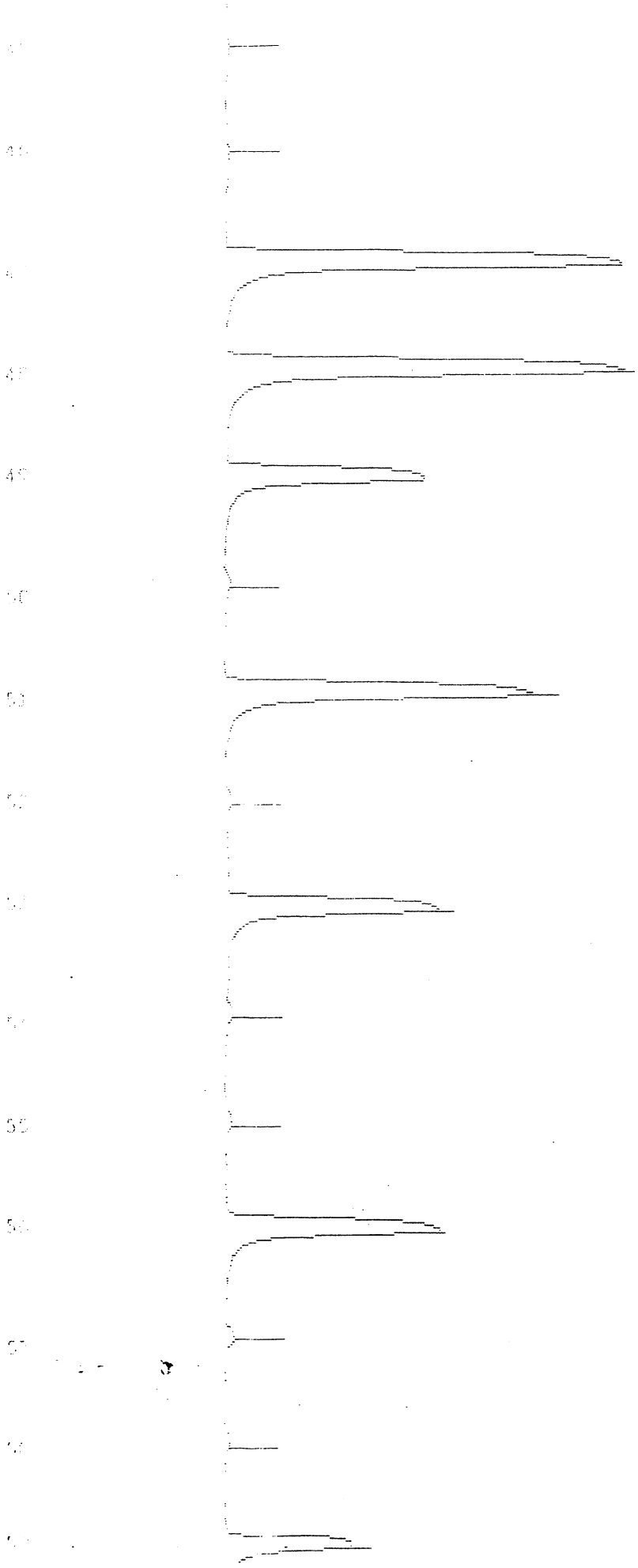
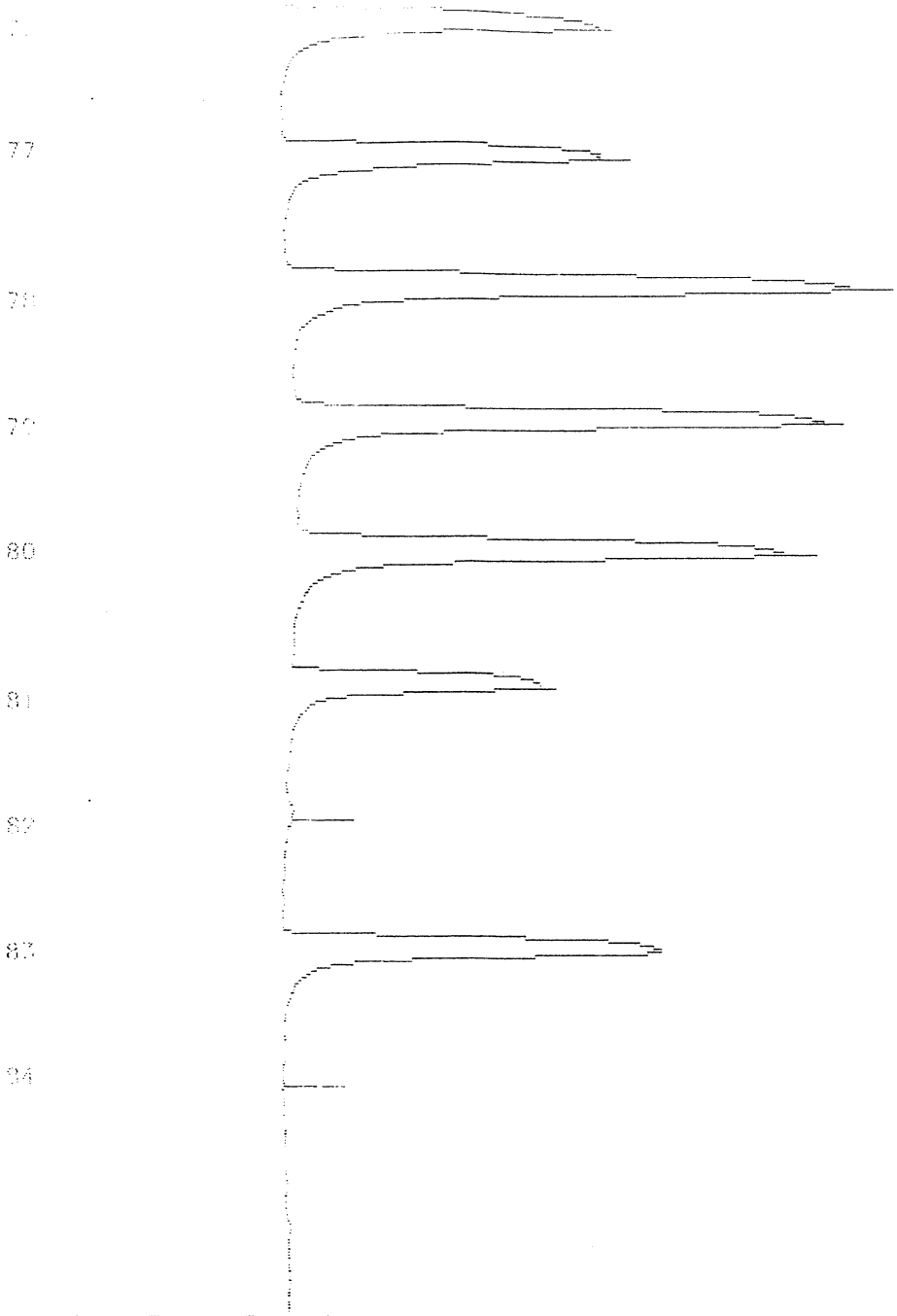
26
27
28

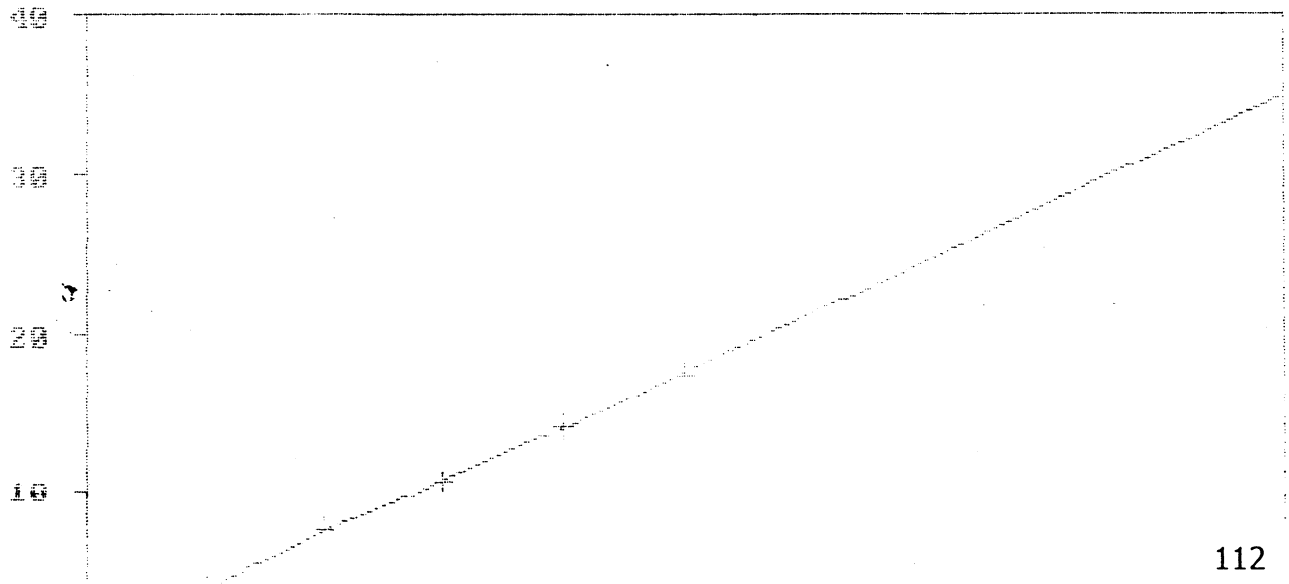


00050





CHANNEL NAME: LDC
RUN NAME: 000128W



DATA TYPE: FIA CALIBRATION ORDER: 1
INTERCEPT = 0.22 SLOPE = 6.939413

CORRELATION: .999849

CHANNEL NAME: LOC
RUN DATE: 01-28-2000
SAMPLE TABLE NAME: 000128W
METHOD NAME: HGWATER

CUP#	SAMPLE ID	DIL	WGT	HEIGHT/AREA		CONCENTRATION (ppb)	SF
1	PRIMER	1	1	10.0		1.411	I
2	DUMMY	1	1	0.1		-0.017	I
3	S1: 0	1	1	0.1		-0.014	I
4	S2: .5	1	1	3.8		0.510	
5	S3: 1	1	1	7.2		1.097	
6	S4: 1.5	1	1	10.6		1.492	
7	S5: 2	1	1	14.3		2.024	
8	S6: 2.5	1	1	17.4		2.481	
9	ICV	1	1	10.4		1.471	98%
10	B	1	1	0.0		-0.032	b
11	D4	1	1	10.6		1.492	d
12	WS 378	1	1	14.4	TUG	2.041	102%
13	ORG REF	1	1	13.8		1.964	98%
14	BL0128-1GPO	1	1	0.0	<0.01	0.032	I
15	BL0128-1GPO 2592	1	1	0.0		-0.032	I
16	BL0128S	1	1	7.0	0.101	0.982	101%
17	BL0128D	1	1	7.4		1.039	
18	BL0128DS	1	1	7.3	0.101	1.007	101%
19	BL0128DS	1	1	7.4		1.028	
20	2595	10	1	0.0	<0.250	-0.245	I
21	2595	10	1	0.0		-0.280	I
22	2595D	10	1	0.0	<0.250	-0.280	I
23	2595D	10	1	0.0		-0.315	I
24	2595S	10	1	7.2	2.530	10.101	101%
25	2595S	10	1	7.3		10.136	
26	2595DS	10	1	7.3	2.561	10.242	102%
27	2595DS	10	1	7.3		10.242	
28	2593	10	1	0.0	<0.050	-0.315	I
29	2593	10	1	0.0		-0.315	I
30	2594	10	1	0.0	<0.100	-0.315	I
31	2594	10	1	0.0		-0.315	I
32	2596	10	1	0.1	<0.250	-0.209	I
33	2596	10	1	0.0		-0.280	I
34	CCV	~~101~~	1	7.0	0.971	9.714	97%
35	B	1	1	0.0		-0.032	b
36	D4	1	1	10.6		1.492	d
37	2597	10	1	0.1	<0.250	-0.209	I
38	2597	10	1	0.1		-0.209	I
39	2598	10	1	0.0	<0.250	-0.315	I
40	2598	10	1	0.0		-0.315	I
41	2599	10	1	0.0	<0.250	-0.315	I
42	2599	10	1	0.0		-0.315	I
43	2600	10	1	0.0	<0.250	-0.315	I
44	2600	10	1	0.0		-0.315	I
45	2593-HYX	1	1	0.0	<0.01	-0.032	I
46	2593-HYX	1	1	0.0		-0.032	
47	CHECK-1	20	1	13.7		38.994	
48	CHECK-2	20	1	14.8		39.775	

00053

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] 333,343	1	[illegible]	[illegible]	[illegible]	[illegible]
53	BLO [illegible]	1	[illegible]	7.3	1.014	101%
54	3559	1	1	0.0	-0.032	I
55	35590	1	1	0.0	-0.032	I
56	35593	1	1	2.4	1.031	103%
57	3522	1	1	0.1	-0.014	I
58	3207	1	1	0.0	-0.032	I
59	3317	10	1	4.2	5.738	
60	3335	1	1	0.0	0.032	I
61	3390	1	1	0.0	-0.032	s
62	3479	1	1	0.0	-0.032	I
63	3481	1	1	0.0	-0.032	I
64	3483	1	1	0.0	-0.032	I
65	[illegible]	1	1	0.0	-0.032	I
66	COV	[illegible]	1	7.0	0.978	98%
67	[illegible]	1	1	0.0	-0.032	b
68	04	1	1	10.6	1.492	d
69	BLO128-3102 3025	1	1	0.0	-0.032	I
70	BLO128S	1	1	7.2	1.003	100%
71	3324	1	1	0.0	-0.032	I
72	33240	1	1	0.0	-0.032	I
73	33243	1	1	7.2	1.007	101%
74	3027	10	1	0.0	-0.245	I
75	[illegible]	1	1	0.0	-0.032	I
76	3150	20	1	3.9	24.918	s
77	31500	20	1	8.8	24.777	
78	31503	20	1	13.5	43.991	96%
79	WS 379	1	1	14.6	2.069	103%
80	080 051	1	1	13.4	1.904	95%
81	COV	1	1	6.9	0.957	96%
82	8	1	1	0.0	-0.032	b
83	04	1	1	10.6	1.492	d

[illegible] 0.22 LINEAR [illegible] 0.[illegible]473
CORRELATION [illegible] [illegible]845

4. SHIPPING/RECEIVING DOCUMENTS

Airbills (No. of shipments)
Chain-of-Custody Records
Sample Log-In Sheets
Miscellaneous Shipping/Receiving Records (describe or list)
Notice of Sample receipt

BEST ENVIRONMENTAL, INC Ph (510) 278 4011; Fx (510) 278 4018

Project ID: AES - Inlet Unit B

Analytical Lab: Method - Source - Run - Fraction

SAMPLE CHAIN OF CUSTODY

MB-2597

1 of 4

#	DATE	TIME	SAMPLE ID (Source/Run#/Method/Fraction)	CONTAINER (# / Vol. / Type)	Volume	Storage Temp °F	SAMPLE DESCRIPTION	ANALYSIS	TAT
1	1/11/00	✓	out. Hydro - Binlet - R1 - Filter ✓	#1 842cc			Quartz fiber filter	250AG	2598
2	1/12/00	✓	out. Hydro - Binlet R2 - Filter ✓	#1 "			Quartz fiber filter	↓	2599
3	1/12/00	✓	out. Hydro - Binlet R3 Filter ✓	#1 "			Quartz fiber filter	↓	2600
4	1/11/00	✓	out. Hydro - train BK - R4 - Filter ✓	#1 "			Quartz fiber filter	↓	2594
5									
6	1/11/00	✓	out. Hydro - Binlet - R1 - P/H rinse ✓	#2 250cc			0.1N HNO_3 - Probe/Nozzle rinse	250AG	2598
7	1/12/00	✓	out. Hydro - Binlet - R2 F/H rinse ✓	#2 "			0.1N HNO_3 - Probe/Nozzle rinse	↓	2599
8	1/12/00	✓	out. Hydro - Binlet - R3 F/H rinse ✓	#2 "			0.1N HNO_3 - Probe/Nozzle rinse	↓	2600
9	1/11/00		out. Hydro - train BK - R4 - F/H rinse ✓	#2 "			0.1N HNO_3 - Probe/Nozzle rinse	↓	2594
10									
11	1/11/00	✓	Out Hydro - Binlet - R1 - KCl ✓	#3 950cc			1N KCl - Impinger solution	1LAG	2595
12	1/12/00	✓	out. Hydro - Binlet - R2 - KCl ✓	#3 950cc			1N KCl - Impinger solution	↓	2599
13	1/12/00	✓	out. Hydro - Binlet - R3 - KCl ✓	#3 950cc			1N KCl - Impinger solution	↓	2600
14	1/11/00	✓	out. Hydro - train BK - R4 - KCl ✓	#3 950cc			1N KCl - Impinger solution	500AG	2594
15									
16	1/11/00	✓	out. Hydro - Binlet - R1 - H_2O_2/HNO_3 ✓	#4 250cc			10% H_2O_2/5% HNO_3 Impinger Sol.	250AG	2598
17	1/12/00	✓	out. Hydro - Binlet - R2 - H_2O_2/HNO_3 ✓	#4 "			10% H_2O_2/5% HNO_3 - Impinger Sol.	↓	2599
18	1/12/00	✓	out. Hydro - Binlet - R3 - H_2O_2/HNO_3 ✓	#4 "			10% H_2O_2/5% HNO_3 Impinger Sol	↓	2600
19	1/11/00	✓	out. Hydro - train BK - R4 - H_2O_2/HNO_3 ✓	#4 "			10% H_2O_2/5% HNO_3 Impinger Sol.	↓	2594
20									
21									

SPECIAL INSTRUCTIONS: Record & Report all liquid sample volumes.

All $KMnO_4$ samples are all in one cooler; All other samples are in 2nd cooler.

Submit Results to Attn: Scott Gates

Best Environmental Inc; 15890 Foothill Blvd, San Leandro, CA 94578

Relinquished by: [signature] Received by: Fed Ex 8147991875 Date: 1-14-00 Time:

Relinquished by: Received by: [signature] Date: 000119 Time: 12:5p

Relinquished by: Received by: Date: Time:

SAMPLE CONDITION AS RECEIVED: OK or not OK

00055

BEST ENVIRONMENTAL INC. TEL (510) 278-4018 FAX (510) 278-4018

Project ID: AES Inlet Unit B

Analytical Lab:

SAMPLE CHAIN OF CUSTODY

2 of 4

#	DATE	TIME	SAMPLE ID Source/Run#/Method/Fraction	CONTAINER	Volume	Storage Temp °F	SAMPLE DESCRIPTION	ANALYSIS	TAT
1	1/11/00	✓	Out-Hydro-B-Inlet-R1-KMnO4 ✓	#5 500cc	500Ml		4% KMnO4/10% H2SO4 imp sol	Out Hydro	Normal (2593)
2	1/12/00	✓	Out-Hydro-B-Inlet-R2-KMnO4 ✓	#5 500cc	↓		4% KMnO4/10% H2SO4 imp. sol	Out-Hydro	Normal (2594)
3	1/12/00	✓	Out-Hydro-B-Inlet R3-KMnO4 ✓	#5 500cc			4% KMnO4/10% H2SO4 imp sol.	Out-Hydro	Normal (2602)
4	1/11/00	✓	Out-Hydro-~~B-Inlet~~ BK R4 KMnO4 ✓	#5 500cc	↓		4% KMnO4/10% H2SO4 imp sol.	Out-Hydro	Normal (2594)
5									
6	1/12/00	✓	Out-Hydro-Reagent BK-F/H rinse ✓	#7 250cc	250Ml		0.1N HNO3 reagent Blank	2543	
7	1/12/00	✓	Out-Hydro-Reagent BK-KCl ✓	#8 "	↓		1N KCl reagent Blank		
8	1/12/00	✓	Out Hydro-Reagent BK-H2O2/HNO3 ✓	#9 "			10% H2O2/5% HNO3 reagent BK.		
9	1/12/00	✓	Out Hydro-Reagent BK-KMnO4 ✓	#10 "			4% KMnO4/10% H2SO4 reagent BK		
10	1/12/00	✓	Out Hydro-Reagent BK-OH NH4-SO4 ✓	#11 "	↓		10% Hydroxylamine sulfate R BK		
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
22									

SPECIAL INSTRUCTIONS: Record & Report all liquid sample volumes.

BEST ENVIRONMENTAL INC. 15890 Foothill Blvd. San Leandro, CA 94578

Relinquished by: [signature] Received by: [signature] Date: 1-14-00 Time:

Relinquished by: Received by: [signature] Date: 1/14/00 Time: 17:15

Relinquished by: Received by: Date: Time:

SAMPLE CONDITION AS RECEIVED: OK or not OK

h:\forms\field\coc

00056

BEST ENVIRONMENTAL, INC. Ph (510) 278 4011; Fx (510) 278 4018

Project ID: AES - outlet B

Analytical Lab:

SAMPLE CHAIN OF CUSTODY

3 of 4

#	DATE	TIME	SAMPLE ID Source/Run#/Method/Fraction	CONTAINER size/type	Volume	Storage Temp °F	SAMPLE DESCRIPTION	ANALYSIS	TAT
1	1/11/00	✓	Out. Hydro - Boutlet - R1 - Filter ✓	#1 8oz wide	250cc	2595	Quartz fiber filter	Out. Hydro	Normal
2	1/12/00	✓	Out. Hydro - Boutlet - R2 - Filter ✓	#1 "	↓	2596	Quartz fiber filter	Out. Hydro	Normal
3	1/12/00	✓	Out. Hydro - Boutlet - R3 - Filter ✓	#1 "	↓	2597	Quartz fiber filter	Out. Hydro	Normal
4	~~1/11/00~~		~~Out. Hydro - Boutlet~~ - R				Quartz		
5	~~1/11/00~~		~~Out. Hydro - Trip Bk - R4 - Filter~~	~~#1~~			~~Quartz fiber filter~~	~~Out. Hydro~~	~~Normal~~
6									
7	1/11/00	✓	Out. Hydro - Boutlet - R1 - F/H rinse ✓	#2 250cc	250cc	2595	0.1N HNO_3 - Probe/nozzle rinse	Out. Hydro	Normal
8	1/12/00	✓	Out. Hydro - Boutlet - R2 - F/H rinse ✓	#2 250cc	↓	2596	0.1N HNO_3 - Probe/Nozzle rinse	Out. Hydro	Normal
9	1/12/00	✓	Out. Hydro - Boutlet - R3 - F/H rinse ✓	#2 250cc	↓	2597	0.1N HNO_3 - Probe/Nozzle rinse	Out. Hydro	Normal
10	~~1/11/00~~		~~Out. Hydro - Boutlet Trip Bk R4 - F/H rinse~~	~~#2~~			~~0.1N HNO_3 - Probe/Nozzle rinse~~	~~Out. Hydro~~	~~Normal~~
11									
12	1/11/00	✓	Out. Hydro - Boutlet - R1 - KCl ✓	#3 950cc	LAB	2595	1N KCl - Impinger Solution	Out. Hydro	Normal
13	1/12/00	✓	Out. Hydro - Boutlet - R2 - KCl ✓	#3 950cc	↓	2596	1N KCl - Impinger Solution	Out. Hydro	Normal
14	1/12/00	✓	Out. Hydro - Boutlet - R3 - KCl ✓	#3 950cc	↓	2597	1N KCl - Impinger Solution	Out. Hydro	Normal
15	~~1/11/00~~		~~Out. Hydro - Boutlet Trip Bk - R4 - KCl~~	~~#3~~			~~1N KCl - Impinger Solution~~	~~Out. Hydro~~	~~Normal~~
16									
17	1/11/00	✓	Out. Hydro - Boutlet - R1 - H_2O_2/HNO_3 ✓	#4 250cc	250cc	2595	10% H_2O_2/5% HNO_3 Impinger Sol.	Out. Hydro	Normal
18	1/12/00	✓	Out. Hydro - Boutlet - R2 - H_2O_2/HNO_3 ✓	#4 "	↓	2596	10% H_2O_2/5% HNO_3 Impinger Sol.	Out. Hydro	Normal
19	1/12/00	✓	Out. Hydro - Boutlet - R3 - H_2O_2/HNO_3 ✓	#4 "	↓	2597	10% H_2O_2/5% HNO_3 Impinger Sol.	Out. Hydro	Normal
20	~~1/11/00~~		~~Out. Hydro - Trip Bk - R4 - H_2O_2/HNO_3~~	~~#4~~			~~10% H_2O_2/5% HNO_3 Impinger Sol.~~	~~Out. Hydro~~	~~Normal~~
21									

SPECIAL INSTRUCTIONS: Record & Report all liquid sample volumes.

Submit Results to: Attn: SCOTT CHESNUT Best Environmental Inc. 15890 Foothill Blvd., San Leandro, CA 94578

Relinquished by: [signature] Received by: [signature] Date: 1-14-00 Time:

Relinquished by: Received by: [signature] Date: 000119 Time: 12:15

Relinquished by: Received by: Date: Time:

SAMPLE CONDITION AS RECEIVED: OK or not OK

BEST ENVIRONMENTAL, INC. Ph (510) 278 4011 Fx (510) 278 4018

Project ID: AES-outlet B

Analytical Lab:

SAMPLE CHAIN OF CUSTODY

4 of 4

#	DATE	TIME	SAMPLE ID (Method - Source - RUN - fraction)	CONTAINER size / type	Volume	Storage Temp °F	SAMPLE DESCRIPTION	ANALYSIS	TAT
1	1/11/00	✓	Out. Hydro - Bottle - R1 KMnO4 ✓	#5 500 cc	500ml	2595	4% KMnO4/10% H2SO4 imp. Sol.	Out. Hydro	Normal
2	1/12/00	✓	Out. Hydro - Bottle - R2 KMnO4 ✓	#5 500 cc		2596	4% KMnO4/10% H2SO4 imp. Sol.	Out. Hydro	Normal
3	1/12/00	✓	Out. Hydro - Bottle - R3 KMnO4 ✓	#5 500 cc	↓	2597	4% KMnO4/10% H2SO4 imp. Sol.	Out. Hydro	Normal
4	1/11/00		~~Out. Hydro train BK - R4 KMnO4~~	#5			~~4% KMnO4/10% H2SO4 imp Sol.~~	~~Out. Hydro~~	~~Normal~~
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									

SPECIAL INSTRUCTIONS: Record & Report all liquid sample volumes.

Submit Results to: Attn: Scott Chestnut Best Environmental Inc, 15890 Foothill Blvd., San Leandro, CA 94578

Relinquished by: [signature] Received by: [signature] Date: 1-14-00 Time:

Relinquished by: Received by: [signature] Date: 000119 Time: 12:15

Relinquished by: Received by: Date: Time:

SAMPLE CONDITION AS RECEIVED: OK or not OK

00058

FedEx USA Airbill 814799918753

0200

1 From
Date 1/14/00 Sender's FedEx Account Number 1221-9771-9
Sender's Name Scott Chesnut Phone 510) 278-4011
Company Best Environmental
Address ~~299 Cayuga Rd (FedEx Depot)~~ 15890 Foothill Blvd
City ~~Cheektowaga~~ San Leandro State ~~NY~~ CA ZIP ~~14225~~ 94578

2 Your Internal Billing Reference

3 To
Recipient's Name Rod McLeod Phone 800) 668-0639
Company Philip Analytical Service
Address 299 Cayuga Road
City Checktowaga State NY ZIP 14225

Questions? Call 1·800·Go·FedEx® (800·463·3339)
Visit our Web site at www.fedex.com

4a Express Package Service
Packages up to 150 lbs.
☐ FedEx Priority Overnight ☐ FedEx Standard Overnight ☐ FedEx First Overnight
☒ FedEx 2Day ☒ FedEx Express Saver*

4b Express Freight Service
Packages over 150 lbs.
☐ FedEx 1Day Freight* ☐ FedEx 2Day Freight ☐ FedEx 3Day Freight

5 Packaging
☐ FedEx Letter* ☐ FedEx Pak* ☒ Other Pkg.

6 Special Handling
☐ Saturday Delivery ☐ Sunday Delivery ☒ HOLD Weekday at FedEx Location ☐ HOLD Saturday at FedEx Location
Does this shipment contain dangerous goods?
☒ No ☐ Yes ☐ Yes ☐ Dry Ice
☐ Cargo Aircraft Only

7 Payment Bill to:
☒ Sender ☐ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check

Total Packages 2 Total Weight 24 Total Declared Value $ .00

8 Release Signature

360

RETAIN THIS COPY FOR YOUR RECORDS

BEST ENVIRONMENTAL INC

Project ID: AES Hawaii
Analytical Lab: Philip Analytical

SAMPLE CHAIN OF CUSTODY

#	DATE	TIME	SAMPLE ID Source/Run#/Method/Fraction	CONTAINER size / type	Volume	Storage Temp °F	SAMPLE DESCRIPTION	ANALYSIS	TAT
1	—	—	Coal Fly Ash - Audit - B	125 ml Jar	~3 lg	Amb	Coal Fly Ash	Hg	Normal
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									

SPECIAL INSTRUCTIONS: Record & Report all liquid sample volumes.

not rec'd

Submit Results to: Scott Chestnut Destructive Environmental Inc. 1890 Rachelle Blvd. San Leandro, CA 94578

Relinquished by: [signature] Received by: 5617675545 Date: 1/19/00 Time: 5:00 pm

Relinquished by: _____ Received by: _____ Date: _____ Time: _____

Relinquished by: _____ Received by: _____ Date: _____ Time: _____

SAMPLE CONDITION AS RECEIVED: OK or not OK

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00061

Best Environmental, Inc. 15890 Foothill Blvd., San Leandro, CA 94578

FAX

Date: 1-20-00

Number of pages including cover sheet: 8

To: ROD MCLEOD
Company: PHILIP ANALYTICAL
Phone: (800) 668 0639
Fax phone: (905) 332 9169

From: SCOTT CHESNUT
Phone: (510) 278-4011
Fax phone: (510) 278-4018

Original Being Mailed? Yes ☐ No ☐ To APCD ☐ Not Yet ☐

REMARKS: ☐ Quotation Follows ☐ Source Test Plan Follows ☐ Per Your Request ☐ Please Respond
☒ As We Discussed ☐ For Your Review ☐ Reply ASAP ☐ Preliminary Draft

Kelly
Call us for Best hours of Sat

BEST ENVIRONMENTAL, INC. Ph (510) 278 4011 Fx (510) 278 4018

Project ID: 4ES Hawaii
Analytical Lab: Philip Analytical

SAMPLE CHAIN OF CUSTODY

MB-2557

#	DATE	TIME	SAMPLE ID Source/Run#/Method/Fraction	CONTAINER size / type	Volume	Storage Temp °F	SAMPLE DESCRIPTION	ANALYSIS	TAT
1	—	—	Coal Fly Ash-Audit-B	125ml Jar	~31g	Amb	Coal Fly Ash 2555	Hg	Normal
2									
3							100%		
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									

SPECIAL INSTRUCTIONS: Record & Report all liquid sample volumes.

00062

Submit Results to: Attn: Scott Chesnut Best Environmental Inc. 15890 Foothill Blvd., San Leandro, CA 94578

Relinquished by: [signature] Received by: 5617675545 Date: 1/19/00 Time: 5:00 p.m.

Relinquished by: _____ Received by: [signature] Date: 1/20/01 Time: 11:45 am

Relinquished by: _____ Received by: _____ Date: _____ Time: _____

SAMPLE CONDITION AS RECEIVED: OK or not OK

h:\forms\field\coc

Page ___ of ___

US SAMPLE LOG IN SHEET

BEST ENVIR

Lab Name: Philip Analytical Services Corporation, Burlington Laboratory

Received By (Print Name): K. Cravens

Received By (Signature):

Client Project ID:

REMARKS:

Condition of Samples/Sample Shipment

Custody Seal(s)	Present ___ Absent ✓	Samples received intact.
Chain of Custody Records	Present ✓ Absent ___	
Airbill	Present ✓ Absent ___	
Airbill No.	814799918753	
	Fed 8164 5052 8713 FedEx Tracking Number for Customer	
Does Information on Custody Records and Samples Agree?	Yes ✓ No ___	
Date Received at Lab	1 19 2000	
Time Received	12:15p	

Temperature of Coolers

Cooler ID:	Temperature
2 coolers	13°C 13°C

Relinquished By:

Date: 1 19 2000

Logbook No:

Logbook Page No.

Page ___ of ___

US SAMPLE LOG IN SHEET

BEST ENVI

Lab Name:	Philip Analytical Services Corporation, Burlington Laboratory
Received By (Print Name):	K. Carraro
Received By (Signature):	
Client Project ID:	

REMARKS:		Condition of Samples/Sample Shipment:
Custody Seal(s)	Present ___ Absent ✓	Samples rec'd intact
Chain of Custody Records	Present ✓ Absent ___	
Airbill	Present ✓ Absent ___	
Airbill No.	5617675545	
Does Information on Custody Records and Samples Agree?	Yes ✓ No ___	
Date Received at Lab	1 21 2000	
Time Received	11:45a.	

Temperature of Coolers	
Cooler ID:	Temperature
1 Box	not taken

Relinquished By: [signature]

Date: 1 21 2000

Logbook No: ___

Logbook Page No.

00065

PHILIP SERVICES

fed USA Airbill 5617675545

From

Name

Phone

Dept./Floor/Suite/Room

Company

Address

City State Zip

2 Your Internal Billing Reference Information

To

Recipient's Name

Phone

Dept./Floor/Suite/Room

Company

Address
(HOLD at FedEx location, print FedEx address here)

City State Zip

For HOLD at FedEx Location check here

☐ Hold Weekday (Not available with FedEx First Overnight)

☐ Hold Saturday (Not available at all locations. Not available with FedEx First Overnight or FedEx Standard Overnight)

For Saturday Delivery check here

☐ (Extra Charge. Not available to all locations. Not available with FedEx First Overnight or FedEx Standard Overnight)

5 6 1 7 6 7 5 5 4 5

4a Express Package Service *Packages under 150 lbs.* Delivery commitment may be later in some areas

☒ FedEx Priority Overnight (Next business morning)

☐ FedEx Standard Overnight (Next business afternoon)

☐ FedEx 2Day* (Second business day)

☐ FedEx First Overnight

*FedEx Letter Rate not available. Minimum charge: One pound FedEx 2Day rate.

4b Express Freight Service *Packages over 150 lbs.* Delivery commitment may be later in some areas

☐ FedEx Overnight Freight

☐ FedEx 2Day Freight

☐ FedEx Express Saver Freight (Up to 3 business day service based upon distance)

(Call for delivery schedule. See back for detailed descriptions of freight products.)

5 Packaging ☐ FedEx Letter ☐ FedEx Pak (Declared value ≤ $500) ☐ FedEx Box ☐ FedEx Tube ☒ Other Pkg.

6 Special Handling

Does this shipment contain dangerous goods? ☐ Yes (As per attached Shipper's Declaration) ☐ Yes (Shipper's Declaration not required)

☐ Dry Ice (Dry Ice, UN 1845 kg ____ x ____ kg. 9/2)

(Dangerous Goods Shipper's Declaration not required)

CA ☐ Cargo Aircraft Only

7 Payment

Bill to: ☒ Sender (Account no. in section 1 will be billed) ☐ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check

(Enter FedEx account no. or Credit Card no. below)

Total Packages	Total Weight	Total Declared Value*	Total Charges
		$ .00	$

*When declaring a value higher than $100 per shipment, you pay an additional charge. See SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY section for further information.

Credit Card Auth.

8 Release Signature

Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claims.

272

Questions?
Call 1·800·Go·FedEx
(1-800-463-3339)

Pick up

PRINTED IN U.S.A.

00066

PSC
PHILIP SERVICES

FedEx Tracking Number 814799918753

Form I.D. No. 0200

Date

Sender's Name — Phone

Company

Address — Dept./Floor/Suite/Room

City — State — ZIP

Recipient's Name — Phone

Company

Address — Dept./Floor/Suite/Room

We cannot deliver to P.O. boxes or P.O. ZIP codes.

For "HOLD" at FedEx location, print FedEx address here.

City — State NY ZIP 14225

814799918753

4a Express Package Service — *Packages up to 150 lbs.* Delivery commitment may be later in some areas.

- ☐ FedEx Priority Overnight — Next business morning
- ☐ FedEx Standard Overnight — Next business afternoon
- ☐ FedEx First Overnight — Earliest next business morning delivery to select locations
- ☒ FedEx 2Day* — Second business day
- ☒ FedEx Express Saver* — Third business day

* FedEx Letter Rate not available. Minimum charge: One-pound rate

4b Express Freight Service — *Packages over 150 lbs.* Delivery commitment may be later in some areas.

- ☐ FedEx 1Day Freight* — Next business day
- ☐ FedEx 2Day Freight — Second business day
- ☐ FedEx 3Day Freight — Third business day

* Call for Confirmation:

5 Packaging — * Declared value limit $500

- ☐ FedEx Letter*
- ☐ FedEx Pak*
- ☒ Other Pkg. — Includes FedEx Box, FedEx Tube, and customer pkg.

6 Special Handling

- ☐ **Saturday Delivery** — Available for FedEx Priority Overnight and FedEx 2Day to select ZIP codes
- ☐ **Sunday Delivery** — Available for FedEx Priority Overnight to select ZIP codes
- ☒ **HOLD Weekday at FedEx Location** — Not available with FedEx First Overnight
- ☐ **HOLD Saturday at FedEx Location** — Available for FedEx Priority Overnight and FedEx 2Day to select locations

Does this shipment contain dangerous goods?

- ☒ No
- ☐ Yes — As per attached Shipper's Declaration
- ☐ Yes — Shipper's Declaration not required
- ☐ Dry Ice — Dry Ice, 9, UN 1845 ____ x ____ kg

Dangerous Goods cannot be shipped in FedEx packaging

☐ Cargo Aircraft Only

7 Payment *Bill to:*

- ☒ Sender — Acct. No. in Section 1 will be billed.
- ☐ Recipient
- ☐ Third Party
- ☐ Credit Card
- ☐ Cash/Check

Total Packages	Total Weight	Total Declared Value†	Total Charges
2	74	$ .00	Credit Card Auth.

†Our liability is limited to $100 unless you declare a higher value. See back for details.

8 Release Signature *Sign to authorize delivery without obtaining signature.*

By signing you authorize us to deliver this shipment without obtaining a signature and agree to indemnify and hold us harmless from any resulting claims.

Questions? Call 1·800·Go·FedEx* (800-463-3339)
Visit our Web site at www.fedex.com

Rev. Date 11/98•Part #154815•©1994–98 FedEx•PRINTED IN U.S.A. GBFE 7/99

360

** TX STATUS REPORT ** AS OF JAN 20 2000 21:27 PAGE.01

PHILIP ANALYTICAL

	DATE	TIME	TO/FROM	MODE	MIN/SEC	PGS	JOB#	STATUS
25	01/20	21:26	15102784018	EC--S	00'20"	001	218	OK

NOTICE OF SAMPLE RECEIPT-PHILIP ANALYTICAL SERVICES

Attention: Scott Chestnut
Client: Best Environmental Inc.
Re Client Project: ABS
FAX #: 510 278 4018
Phone #: 510 278 4011

Samples for: 'OH' Hg Train
were received in good condition unless
indicated below.

SAMPLE LISTING

Philip ID #	Sample ID	Date Sampled	Date Received
002593	OH-Reagent Blank	00/01/11	00/01/19
002594	OH-Train Blank	00/01/11	00/01/19
002595	OH-Unit B Outlet-R1	00/01/11	00/01/19
002596	OH-Unit B Outlet-R2	00/01/12	00/01/19
002597	OH-Unit B Outlet-R3	00/01/12	00/01/19
002598	OH-Unit B Inlet-R1	00/01/11	00/01/19
002599	OH-Unit B Inlet-R2	00/01/12	00/01/19
002600	OH-Unit B Inlet-R3	00/01/12	00/01/19

Did not received audit fly ash Sample

Comments:

Date 00/01/20

** TX STATUS REPORT ** AS OF JAN 24 2000 11:56 PAGE.01

PHILIP ANALYTICAL

	DATE	TIME	TO/FROM	MODE	MIN/SEC	PGS	JOB#	STATUS
12	01/24	11:56	15102784018	EC--S	00'17"	001	055	OK

NOTICE OF SAMPLE RECEIPT-PHILIP ANALYTICAL SERVICES

Attention: Scott Chestnut
Client: Best Environmental Inc.
Re Client Project: AES
FAX #: 510 278 4018
Phone #: 510 278 4011

Samples for: Fly Ash Audit
were received in good condition unless
indicated below.

SAMPLE LISTING

Philip ID #	Sample ID	Date Sampled	Date Received
002888	Coal Fly Ash Audit-B	00/01/21	00/01/21

Comments:

Date 00/01/24

NOTICE OF SAMPLE RECEIPT-PHILIP ANALYTICAL SERVICES 00069

Attention: Scott Chestnut
Client: Best Environmental Inc.
Re Client Project: AES
FAX #: 510 278 4018
Phone #: 510 278 4011

Samples for: Fly Ash Audit
were received in good condition unless
indicated below.

SAMPLE LISTING

Philip ID #	Sample ID	Date Sampled	Date Received
002888	Coal Fly Ash Audit-B	00/01/21	00/01/21

Comments:

Date 00/01/24

NOTICE OF SAMPLE RECEIPT-PHILIP ANALYTICAL SERVICES 00070

Attention: Scott Chestnut
Client: Best Environmental Inc.
Re Client Project: AES
FAX #: 510 278 4018
Phone #: 510 278 4011

Samples for: [illegible]
were received in good condition unless
indicated below.

SAMPLE LISTING

Philip ID #	Sample ID	Date Sampled	Date Received
002593	OH-Reagent Blank	00/01/11	00/01/19
002594	OH-Train Blank	00/01/11	00/01/19
002595	OH-Unit B Outlet-R1	00/01/11	00/01/19
002596	OH-Unit B Outlet-R2	00/01/12	00/01/19
002597	OH-Unit B Outlet-R3	00/01/12	00/01/19
002598	OH-Unit B Inlet-R1	00/01/11	00/01/19
002599	OH-Unit B Inlet-R2	00/01/12	00/01/19
002600	OH-Unit B Inlet-R3	00/01/12	00/01/19

Did not received audit fly ash sample

Comments: _____

Date 00/01/20

STANDARD LABORATORIES, INC.
P.O. Box 39, Freeburg, Illinois 62243 (618) 539-5836

Facsimile Communication

TO: Scott Chestnut

FROM: Jim Hutchison

DATE: 2-2-00

Number of pages 6 (including this cover sheet)

Comments:

X This will be followed by copy through the mail.

____ This will not be followed by copy through the mail.

This facsimile transmission is legally privileged and confidential information intended for the addressee named above. Any review, dissemination, or use of this information by persons other than addressee is strictly prohibited. All analytical reports, interpretations or data contained herein are preliminary information only. Problems inherent in fax technology prohibits Standard Laboratories, Inc. from guaranteeing or assuming any responsibility for the transmission of the following information. If you have received this facsimile in error, please notify us immediately by telephone at the number listed above. Thank you.

STANDARD LABORATORIES, INC.
8451 River King Dr. (Shipping)
Freeburg , IL 62243-0039

Lab No. 2000-00093-001->004

Date Rec'd. 1/20/2000

Date Sampled 1/11/2000 to 1/11/2000

Sampled By CLIENT

Page: 1 of 1
Date: 02/02/2000 08:40:43

Sample ID: 20000009301->004

P.O.# 9581

BEST ENVIRONMENTAL, INC.
15890 FOOTHILL BOULEVARD
SAN LEANDRO, CA 94578

ATTN: SCOTT CHESTNUT

TRACE ELEMENT		DRY BASIS	RESULTS	METHOD
Remark: FUEL ANALYSIS - INLET - RUN 1 - 01/11/2000 TIME: 14:23-17:13				
CHLORINE	CL	PPM	60	ASTM D2361-95 MOD
MERCURY	HG	PPM	0.03	ASTM D3684-94 - FICVAA
Remark: FUEL ANALYSIS - INLET - RUN 2 - 01/12/2000 TIME: 09:14-12:11				
CHLORINE	CL	PPM	< 50	ASTM D2361-95 MOD
MERCURY	HG	PPM	0.03	ASTM D3684-94 - FICVAA
Remark: FUEL ANALYSIS - INLET - RUN 3 - 01/12/2000 TIME: 13:42-16:39				
CHLORINE	CL	PPM	52	ASTM D2361-95 MOD
MERCURY	HG	PPM	0.02	ASTM D3684-94 - FICVAA
Remark: COAL FLY ASH AUDIT				
MERCURY	HG	PPM	0.12	ASTM D3684-94 - FICVAA

Respectfully Submitted, Pam Hutchison

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STANDARD LABORATORIES, INC.

8451 RIVER KING DRIVE, P.O. BOX 39, FREEBURG, IL 62243 (618) 539-5836

Date: 02/02/2000 08:43:56

QUALITY CONTROL INFORMATION

60 MESH MOISTURE METHOD: ASTM D3173-87 UNITS: % DET. LIMIT: 0.01
ANALYSIS DATE: 1/24/2000 TIME: 9:59 QUE LIST: 27753 TECHNICIAN: HS

QC TYPE	DESCRIPTION	RESULT	QC RESULT	KNOWN/SPIKE	QC VALUE
DUPLICATE	9901-2236-40D	4.90	4.91		0.2039

CHLORINE METHOD: D2361 UNITS: % DET. LIMIT: .01
ANALYSIS DATE: 1/24/2000 TIME: 0:00 QUE LIST: 27776 TECHNICIAN: TD

QC TYPE	DESCRIPTION	RESULT	QC RESULT	KNOWN/SPIKE	QC VALUE
BLANK	BLANK	0.0052			
DUPLICATE	9901-2232-22D	0.0951	0.0935		1.6967
KNOWN	NIST 1630A	0.1127		0.1144	98.5140
SPIKE	2000-93-1S	0.0060	0.1153	0.1080	101.2037
STANDARD	STANDARD	0.1030		0.1000	103.0

MERCURY METHOD: ASTM D3684-94 - FICVAUNITS: UG/G DET. LIMIT: 0.01
ANALYSIS DATE: 1/26/2000 TIME: 0:00 QUE LIST: 27816 TECHNICIAN: TJH

QC TYPE	DESCRIPTION	RESULT	QC RESULT	KNOWN/SPIKE	QC VALUE
BLANK	BLANK	< 0.01			
DUPLICATE	2000-74-1D	0.061	0.070		13.7405
DUPLICATE	2000-93-1D	0.026	0.029		10.9091
DUPLICATE	2000-93-4D	0.117	0.112		4.3668
KNOWN	NIST 1630A	0.109		0.106	102.8302
SPIKE	2000-80-1S	0.066	0.174	0.104	103.8462

SAMPLE 2000-93-1 -> 2000-93-4

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Freeburg , IL 62243-0039

Lab No. 2000-00093-001

Date Rec'd. 1/20/2000

Date Sampled 1/11/2000 to 1/11/2000

Sampled By CLIENT

Page: 1 of 3
Date: 02/02/2000 08:39:15

Sample ID: 20000009301

P.O.# 9581

BEST ENVIRONMENTAL, INC.
15890 FOOTHILL BOULEVARD
SAN LEANDRO, CA 94578

ATTN: SCOTT CHESTNUT

Remark: FUEL ANALYSIS - INLET - RUN 1 - 01/11/2000 TIME: 14:23-17:13

PROXIMATE ANALYSIS		As Received	Dry Basis
% Moisture	D3302	12.72	*****
% Ash	D3174	7.13	8.17
% Volatile	D3175	38.18	43.74
% Fixed Carbon	D3172	41.97	48.09
BTU	D1989	11121	12742
MAF-BTU	D1989	13876	
% Total Sulfur	D4239	0.58	0.67
SULFUR FORMS			
% Pyritic	D2492	*****	*****
% Sulfate	D2492	*****	*****
% Organic	D2492	*****	*****
% Total Sulfur	D4239	0.58	0.67
WATER SOLUBLE			
% Na2O	ASME1974	*****	*****
% K2O	ASME1974	*****	*****
% Chlorine	ASME1974	*****	*****
Alkalies as Na2O	ASME197	*****	*****

FUSION TEMP. OF ASH D1857	Reducing	Oxidizing
I.D.	*****	*****
H=W	*****	*****
H=1/2W	*****	*****
Fluid	*****	*****

GRINDABILITY INDEX D409 ***** @ ***** % Moist.
GRIND INDEX UNCONDITIONED ***** @ ***** % Moist.

FREE SWELLING INDEX D720 *****

Apparent Specific Gravity of Coal ModIC7113 *****

Equilibrium Moisture D1412 *****

ULTIMATE ANALYSIS		As Received	Dry Basis
		Weight %	
% Moisture	D3302	12.72	*****
% Carbon	D5373	62.75	71.89
% Hydrogen	D5373	4.83	5.53
% Nitrogen	D5373	1.54	1.77
% Chlorine	D2361	< 0.01	< 0.01
% Sulfur	D4239	0.58	0.67
% Ash	D3174	7.13	8.17
% Oxygen (Diff.)	D3176	10.44	11.96

MINERAL ANALYSIS D6349 %	Ignited Basis
Phos. Pentoxide, P2O5	*****
Silica, SiO2	*****
Ferric Oxide, Fe2O3	*****
Alumina, Al2O3	*****
Titania, TiO2	*****
Lime, CaO	*****
Magnesia, MgO	*****
Sulfur Trioxide, SO3	*****
Potassium Oxide, K2O	*****
Sodium Oxide, Na2O	*****
Barium Oxide, BaO	*****
Strontium Oxide, SrO	*****
Manganese Dioxide, MnO2	*****
Undetermined	*****
Type of Ash ASME1974	*****
Silica Value ASME1974	*****
T250 Deg B&W	*****
Base/Acid Ratio ASME1974	*****
lb Ash/mm BTU	*****
lb SO2/mm BTU	1.05
Fouling Index ASME1974	*****
Slagging Index ASME1974	*****

Respectfully Submitted, Pm Hutchison

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Lab No. 2000-00093-002

Date Rec'd. 1/20/2000

Date Sampled 1/12/2000 to 1/12/2000

Sampled By CLIENT

Page: 2 of 3
Date: 02/02/2000 08:39:17

Sample ID: 20000009302

P.O.# 9581

BEST ENVIRONMENTAL, INC.
15890 FOOTHILL BOULEVARD
SAN LEANDRO, CA 94578

ATTN: SCOTT CHESTNUT

Remark: FUEL ANALYSIS - INLET - RUN 2 - 01/12/2000 TIME: 09:14-12:11

PROXIMATE ANALYSIS		As Received	Dry Basis
% Moisture	D3302	12.79	*****
% Ash	D3174	7.01	8.04
% Volatile	D3175	37.83	43.38
% Fixed Carbon	D3172	42.37	48.58
BTU	D1989	11113	12743
MAF-BTU	D1989	13857	
% Total Sulfur	D4239	0.57	0.65
SULFUR FORMS			
% Pyritic	D2492	*****	*****
% Sulfate	D2492	*****	*****
% Organic	D2492	*****	*****
% Total Sulfur	D4239	0.57	0.65
WATER SOLUBLE			
% Na2O	ASME1974	*****	*****
% K2O	ASME1974	*****	*****
% Chlorine	ASME1974	*****	*****
Alkalies as Na2O	ASME197	*****	*****
FUSION TEMP. OF ASH	D1857	Reducing	Oxidizing
I.D.		*****	*****
I=W		*****	*****
I=1/2W		*****	*****
Fluid		*****	*****
GRINDABILITY INDEX	D409	***** @	***** % Moist.
GRIND INDEX UNCONDITIONED		***** @	***** % Moist.
FREE SWELLING INDEX	D720	*****	
Apparent Specific Gravity of Coal	ModIC7113	*****	
Equilibrium Moisture	D1412	*****	

ULTIMATE ANALYSIS		Weight % As Received	Dry Basis
% Moisture	D3302	12.79	*****
% Carbon	D5373	62.22	71.39
% Hydrogen	D5373	4.66	5.34
% Nitrogen	D5373	1.42	1.63
% Chlorine	D2361	< 0.01	< 0.01
% Sulfur	D4239	0.57	0.65
% Ash	D3174	7.01	8.04
% Oxygen (Diff.)	D3176	11.33	12.99
MINERAL ANALYSIS	D6349 %	Ignited	Basis
Phos. Pentoxide,	P2O5		*****
Silica,	SiO2		*****
Ferric Oxide,	Fe2O3		*****
Alumina,	Al2O3		*****
Titania,	TiO2		*****
Lime,	CaO		*****
Magnesia,	MgO		*****
Sulfur Trioxide,	SO3		*****
Potassium Oxide,	K2O		*****
Sodium Oxide,	Na2O		*****
Barium Oxide,	BaO		*****
Strontium Oxide,	SrO		*****
Manganese Dioxide,	MnO2		*****
Undetermined			*****
Type of Ash	ASME1974		*****
Silica Value	ASME1974		*****
T250 Deg	B&W		*****
Base/Acid Ratio	ASME1974		*****
lb Ash/mm BTU			*****
lb SO2/mm BTU			1.02
Fouling Index	ASME1974		*****
Slagging Index	ASME1974		*****

Respectfully Submitted, Pam Hutchison

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Lab No. 2000-00093-003

Date Rec'd. 1/20/2000

Date Sampled 1/12/2000 to 1/12/2000

Sampled By CLIENT

Page: 3 of 3
Date: 02/02/2000 08:39:19

Sample ID: 20000009303

P.O.# 9581

BEST ENVIRONMENTAL, INC.
15890 FOOTHILL BOULEVARD
SAN LEANDRO, CA 94578

ATTN: SCOTT CHESTNUT

Remark: FUEL ANALYSIS - INLET - RUN 3 - 01/12/2000 TIME: 13:42-16:39

PROXIMATE ANALYSIS		As Received	Dry Basis
% Moisture	D3302	13.00	*****
% Ash	D3174	7.70	8.85
% Volatile	D3175	36.82	42.32
% Fixed Carbon	D3172	42.48	48.83
BTU	D1989	10984	12625
MAF-BTU	D1989	13851	
% Total Sulfur	D4239	0.57	0.66
SULFUR FORMS			
% Pyritic	D2492	*****	*****
% Sulfate	D2492	*****	*****
% Organic	D2492	*****	*****
% Total Sulfur	D4239	0.57	0.66
WATER SOLUBLE			
% Na2O	ASME1974	*****	*****
% K2O	ASME1974	*****	*****
% Chlorine	ASME1974	*****	*****
Alkalies as Na2O	ASME197	*****	*****

FUSION TEMP. OF ASH D1857	Reducing	Oxidizing
I.D.	*****	*****
H=W	*****	*****
H=1/2W	*****	*****
Fluid	*****	*****

GRINDABILITY INDEX D409 ***** @ ***** % Moist.
GRIND INDEX UNCONDITIONED ***** @ ***** % Moist.

FREE SWELLING INDEX D720 *****

Apparent Specific Gravity of Coal ModIC7113 *****

Equilibrium Moisture D1412 *****

ULTIMATE ANALYSIS		Weight % As Received	Dry Basis
% Moisture	D3302	13.00	*****
% Carbon	D5373	63.32	72.78
% Hydrogen	D5373	4.62	5.31
% Nitrogen	D5373	1.48	1.70
% Chlorine	D2361	< 0.01	< 0.01
% Sulfur	D4239	0.57	0.66
% Ash	D3174	7.70	8.85
% Oxygen (Diff.)	D3176	9.31	10.69

MINERAL ANALYSIS D6349	% Ignited	Basis
Phos. Pentoxide, P2O5		*****
Silica, SiO2		*****
Ferric Oxide, Fe2O3		*****
Alumina, Al2O3		*****
Titania, TiO2		*****
Lime, CaO		*****
Magnesia, MgO		*****
Sulfur Trioxide, SO3		*****
Potassium Oxide, K2O		*****
Sodium Oxide, Na2O		*****
Barium Oxide, BaO		*****
Strontium Oxide, SrO		*****
Manganese Dioxide, MnO2		*****
Undetermined		*****
Type of Ash	ASME1974	*****
Silica Value	ASME1974	*****
T250 Deg	B&W	*****
Base/Acid Ratio	ASME1974	*****
lb Ash/mm BTU		*****
lb SO2/mm BTU		1.04
Fouling Index	ASME1974	*****
Slagging Index	ASME1974	*****

Respectfully Submitted, Tim Hedelson

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Lab No. 2000-00093-001

Date Rec'd. 1/20/2000

Date Sampled 1/11/2000 to 1/11/2000

Sampled By CLIENT

Date: 02/02/2000 08:39:15

Sample ID: 20000009301

P.O.# 9581

BEST ENVIRONMENTAL, INC.
15890 FOOTHILL BOULEVARD
SAN LEANDRO, CA 94578

ATTN: SCOTT CHESTNUT

Remark: FUEL ANALYSIS - INLET - RUN 1 - 01/11/2000 TIME: 14:23-17:13

PROXIMATE ANALYSIS		As Received	Dry Basis
% Moisture	D3302	12.72	*****
% Ash	D3174	7.13	8.17
% Volatile	D3175	38.18	43.74
% Fixed Carbon	D3172	41.97	48.09
BTU	D1989	11121	12742
MAF-BTU	D1989	13876	
% Total Sulfur	D4239	0.58	0.67
SULFUR FORMS			
% Pyritic	D2492	*****	*****
% Sulfate	D2492	*****	*****
% Organic	D2492	*****	*****
% Total Sulfur	D4239	0.58	0.67
WATER SOLUBLE			
% Na2O	ASME1974	*****	*****
% K2O	ASME1974	*****	*****
% Chlorine	ASME1974	*****	*****
Alkalies as Na2O	ASME197	*****	*****

FUSION TEMP. OF ASH D1857	Reducing	Oxidizing
I.D.	*****	*****
H=W	*****	*****
H=1/2W	*****	*****
Fluid	*****	*****

GRINDABILITY INDEX D409 ***** @ ***** % Moist.
GRIND INDEX UNCONDITIONED ***** @ ***** % Moist.

FREE SWELLING INDEX D720 *****

Apparent Specific Gravity of Coal ModIC7113 *****

% Equilibrium Moisture D1412 *****

ULTIMATE ANALYSIS		Weight % As Received	Weight % Dry Basis
% Moisture	D3302	12.72	*****
% Carbon	D5373	62.75	71.89
% Hydrogen	D5373	4.83	5.53
% Nitrogen	D5373	1.54	1.77
% Chlorine	D2361	< 0.01	< 0.01
% Sulfur	D4239	0.58	0.67
% Ash	D3174	7.13	8.17
% Oxygen (Diff.)	D3176	10.44	11.96

MINERAL ANALYSIS D6349 %	Ignited Basis
Phos. Pentoxide, P2O5	*****
Silica, SiO2	*****
Ferric Oxide, Fe2O3	*****
Alumina, Al2O3	*****
Titania, TiO2	*****
Lime, CaO	*****
Magnesia, MgO	*****
Sulfur Trioxide, SO3	*****
Potassium Oxide, K2O	*****
Sodium Oxide, Na2O	*****
Barium Oxide, BaO	*****
Strontium Oxide, SrO	*****
Manganese Dioxide, MnO2	*****
Undetermined	*****
Type of Ash ASME1974	*****
Silica Value ASME1974	*****
T250 Deg B&W	*****
Base/Acid Ratio ASME1974	*****
lb Ash/mm BTU	*****
lb SO2/mm BTU	1.05
Fouling Index ASME1974	*****
Slagging Index ASME1974	*****

Respectfully Submitted, Pam Hutchison

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Lab No. 2000-00093-002

Date Rec'd. 1/20/2000

Date Sampled 1/12/2000 to 1/12/2000

Sampled By CLIENT

Date: 02/02/2000 08:39:17

Sample ID: 20000009302

P.O.# 9581

BEST ENVIRONMENTAL, INC.
15890 FOOTHILL BOULEVARD
SAN LEANDRO, CA 94578

ATTN: SCOTT CHESTNUT

Remark: FUEL ANALYSIS - INLET - RUN 2 - 01/12/2000 TIME: 09:14-12:11

PROXIMATE ANALYSIS		As Received	Dry Basis
% Moisture	D3302	12.79	*****
% Ash	D3174	7.01	8.04
% Volatile	D3175	37.83	43.38
% Fixed Carbon	D3172	42.37	48.58
BTU	D1989	11113	12743
MAF-BTU	D1989	13857	
% Total Sulfur	D4239	0.57	0.65
SULFUR FORMS			
% Pyritic	D2492	*****	*****
% Sulfate	D2492	*****	*****
% Organic	D2492	*****	*****
% Total Sulfur	D4239	0.57	0.65
WATER SOLUBLE			
% Na2O	ASME1974	*****	*****
% K2O	ASME1974	*****	*****
% Chlorine	ASME1974	*****	*****
Alkalies as Na2O	ASME197	*****	*****

FUSION TEMP. OF ASH D1857	Reducing	Oxidizing
I.D.	*****	*****
H=W	*****	*****
H=1/2W	*****	*****
Fluid	*****	*****

GRINDABILITY INDEX D409 ***** @ ***** % Moist.
GRIND INDEX UNCONDITIONED ***** @ ***** % Moist.

FREE SWELLING INDEX D720 *****

Apparent Specific Gravity of Coal ModIC7113 *****

% Equilibrium Moisture D1412 *****

ULTIMATE ANALYSIS		Weight % As Received	Dry Basis
% Moisture	D3302	12.79	*****
% Carbon	D5373	62.22	71.35
% Hydrogen	D5373	4.66	5.34
% Nitrogen	D5373	1.42	1.63
% Chlorine	D2361	< 0.01	< 0.01
% Sulfur	D4239	0.57	0.65
% Ash	D3174	7.01	8.04
% Oxygen (Diff.)	D3176	11.33	12.99

MINERAL ANALYSIS D6349 %	Ignited Basis
Phos. Pentoxide, P2O5	*****
Silica, SiO2	*****
Ferric Oxide, Fe2O3	*****
Alumina, Al2O3	*****
Titania, TiO2	*****
Lime, CaO	*****
Magnesia, MgO	*****
Sulfur Trioxide, SO3	*****
Potassium Oxide, K2O	*****
Sodium Oxide, Na2O	*****
Barium Oxide, BaO	*****
Strontium Oxide, SrO	*****
Manganese Dioxide, MnO2	*****
Undetermined	*****
Type of Ash ASME1974	*****
Silica Value ASME1974	*****
T250 Deg B&W	*****
Base/Acid Ratio ASME1974	*****
lb Ash/mm BTU	*****
lb SO2/mm BTU	1.02
Fouling Index ASME1974	*****
Slagging Index ASME1974	*****

Respectfully Submitted, Pam Hutchison

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Lab No. 2000-00093-003

Date Rec'd. 1/20/2000

Date Sampled 1/12/2000 to 1/12/2000

Sampled By CLIENT

Date: 02/02/2000 08:39:19

Sample ID: 20000009303

P.O.# 9581

BEST ENVIRONMENTAL, INC.
15890 FOOTHILL BOULEVARD
SAN LEANDRO, CA 94578

ATTN: SCOTT CHESTNUT

Remark: FUEL ANALYSIS - INLET - RUN 3 - 01/12/2000 TIME: 13:42-16:39

PROXIMATE ANALYSIS		As Received	Dry Basis
% Moisture	D3302	13.00	*****
% Ash	D3174	7.70	8.85
% Volatile	D3175	36.82	42.32
% Fixed Carbon	D3172	42.48	48.83
BTU	D1989	10984	12625
MAF-BTU	D1989	13851	
% Total Sulfur	D4239	0.57	0.66
SULFUR FORMS			
% Pyritic	D2492	*****	*****
% Sulfate	D2492	*****	*****
% Organic	D2492	*****	*****
% Total Sulfur	D4239	0.57	0.66
WATER SOLUBLE			
% Na2O	ASME1974	*****	*****
% K2O	ASME1974	*****	*****
% Chlorine	ASME1974	*****	*****
Alkalies as Na2O	ASME197	*****	*****

FUSION TEMP. OF ASH D1857	Reducing	Oxidizing
I.D.	*****	*****
H=W	*****	*****
H=1/2W	*****	*****
Fluid	*****	*****

GRINDABILITY INDEX D409 ***** @ ***** % Moist.
GRIND INDEX UNCONDITIONED ***** @ ***** % Moist.

FREE SWELLING INDEX D720 *****

Apparent Specific Gravity of Coal ModIC7113 *****

% Equilibrium Moisture D1412 *****

ULTIMATE ANALYSIS		Weight % As Received	Dry Basis
% Moisture	D3302	13.00	*****
% Carbon	D5373	63.32	72.78
% Hydrogen	D5373	4.62	5.31
% Nitrogen	D5373	1.48	1.70
% Chlorine	D2361	< 0.01	< 0.01
% Sulfur	D4239	0.57	0.66
% Ash	D3174	7.70	8.85
% Oxygen (Diff.)	D3176	9.31	10.69

MINERAL ANALYSIS D6349	% Ignited Basis
Phos. Pentoxide, P2O5	*****
Silica, SiO2	*****
Ferric Oxide, Fe2O3	*****
Alumina, Al2O3	*****
Titania, TiO2	*****
Lime, CaO	*****
Magnesia, MgO	*****
Sulfur Trioxide, SO3	*****
Potassium Oxide, K2O	*****
Sodium Oxide, Na2O	*****
Barium Oxide, BaO	*****
Strontium Oxide, SrO	*****
Manganese Dioxide, MnO2	*****
Undetermined	*****
Type of Ash ASME1974	*****
Silica Value ASME1974	*****
T250 Deg B&W	*****
Base/Acid Ratio ASME1974	*****
lb Ash/mm BTU	*****
lb SO2/mm BTU	1.04
Fouling Index ASME1974	*****
Slagging Index ASME1974	*****

Respectfully Submitted,

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Lab No. 2000-00093-001->004

Date Rec'd. 1/20/2000

Date Sampled 1/11/2000 to 1/11/2000

Sampled By CLIENT

Date: 02/02/2000 08:40:43

Sample ID: 20000009301->004

P.O.# 9581

BEST ENVIRONMENTAL, INC.
15890 FOOTHILL BOULEVARD
SAN LEANDRO, CA 94578

ATTN: SCOTT CHESTNUT

TRACE ELEMENT	DRY BASIS		RESULTS	METHOD
Remark: FUEL ANALYSIS - INLET - RUN 1 - 01/11/2000 TIME: 14:23-17:13				
CHLORINE	CL	PPM	60	ASTM D2361-95 MOD
MERCURY	HG	PPM	0.03	ASTM D3684-94 - FICVAA
Remark: FUEL ANALYSIS - INLET - RUN 2 - 01/12/2000 TIME: 09:14-12:11				
CHLORINE	CL	PPM	< 50	ASTM D2361-95 MOD
MERCURY	HG	PPM	0.03	ASTM D3684-94 - FICVAA
Remark: FUEL ANALYSIS - INLET - RUN 3 - 01/12/2000 TIME: 13:42-16:39				
CHLORINE	CL	PPM	52	ASTM D2361-95 MOD
MERCURY	HG	PPM	0.02	ASTM D3684-94 - FICVAA
Remark: COAL FLY ASH AUDIT				
MERCURY	HG	PPM	0.12	ASTM D3684-94 - FICVAA

Respectfully Submitted, Pam Atkinson

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STANDARD LABORATORIES, INC.

8451 RIVER KING DRIVE, P.O. BOX 39, FREEBURG, IL 62243 (618) 539-5836

Date: 02/02/2000 08:43:56

QUALITY CONTROL INFORMATION

60 MESH MOISTURE METHOD: ASTM D3173-87 UNITS: % DET. LIMIT: 0.01
ANALYSIS DATE: 1/24/2000 TIME: 9:59 QUE LIST: 27753 TECHNICIAN: HS

QC TYPE	DESCRIPTION	RESULT	QC RESULT	KNOWN/SPIKE	QC VALUE
DUPLICATE	9901-2238-40D	4.90	4.91		0.2039

CHLORINE METHOD: D2361 UNITS: % DET. LIMIT: .01
ANALYSIS DATE: 1/24/2000 TIME: 0:00 QUE LIST: 27776 TECHNICIAN: TD

QC TYPE	DESCRIPTION	RESULT	QC RESULT	KNOWN/SPIKE	QC VALUE
BLANK	BLANK	0.0052			
DUPLICATE	9901-2232-22D	0.0951	0.0935		1.6967
KNOWN	NIST 1630A	0.1127		0.1144	98.5140
SPIKE	2000-93-1S	0.0060	0.1153	0.1080	101.2037
STANDARD	STANDARD	0.1030		0.1000	103.0

MERCURY METHOD: ASTM D3684-94 - FICVAUNITS: UG/G DET. LIMIT: 0.01
ANALYSIS DATE: 1/26/2000 TIME: 0:00 QUE LIST: 27816 TECHNICIAN: TJH

QC TYPE	DESCRIPTION	RESULT	QC RESULT	KNOWN/SPIKE	QC VALUE
BLANK	BLANK	< 0.01			
DUPLICATE	2000-74-1D	0.061	0.070		13.7405
DUPLICATE	2000-93-1D	0.026	0.029		10.9091
DUPLICATE	2000-93-4D	0.117	0.112		4.3668
KNOWN	NIST 1630A	0.109		0.106	102.8302
SPIKE	2000-80-1S	0.066	0.174	0.104	103.8462

SAMPLE 2000-93-1 -> 2000-93-4

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APPENDIX
E - Audit Data Sheets

National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material 1633b

Constituent Elements in Coal Fly Ash

This Standard Reference Material (SRM) is intended for use in the evaluation of analytical methods for the determination of constituent elements in coal fly ash or materials with a similar matrix. SRM 1633b is a bituminous coal fly ash that was sieved through a nominal sieve opening of 90 μm (170 mesh) and then blended to assure homogeneity. A unit of SRM 1633b consists of 75 g of powdered material.

The certified values for the constituent elements are given in Table 1. The values, except for Hg, are based on measurements using one definitive method or two or more independent and reliable analytical techniques. Noncertified values for a number of elements are given in Table 2 as additional information on the composition of the material. The noncertified values should not be used for calibration or quality control. Analytical methods used for the certification of this SRM are given in Table 3 along with analysts and cooperating laboratories. All values are based on measurements using a dry sample weight of at least 250 mg.

NOTICE AND WARNING TO USERS

Expiration of Certification: This certification is valid for 5 years from the date of shipment from NIST. Should any of the certified values change before the expiration of the certification, the purchaser will be notified by NIST.

Stability: This material is considered to be stable; however, its stability has not been rigorously assessed. NIST will monitor this material and will report any substantive changes in certification to the purchaser.

Use: A minimum dry sample weight (see Instructions for Drying) of 250 mg should be used for analytical determinations to be related to the certified values on this Certificate of Analysis.

To obtain the certified values, sample preparation procedures should be designed to affect complete dissolution. If volatile elements (e.g., Hg, As, Se) are to be determined, precautions should be taken in the dissolution of SRM 1633b to avoid volatilization losses.

Statistical consultation was provided by S.B. Schiller of the NIST Statistical Engineering Division.

The overall direction and coordination of the analyses were under the chairmanship of R.R. Greenberg of the NIST Inorganic Analytical Research Division.

The technical and support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by J.S. Kane.

Gaithersburg, MD 20899
June 22, 1993

Thomas E. Gills, Acting Chief
Standard Reference Materials Program

(over)

Instructions for Drying: When non-volatile elements are being determined, this material should be dried to constant weight before using. Recommended procedures for drying are: 1) Vacuum drying for 24 h at ambient temperature using a cold trap at or below -50 °C and a pressure not greater than 0.2 mm Hg (30 Pa); 2) drying for 2 h in an oven of 105 °C. Samples of the dried material weighing at least 250 mg should be used for analysis. When not in use, the material should be kept in a tightly sealed bottle. Volatile elements should be determined on an as-received basis, and corrected to dry weight. Correction should be based on a separate determination of moisture, using one of the above drying procedures.

Source and Preparation of the Material: The fly ash was supplied by a coal fired power plant and is the product of Pennsylvania and West Virginia coals. It was selected as a typical bituminous coal fly ash and is not intended as a fly ash from a specific coal or combustion process. The material was air dried, sieved, and blended for 24 h, before being placed in a series of bulk containers. X-ray fluorescence and inductively coupled plasma atomic emission analyses were performed on ten grab samples taken from the bulk for a preliminary homogeneity assessment before proceeding with bottling the material in 75 g units.

Analysis: The homogeneity of the bottled material was assessed by X-ray fluorescence spectrometry and instrumental neutron activation analysis, using selected elements as indicators. In some cases, statistically significant differences between samples were seen, and the variance due to material inhomogeneity is included in the overall uncertainties of the certified values. The estimated relative standard deviation for material inhomogeneity is less than 1% for those elements for which homogeneity was assessed, except Th, for which material inhomogeneity was estimated to be 2%.

Certified Values and Uncertainties: The certified values are weighted means of results of two or more independent analytical methods, or the means of results from a single definitive method, except for mercury. Mercury certification is based on cold vapor atomic absorption spectrometry measurements performed at NIST. The weights for the weighted means were computed according to the iterative procedure of Paule and Mandel (NBS Journal of Research 87, 1982, pp. 377-385). The stated uncertainty includes allowances for measurement imprecision, material variability, and differences among analytical methods. Each uncertainty is the sum of the half-width of a 95% prediction interval, and includes an allowance for the systematic error among the methods used. In the absence of systematic error, a 95% prediction interval predicts where the true concentrations of 95% of the samples of this SRM lie.

144-A

Table 1. Certified Values

Element	wt %			Element	mg/kg		
Aluminum	15.05	±	0.27	Arsenic	136.2	±	2.6
Calcium	1.51	±	0.06	Barium	709	±	27
Iron	7.78	±	0.23	Cadmium	0.784	±	0.006
Magnesium	0.482	±	0.008	Chromium	198.2	±	4.7
Potassium	1.95	±	0.03	Copper	112.8	±	2.6
Silicon	23.02	±	0.08	Lead	68.2	±	1.1
Sodium	0.201	±	0.003	Manganese	131.8	±	1.7
Sulfur	0.2075	±	0.0011	Mercury	0.141	±	0.019
Titanium	0.791	±	0.014	Nickel	120.6	±	1.8
				Selenium	10.26	±	0.17
				Strontium	1041	±	14
				Thorium	25.7	±	1.3
				Uranium	8.79	±	0.36
				Vanadium	295.7	±	3.6

Table 2. Noncertified Values

Element	mg/kg	Element	mg/kg
Antimony	6	Phosphorus	2300
Bromine	2.9	Rubidium	140
Cerium	190	Scandium	41
Cobalt	50	Samarium	20
Cesium	11	Tantalum	1.8
Dysprosium	17	Terbium	2.6
Europium	4.1	Thallium	5.9
Gadolinum	13	Thulium	2.1
Hafnium	6.8	Tungsten	5.6
Holmium	3.5	Ytterbium	7.6
Lanthanum	94	Zinc	210
Lutetium	1.2		
Neodymium	85		

Table 3. Analytical Methods Used for Certification Analyses of SRM 1633b

Element	Certification Methods
Al	INAA, XRF
As	FIA-HAAS, INAA
Ba	ICP-MS, INAA
Ca	ICP, INAA, XRF
Cd	ETAAS, IDTIMS
Cr	FAAS, INAA
Cu	FAAS, ICP-MS
Fe	INAA, XRF
Hg	CVAAS
K	FAES, INAA, XRF
Mg	ICP, IDTIMS
Mn	FAAS, INAA
Na	FAES, INAA
Ni	ETAAS, ICP
Pb	ETAAS, ICP-MS
Rb	FAES, INAA
S	IDTIMS
Sb	ETAAS, INAA
Se	FIA-HAAS, INAA
Si	GRAV, XRF
Sr	FAES, INAA, IDTIMS
Th	ICP-MS, INAA
Ti	INAA, XRF
U	ICP-MS, INAA
V	ICP, INAA

ID-TIMS - Isotope dilution thermal ionization mass spectrometry, mixed acid digestion.
ICP-MS - Inductively coupled plasma mass spectrometry; mixed acid digestion.
INAA - Instrumental neutron activation analysis.
XRF - Wavelength dispersive X-ray fluorescence on fused borate discs.
ICP-AES - Inductively coupled plasma atomic emission spectrometry; mixed acid digestion.
ETAAS - Electrothermal atomic absorption spectrometry; mixed acid digestion.
CVAAS - Cold vapor atomic absorption spectrometry.
FIA-HAAS - Flow injection analyses - Hydride generation atomic absorption spectrometry.
FAAS - Flame atomic absorption spectrometry; mixed acid digestion except for Au, leached with $HBr\text{-}Br_2$.
GRAV - Gravimetry; sodium carbonate fusion.

Most information values were determined by INAA only; P was determined by ICP-AES and XRF, Tl was determined by ICP-MS, and Zn was determined by FAAS and ICP-AES.

Participating NIST Analysts

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U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

STANDARD REFERENCE MATERIALS PACKING SLIP

JMM

ADDRESS: 100 BUREAU DRIVE STOP 2322 GAITHERSBURG, MD 20899-2322 TELEPHONE: (301)975-OSRM(6776) FAX: (301)948-3730

ORDER #	ORDER DATE	SHIP DATE	REQUESTED SHIP DATE	CUSTOMER P.O.	SHIP VIA	PAGE
20028189	12/20/99		12/20/99	9571	U.P.S.	1

PHONE ORDER NEW ACCOUNT

CUSTOMER ACCOUNT #: 22992 SHIP ACCT #: 00000

SHIP TO:
BEST ENVIRONMENTAL
BEST ENVIRONMENTAL
15890 FOOTHILL BLVD

SAN LEANDRO CA 94578

SOLD TO:
BEST ENVIRONMENTAL
ACCOUNTS PAYABLE
15890 FOOTHILL BLVD

SAN LEANDRO CA 94578

Order discrepancies (other than back ordered items) must be reported to our Customer Relations Department at 301-975-6776 within 5 days of receipt of shipment or this order will be considered complete. NIST SRMs/RMs are generally not returnable - with the exception of defective goods or shipments made in error by NIST. To return a SRM/RM, please call for instructions and a Return SRM/RM Authorization Number before shipment. Returns WILL NOT BE ACCEPTED without prior authorization.

	ITEM #	DESCRIPTION		QUANTITY ORDERED	QUANTITY SHIPPED	QUANTITY BACK ORDERED
	1633B	COAL FLY ASH VALUE 279.00		1	1	

PACKED BY TOTAL PKGS TOTAL WEIGHT INSPECTED BY

SRM Number: 1633b
MSDS Number: 1633b
SRM Name: Constituent Elements in Coal Fly Ash
Issued: September, 1995

MATERIAL SAFETY DATA SHEET

National Institute of Standards and Technology
Standard Reference Materials Program
Gaithersburg, Maryland 20899
(301) 975-2019

SECTION I. MATERIAL IDENTIFICATION

Material Name: Constituents in Coal Fly Ash

Description: Coal is formed naturally from fossilized plants, consisting of amorphous carbon with various organic and inorganic compounds. These compounds form conjugated polyaromatic, polyunsaturated and polysaturated ring structures with heterocycles containing oxygen, nitrogen and sulfur. Bituminous coal includes coal between anthracite (the hardest coal) and lignite (the softest), with a fixed carbon < 86% and volatile matter > 14%. Coal fly ash is a byproduct of coal.

This SRM is 75 grams of a bituminous coal fly ash that was sieved through a nominal sieve opening of 90 μm (170 mesh) and then blended to assure homogeneity.

Other Designations: Constituents in Bituminous Coal Fly Ash

Chemical Formula: N/A

CAS Reg. No.: N/A

DOT Classification: Not regulated by DOT.

Manufacturer/Supplier: SRM 1633b was supplied by a coal fired plant.

SECTION II. HAZARDOUS INGREDIENTS

Hazardous Ingredient	Nominal Concentration (%)	Limits and Toxicity Data*
Coal Fly Ash	~100	ACGIH TLV-TWA:
alumina**		2 mg/m^3 (respirable dust fraction
iron oxide**		with >5% SiO_2)
zinc oxide**		
calcium oxide**		OSHA PEL-TWA:
copper**		2 mg/m^3 (respirable dust fraction
titanium**		with >5% SiO_2)
magnesium**		
other***		

*Limits and toxicity data applied to coal ash compound as a whole - **NOT** the individual components. Limits based on bituminous coal.

**Major components of coal fly ash.

***This material is certified for its elemental composition. For the actual certified elements and their values, refer to the corresponding Certificate of Analysis.

SECTION III. PHYSICAL/CHEMICAL CHARACTERISTICS

Coal Fly Ash

Appearance and Odor: Black powder with little or no odor.
Relative Molecular Mass: Not applicable
Solubility in Water: Negligible

SECTION IV. FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A

Method Used: N/A

Autoignition Temperature: N/A

Flammability Limits in Air (Volume %): **UPPER:** N/A
LOWER: N/A

Extinguishing Media: Use dry chemical, carbon dioxide, water spray or alcohol-resistant foam.

Special Fire Procedures: Fire-fighters should wear a self-contained breathing apparatus (SCBA) with a full face piece operated in the pressure-demand or positive-pressure mode and full protective gear.

Unusual Fire and Explosion Hazards: No unusual fire hazards are associated with this material.

SECTION V. REACTIVITY DATA

Stability: __X__ **Stable** _____ **Unstable**

Conditions to Avoid: Avoid creating dust.

Incompatibility (Materials to Avoid): No incompatible materials.

Hazardous Decomposition or Byproducts: Coal fly ash is a thermal oxidative product of coal; soot may also be produced.

Hazardous Polymerization: _____ **Will Occur** __X__ **Will Not Occur**

SECTION VI. HEALTH HAZARD DATA

Route of Entry: __X__ **Inhalation** __X__ **Skin** __X__ **Ingestion**

Health Hazards (Acute and Chronic): Prolonged exposure to coal and coal byproducts may result in *coalworker's pneumoconiosis*. This is the occupational disease caused by abnormal amounts of the dust in the lungs. It can occur after years of excessive exposure to respirable coal dust in coal mining, handling, and

processing. Since anthracite and hard coal dusts in the respirable size have greater mass, the risk of developing *pneumoconiosis* diminishes as one proceeds from anthracite (hard coal) to lignite (soft coal). Respirable quartz particulate can be simultaneously present in coal as well as the ash. In general, coal dust is deposited in the lungs like quartz, but requires over ten times as much for adverse effects. There are two forms of *coalworkers pneumoconiosis*: simple and complicated (progressive massive fibrosis). Simple *pneumoconiosis* results from inhalation and retention of excessive airborne dust; reticulin fibers form, but little collagen is generated. Complicated *pneumoconiosis* develops in lungs that are already affected by simple *pneumoconiosis*. Masses of fibrous tissue appear and gradually distort pulmonary architecture. In advanced cases, coal workers' *pneumoconiosis* does may progress beyond the simple stage.

Signs and Symptoms of Exposure: Acute effects of excessive inhalation include coughing, wheezing and shortness of breath. Long term effects include chronic *bronchitis* (chronic or acute inflammation of the mucous membrane of the bronchial tubes) and *emphysema* (a condition of the lungs in which there is dilation of the air vesicles following atrophy of the *septa* (a thin partition or membrane between to cavities or soft masses of tissue), resulting in labored breathing and increased susceptibility to infection). Individuals having rheumatoid arthritis in conjunction with *coal workers' pneumoconiosis* may have rapidly developing lung damage - *Caplan's Syndrome*.

See Section VI: Health Hazards Acute and Chronic.

Medical Conditions Generally Aggravated by Exposure: Any individual with a chronic pulmonary disorder.

Listed as a Carcinogen/Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens	___	X
In the International Agency for Research (IARC) Monograph	___	X
By the Occupational Safety and Health Administration (OSHA)	___	X

EMERGENCY AND FIRST AID PROCEDURES:

Skin Contact: Remove contaminated shoes and clothing. Rinse affected area with large amounts of water followed by washing the area with soap and water. Watch for chemical irritations and treat them accordingly. Contact medical assistance if necessary.

Eye Contact: Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 minutes. Contact medical assistance if necessary.

Inhalation: If inhaled, move the victim to fresh air. If breathing is difficult, give oxygen; if the victim is not breathing, give artificial respiration. Contact medical assistance if necessary.

Ingestion: If ingestion occurs, wash out mouth with water. If the victim is conscious, give one or two glasses of water to drink and then induce vomiting. Never give anything by mouth to someone who is unconscious or convulsing. Contact medical assistance if necessary.

Note to Physician: There is no specific treatment for coalworkers' pneumoconiosis. Medical surveillance is essential to prevention. Perform regular chest x-rays

examinations for individuals at risk. Simple pneumoconiosis is detectable by x-ray as round, irregular, 1 to 5 mm diameter "coal macules." Remove individuals diagnosed with simple pneumoconiosis from dusty environments.

TARGET ORGAN(S) OF ATTACK: The lungs.

SECTION VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be taken in Case Material is Released or Spilled: Notify safety personnel of major spills and/or leaks. Evacuate nonessential personnel. Cleanup personnel should be protected against dust inhalation and eye contact. Clean up dust in a manner that avoids dispersing particulates into the air or environment.

Waste Disposal: Follow all Federal, state and local laws governing disposal.

Handling and Storage: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the TLV Local exhaust ventilation is preferred since it prevents contaminant dispersing into the work area by controlling it at its source. Persons handling this material must wear protective eyewear, clothing and gloves to prevent contact with this material.

> **Note:** Contact lenses pose a special problem; soft lenses may absorb irritants and all lenses concentrate them. **DO NOT** wear contact lenses in the lab.

Store material in a cool, dry, well ventilated area. Protect containers from physical damage.

SECTION VIII. SOURCE DATA/OTHER COMMENTS

Sources: Genium Publishing Corporation, MSDS No. 491 *Coal Dust, Bituminous,* August, 1990.
Potomac Electric Power Company, MSDS *Bituminous Coal Ash*, November 1985.
Hawley's Condensed Chemical Dictionary, 11th ed., 1987.
Stedman's Medical Dictionary, 24th ed., 1984.
Webster's Ninth New Collegiate Dictionary, 1990.

Carmelita S. Davis (301) 975-6439
National Institute of Standards and Technology
Standard Reference Materials Program
Gaithersburg, Maryland 20899

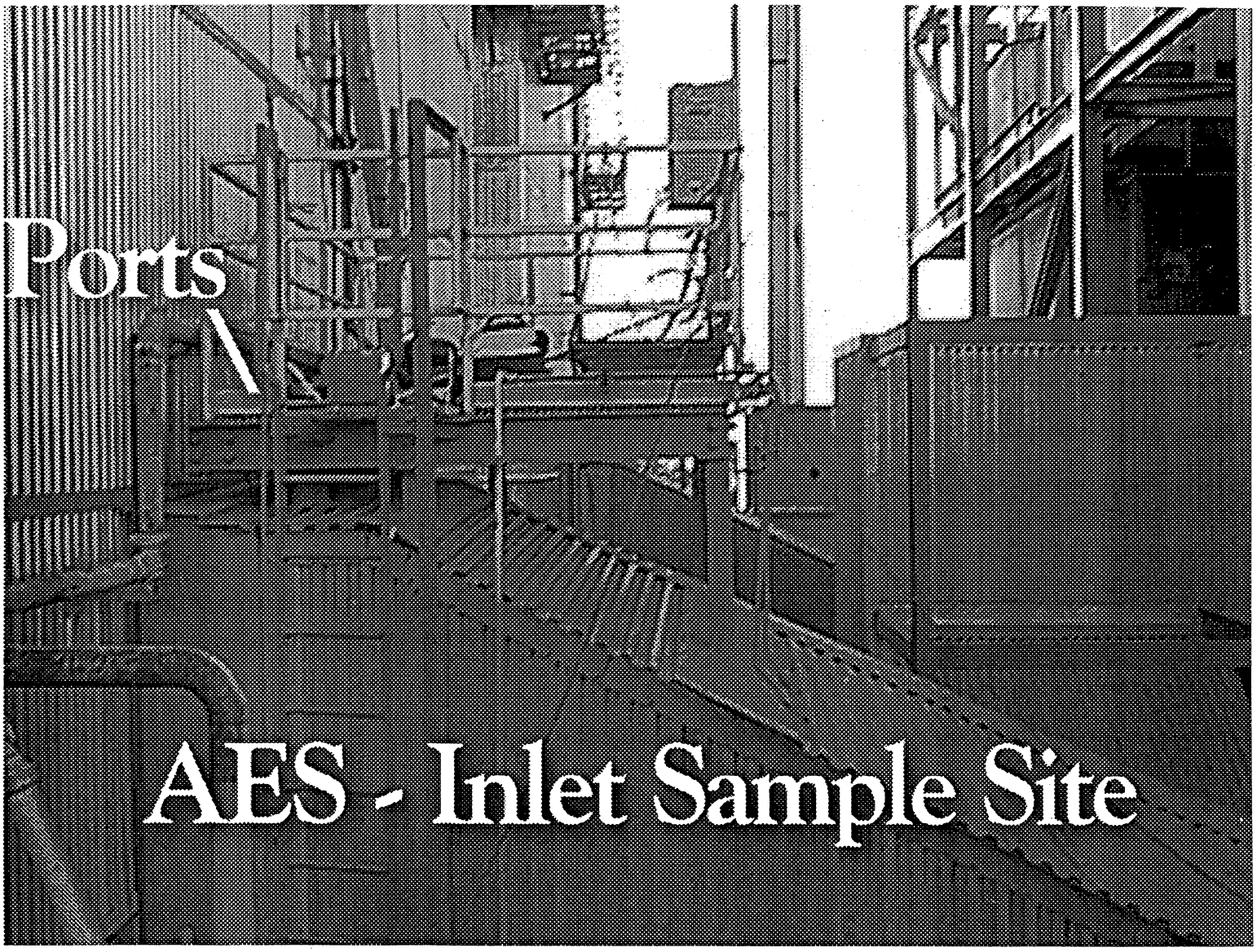
Note: Physical an chemical data contained in this MSDS are provided for use assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data on the MSDS. The certified values for this material are given only on the NIST Certificate of Analysis.

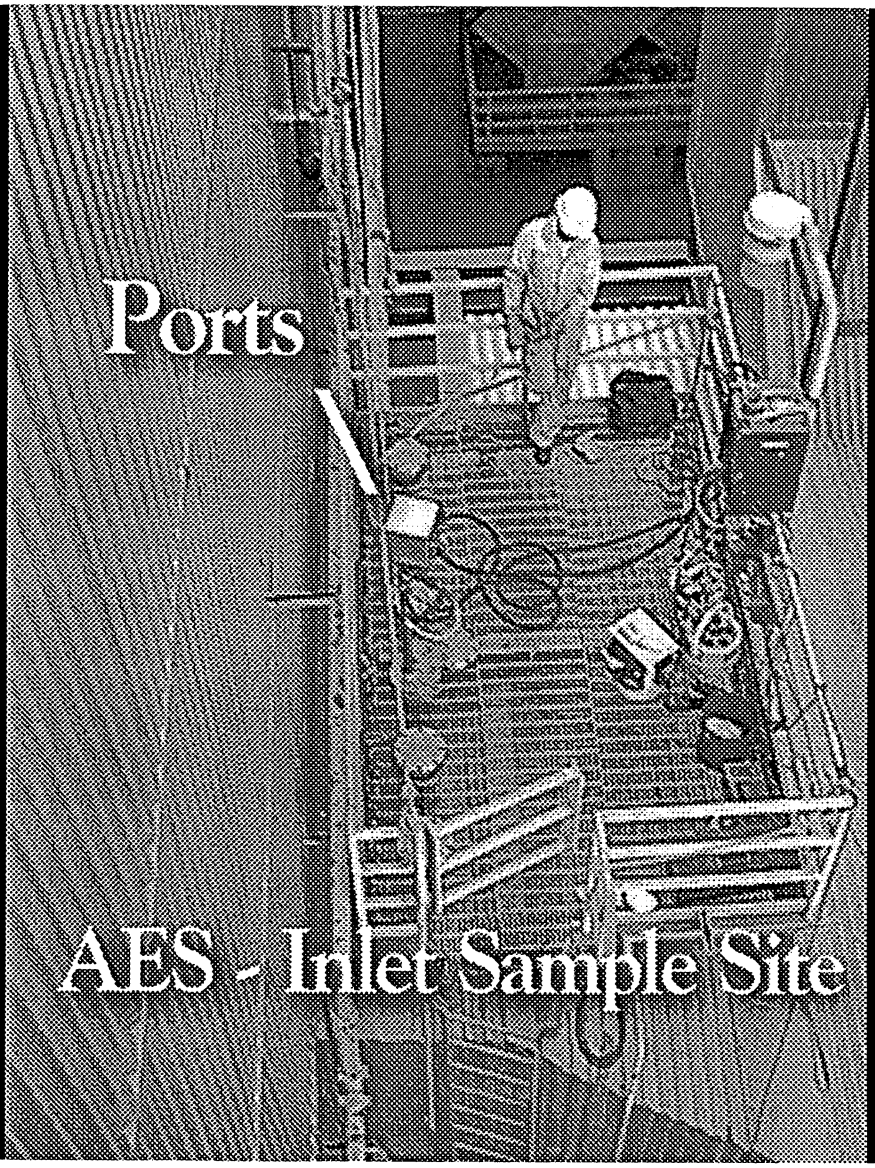
APPENDIX
F - List of Participants

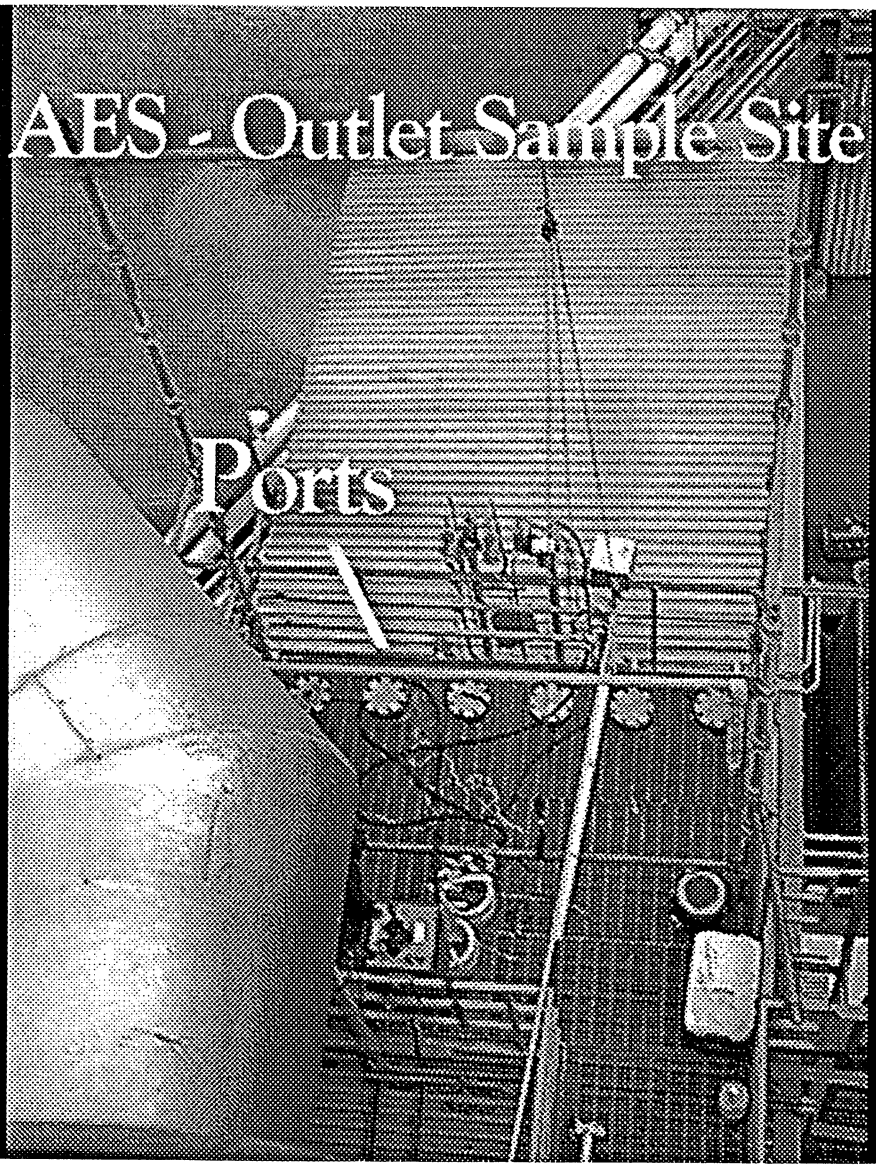
TEST PROGRAM PARTICIPANTS

Title	Name
EPA Source Test Plan Contact	William Grimly EPA EMAD
EPA QAPP Contact	Lara Autry EPA ESD
Test Director	Pat Murphy Vice-President AES Hawaii, Inc.
Plant Contact	Mel Patton AES Hawaii, Inc.
Project Manager	Scott Chesnut Best Environmental, Inc.
Quality Coordinator	Guy Worthington Best Environmental, Inc.
Laboratory Coordinator	Mike Wiley Best Environmental, Inc.
Inlet Sample Team Leader	Jeff Mesloh Best Environmental, Inc.
Outlet Sample Team Leader	Robert Chute Best Environmental, Inc.
Client Services Representative (Flue Gas Samples)	Ron McLeod Philip Analytical Services
Client Services Representative (Coal Samples)	Tim Hutchison Standard Laboratories

APPENDIX
G - Sample Site Images


Ports
AES - Inlet Sample Site


Ports
AES - Inlet Sample Site


AES - Outlet Sample Site
Ports

APPENDIX
H - Test Methods

March 2, 1999
DRAFT

Standard Test Method for Elemental, Oxidized, Particle-Bound, and Total Mercury in Flue Gas Generated from Coal-Fired Stationary Sources (Ontario Hydro Method)[1]

1. Scope

1.1 This method applies to the determination of elemental, oxidized, particle-bound, and total mercury emissions from coal-fired stationary sources.

1.2 This method is applicable to elemental, oxidized, particle-bound, and total mercury concentrations ranging from approximately 0.5 to 100 μg/dscm.

1.3 This method describes equipment and procedures for obtaining samples from effluent ducts and stacks, equipment and procedures for laboratory analysis, and procedures for calculating results.

1.4 This method is applicable for sampling elemental, oxidized, and particle-bound mercury at the inlet and outlet of emission control devices and for calculating control device mercury collection efficiency.

1.5 Method applicability is limited to flue gas stream temperatures within the thermal stability range of the sampling probe and filter components.

1.6 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information only.

1.7 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 *ASTM Standards:*
D 1193 Specification for Reagent Water[2]
D1356 Definitions of Terms Relating to Atmospheric Sampling and Analysis[3]
D 2986 Evaluation of Air-Assay Media by the Monodisperse DOP (Dioctyl Phthalate) Smoke Test[3]
D 3154 Test Method for Average Velocity in a Duct (Pitot Tube Method)[3]
D 3685 Particulates Independently or for Particulates and Collected Residue Simultaneously in Stack Gases[3]

---

[1] This test method is under the jurisdiction of ASTM Committee D-22 on Sampling and Analysis of Atmospheres and is the direct responsibility of Subcommittee D22.03 on Ambient Atmospheres and Source Emissions.

[2] *Annual Book of ASTM Standards*, Vol. 11.01.

[3] *Annual Book of ASTM Standards*, Vol. 11.03.

E 1 Specification for ASTM Thermometers[4]

DRAFT

2.2 *Other Standards:*[5]
EPA Method 1 – Sample and Velocity Traverses for Stationary Sources
EPA Method 2 – Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
EPA Method 3 – Gas Analysis for the Determination of Dry Molecular Weight
EPA Method 4 – Determination of Moisture Content in Stack Gases
EPA Method 5 – Determination of Particulate Emissions from Stationary Sources
EPA Method 12 – Determination of Inorganic Lead Emissions from Stationary Sources
EPA Method 17– Determination of Particulate Emissions from Stationary Sources (In-Stack Filtration Method)
EPA Method 29 – Determination of Metals Emissions from Stationary Sources
EPA Method 101A – Determination of Particle-Bound and Gaseous Mercury Emissions from Sewage Sludge Incinerators
EPA Method 301 – Field Validation of Pollutant Measurement Methods from Various Waste Media
EPA SW 846 7470 – Mercury in Liquid Waste – Manual Cold Vapor Technique
EPA Water and Waste 600/4-79-020 – Methods for Chemical Analysis of Water and Wastes

3. Terminology

3.1 Definitions other than those given below in Sections 3.2, 3.3, and 3.4 are listed in ASTM D 1356.

3.2 *Definitions:*

3.2.1 *elemental mercury*—mercury in its zero oxidation state, Hg^0.

3.2.2 *oxidized mercury*—mercury in its mercurous or mercuric oxidation states: Hg_2^{2+} and Hg^{2+}, respectively.

3.2.3 *elemental mercury catch*—mercury collected in the acidified peroxide (HNO_3–H_2O_2) and potassium permanganate (H_2SO_4–$KMnO_4$) impinger solutions employed in this method. This is gaseous Hg^0.

3.2.4 *oxidized mercury* catch—mercury collected in the aqueous potassium chloride (KCl) impinger solution employed in this method. This is gaseous Hg^{2+}.

---

[4] *Annual Book of ASTM Standards, Vol 14.02.*

[5] Available from the U.S. Environmental Protection Agency's Emission Measurement Technical Information Center or Code of Federal Regulations (40 CFR Part 60, Appendix A or 40 CFR Part 61, Appendix B).

3.2.5 *particle-bound mercury catch*—mercury associated with the particulate matter collected in the front half of the sampling train.

DRAFT

3.2.6 *front half of the sampling train*—all mercury collected on and upstream of the sample filter.

3.2.7 *total mercury*— all mercury (solid-bound, liquid, or gaseous) however generated or entrained in the flue gas stream (i.e., summation of elemental, oxidized, and particle-bound mercury).

3.3 *Symbols*:

A = cross-sectional area of stack, m^2 (ft^2)
B_{ws} = water vapor in the gas stream, proportion by volume
C_p = Pitot tube coefficient, dimensionless
Δp = velocity head of stack gas, mm H_2O (in. H_2O)
ΔH = average pressure differential across the orifice meter, mm H_2O (in. H_2O)
Hg_{ash} = concentration of mercury in sample filter ash, µg/g
Hg^{tp} = concentration of particle-bound mercury, µg/dscm
Hg^0 = concentration of elemental mercury, µg/dscm
Hg^{2+} = concentration of oxidized mercury, µg/dscm
I = variation from isokinetic sampling rate
IR = instrument reading from mercury analyzer, µg/L
K_p = Pitot tube constant
L_p = leakage rate observed during the posttest leak check, m^3/min (cfm)
L_a = maximum acceptable leakage rate
M_s = molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole)
M_w = molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole)
N = Normal conditions, defined as 0°C and 1 atmosphere pressure (in the U.S. N and standard conditions are the same in SI units)
P_{bar} = barometric pressure at the sampling site, mm Hg (in. Hg)
P_s = absolute stack gas pressure, mm Hg (in. Hg)
P_{std} = standard absolute pressure, 760 mm Hg (29.92 in. Hg)
Q_{sd} = stack gas dry volumetric flow rate, dscm/hr
R = ideal gas constant, 0.06236 mm Hg-m^3/K-g-mole (21.85 in. Hg-ft^3/°R-lb-mole)
T_m = absolute average dry gas meter temperature, K (°R)
T_s = absolute stack temperature, K (°R)
T_{std} = standard absolute temperature, 293 K (528°R)
V_D = total digested volume, mL
V_m = volume of gas sample as measured by dry gas meter, dcm (dscf)
$V_{m(std)}$ = volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf)
$V_{w(std)}$ = volume of water vapor in the gas sample, corrected to standard conditions, scm(scf)
v_s = average stack gas velocity, m/sec (ft/sec)
W_{ash} = total mass of ash on sample filter, g

W_{lc} = total weight of liquid collected in impingers and silica gel, g (lb)
Y = dry gas meter calibration factor
θ = total sampling time, minute
θ_1 = sampling time interval, from the beginning of a run until the first component change, minute

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4. Summary of Test Method

4.1 A sample is withdrawn from the flue gas stream isokinetically through a probe/filter system, maintained at 393 K (120°C) or the flue gas temperature, whichever is greater, followed by a series of impingers in an ice bath. Particle-bound mercury is collected in the front half of the sampling train. Oxidized mercury is collected in impingers containing a chilled aqueous potassium chloride solution. Elemental mercury is collected in subsequent impingers (one impinger containing a chilled aqueous acidic solution of hydrogen peroxide and three impingers containing chilled aqueous acidic solutions of potassium permanganate). Samples are recovered, digested, and then analyzed for mercury using cold-vapor atomic absorption (CVAAS) or fluorescence spectroscopy (CVAFS).

5. Significance and Use

5.1 The measurement of particle-bound, oxidized, elemental, and total mercury in stationary-source flue gases provides data that can be used for dispersion modeling, deposition evaluation, human health and environmental impact assessments, emission reporting, compliance determinations, etc. Particle-bound, oxidized, and elemental mercury measurements before and after control devices may be necessary for optimizing and evaluating the mercury removal efficiency of emission control technologies.

6. Interferences

There are no known interferences, but certain biases may be encountered (See Section 16).

7. Apparatus

7.1 *Sampling Train*—similar to ASTM D 3685, EPA Method 5/EPA Method 17 and EPA Method 29 trains, as illustrated in Fig. 1.

7.1.1 *Probe Nozzle (Probe Tip)*—Glass nozzles are required unless alternate nozzles are constructed of materials that are free from contamination and will not interact with the sample. Probe fittings constructed of Teflon, polypropylene, etc., are required instead of metal fittings to prevent contamination.

7.1.2. *Probe Liner*—If the sample train is to be in EPA Method 5 configuration (out-of-stack filtration), the probe liner must be constructed of quartz or borosilicate glass. If an EPA Method 17 (in-stack filtration) sampling configuration is used, the probe liner may be constructed of borosilicate glass, quartz or, depending on the flue gas temperature, Teflon.

7.1.3 *Pitot Tube*—Type S pitot tube. Refer to Section 2.2 of EPA Method 2 for a description.

7.1.4 *Differential Pressure Gauges*—inclined manometers or equivalent devices. Refer to Section 2.1 of EPA Method 2 for a description.

7.1.5 *Filter Holder*—constructed of borosilicate glass or Teflon-coated stainless steel with a Teflon filter support or other nonmetallic, noncontaminating support. Do not use a glass frit or stainless steel wire screen. A silicone rubber or Teflon gasket, designed to provide a positive seal against leakage from outside or around the filter, may be used.

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7.1.6 *Connecting Umbilical Tube*—heated Teflon tubing. This tube must be heated to a minimum of 120°C to help prevent water and acid condensation.

7.1.7 *Probe and Filter Heating System*

7.1.7.1 *EPA Method 5 Configuration*—For EPA Method 5 configuration, the temperature of the flue gas, sample probe, and the exit of the sample filter must be monitored using temperature sensors capable of measuring temperature to within 3°C (5.4°F). The heating system must be capable of maintaining the sample gas temperature of the probe and exit of the sample filter to within ±15°C (±27°F) of the flue gas temperature. Regardless of the flue gas temperature, to prevent water and acid condensation, at no time must the probe temperature, sample filter exit gas temperature, or the temperature of the connecting umbilical cord be less than 120°C.

7.1.7.2 *EPA Method 17 Configuration*—For EPA Method 17 configuration, the sample filter is located in the duct and, therefore, naturally maintained at the flue gas temperature. The heating system is only required to maintain the probe and connecting umbilical cord to at least 120°C. If the flue gas temperature is less than 120°C, then EPA Method 5 configuration must be used.

7.1.8 *Condensing/Absorbing System*—consists of eight impingers immersed in an ice bath and connected in series with leak-free ground glass fittings or other noncontaminating leak-free fittings. (At no time is silicon grease or other greases to be used for this method). The first, second, fourth, fifth, sixth, and eighth impingers are of the Greenburg–Smith design modified by replacing the standard tip with a 1.3-cm (0.5-in.)-ID straight glass tube extending to about 1.3 cm (0.5 in.) from the bottom of the flask. The third and seventh impingers are also Greenburg–Smith design, but with the standard tip including the glass impinging plate. The first, second, and third impingers contain aqueous 1 N potassium chloride (KCl) solution. The fourth impinger contains an aqueous solution of 5%$^{V}/_{V}$ nitric acid (HNO_3) and 10% $^{V}/_{V}$ hydrogen peroxide (H_2O_2). The fifth, sixth, and seventh impingers contain an aqueous solution of 4%$^{W}/_{V}$ potassium permanganate ($KMnO_4$) and 10%$^{V}/_{V}$ sulfuric acid (H_2SO_4). The last impinger contains silica gel or an equivalent desiccant. Refer to Note 1.

Note 1—When flue gas streams are sampled with high moisture content (>20%), additional steps must be taken to eliminate carryover of impinger contents from one sample type to the next. These steps must include use of oversized impinger(s) or use of an empty impinger between the KCl and HNO_3/H_2O_2 and after the HNO_3/H_2O_2 impingers. If dry impingers are used, they must be rinsed as discussed in Section 13.2 of this method and the rinse added to the preceding impinger.

7.1.9 *Metering System*—vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3°C (5.4°F), and a dry gas meter or controlled orifice capable of measuring volume to within 2%.

7.1.10 *Barometer*— barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby National Weather Service station, in which case, the station value (which is the absolute barometric pressure) shall be requested. An adjustment for elevation differences between the weather station and sampling point shall be applied at a rate of negative 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase or vice versa for elevation decrease.

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7.1.11 *Gas Density Determination Equipment*—temperature sensor and pressure gauge, as described in Section 2.3 and 2.4 of EPA Method 2. The temperature sensor shall, preferably, be permanently attached to the pitot tube or sampling probe in a fixed configuration, such that the sensor tip extends beyond the leading edge of the probe sheath and does not touch any metal. Alternative temperature sensor configurations are described in Section 2.1.10 of EPA Method 5. If necessary, a gas analyzer will be used to determine dry molecule weight of the gas (refer to EPA Method 3).

7.2 *Digestion Apparatus*

7.2.1 *Dry Block Heater or Hot Water Bath*—a heater capable of maintaining a temperature of 95°C is required for digestion of samples, similar to that described in EPA SW846 Method 7470.

7.2.2 *Ice Bath*

7.2.3 *Digestion Flasks*—Use 50- to 70-mL tubes or flasks with screw caps that will fit a dry block heater. For a water bath, 300-mL biological oxygen demand bottles for SW846 Method 7470 are to be used. In addition, borosilicate glass test tubes, 35- to 50-mL volume, with rack are needed.

7.2.4 *Microwave or Convection Oven and Teflon Digestion Vessels*—120 mL, or equivalent digestion vessels with caps equipped with pressure relief valves for the dissolution of ash, along with a capping station or the equivalent to seal the digestion vessel caps. Use a vented microwave or convection oven for heating. In addition, polymethylpentene (PMP) or equivalent volumetric flasks are recommended for the digested ash solutions.

7.3 *Analytical Equipment*—dedicated mercury analyzer or equivalent apparatus for the analysis of mercury via CVAAS. Alternatively, CVAFS may be used. CVAAS is a method based on the absorption of radiation at 253.7 nm by mercury vapor. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrometer. Absorbency is measured as a function of mercury concentration. A soda–lime trap and a magnesium perchlorate trap must be used to precondition the gas before it enters the absorption cell.

8. Reagents and Materials

8.1 *Purity of Reagents*—Reagent-grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are

available.[6] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

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8.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water as defined by Type II in ASTM Specification D 1193.

8.3 *Reagents:*

8.3.1 *Boric Acid (H_3BO_3)*—purified reagent grade.

8.3.2 *Hydrochloric Acid (HCl)*—trace metal-grade concentrated hydrochloric acid, with a specific gravity of 1.18.

8.3.3 *Hydrofluoric Acid (HF)*—concentrated hydrofluoric acid, 48%–50%.

8.3.4 *Hydrogen Peroxide (H_2O_2)*—30%$^{v}/_{v}$ hydrogen peroxide.

8.3.5 *Hydroxylamine Sulfate ($NH_2OH \cdot H_2SO_4$)*—solid.

8.3.6 *Mercury Standard Solution*—a certified (1000 µg/mL) mercury standard.

8.3.7 *Nitric Acid (HNO_3)*—trace metal-grade concentrated nitric acid with a specific gravity of 1.42.

8.3.8 *Potassium Chloride (KCl)*—solid.

8.3.9 *Potassium Permanganate ($KMnO_4$)*—solid.

8.3.10 *Potassium Persulfate ($K_2S_2O_8$)*—solid.

8.3.11 *Stannous Chloride ($SnCl_2 \cdot 2H_2O$)*—solid.

8.3.12 *Sulfuric Acid (H_2SO_4)*—trace metal-grade concentrated sulfuric acid, with a specific gravity of 1.84.

8.4 *Materials:*

8.4.1 *Indicating Silica Gel*—with a size of 6–16 mesh.

8.4.2 *Crushed or Cubed Ice.*

8.4.3 *Sample Filters*—quartz fiber filters, without organic binders, exhibiting at least 99.95% efficiency (<0.05% penetration) for 0.3-µm dioctyl phthalate smoke particles and containing less than 0.2 µg/m^2 of mercury. Test data provided by filter manufacturers and suppliers stating filter efficiency and mercury content are acceptable. However, if no such results are available, determine filter efficiency using ASTM Test Method D 2986, and analyze filter

[6] "Reagent Chemicals, American Chemical Society Specifications," Am. Chemical Soc., Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see "Reagent Chemicals and Standards," by Joseph Rosin, D. Van Nostrand Co., Inc., New York, NY, and the "United States Pharmacopeia."

blanks for mercury prior to emission testing. Filter material must be unreactive to sulfur dioxide (SO_2) or sulfur trioxide (SO_3).[7]

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8.4.4 *Filter Papers*—for filtration of digested samples. The filter paper must have a particle retention of >20 µm and filtration speed of >12 sec.

8.4.5 *Nitrogen Gas (N_2)*—carrier gas of at least 99.998% purity. Alternatively, argon gas may be used.

8.4.6 *Soda Lime*—indicating 4- to 8-mesh absorbent for trapping carbon dioxide.

8.4.7 *Sample Containers*—glass with Teflon-lined lids.

8.5 *Sampling Reagents*—All sample reagents must be used within 48 hours of preparation.

8.5.1 *KCl Absorbing Solution* (1 mol/L)—Dissolve 74.56 g of KCl in 500 mL of reagent water in a 1000-mL volumetric flask, swirl to mix, and dilute to volume with water. Mix well.

8.5.2 *HNO_3-H_2O_2 Absorbing Solution* (5%$^V/_V$ HNO_3, 10%$^V/_V$ H_2O_2)—Add slowly, with stirring, 50 mL of concentrated HNO_3 to a 1000-mL volumetric flask containing approximately 500 mL of water, and then add carefully, with stirring, 333 mL of 30%$^V/_V$ H_2O_2. Dilute to volume with water. Mix well.

8.5.3 *Acidic $KMnO_4$ Absorbing Solution* (4%$^W/_V$ $KMnO_4$, 10%$^V/_V$ H_2SO_4)— Mix carefully, with stirring, 100 mL of concentrated H_2SO_4 into approximately 800 mL of water. When mixing, be sure to follow standard acid to water addition procedures and safety precautions associated with strong acids. Then add water, with stirring, to make 1 L. This solution is 10%$^V/_V$ H_2SO_4. Dissolve, with stirring, 40 g of $KMnO_4$ into 10%$^V/_V$ H_2SO_4, and add 10%$^V/_V$ H_2SO_4, with stirring, to make 1 L. (**Warning**—See 9.1.1).

8.6 *Rinse Solutions for Sample Train*

8.6.1 *0.1 N HNO_3 Solution*—A certified reagent grade 0.1 N HNO_3 solution can be purchased directly or can be made by slowly adding 12.5 mL of concentrated HNO_3 to a 2000-mL volumetric flask containing approximately 500 mL of water, then diluting with water to volume.

8.6.2 *10% $^W/_V$ Hydroxylamine Sulfate*—Add 100 g hydroxylamine sulfate to a 1000-mL volumetric flask containing approximately 500 mL of water. After the hydroxylamine sulfate has been dissolved, dilute with water to volume.

8.7 *Sample Digestion Reagents*:

8.7.1 *Boric Acid Solution (4%$^W/_V$)*—Dissolve 4 g H_3BO_3 in water, and dilute to 100 mL.

8.7.2 *Aqua Regia (HCl:HNO_3 3:1)*—Add 3 parts concentrated HCl to 1 part concentrated HNO_3. Note that this should be made up in advance and allowed to form a dark orange color. This mixture should be loosely capped, as pressure will build as gases form.

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[7] Felix, L.G.; Clinard, G.I.; Lacey, G.E.; McCain, J.D. "Inertial Cascade Impactor Substrate Media for Flue Gas Sampling," U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, Publication No. EPA-600/7-77-060; June 1977, 83 p.

8.7.3 *Saturated Potassium Permanganate Solution (5%$^{W}/_{V}$)*—Mix 5 g $KMnO_4$ into water, dilute to 100 mL, and stir vigorously.

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8.7.4 *Potassium Persulfate Solution (5%$^{W}/_{V}$)*—Dissolve 5 g $K_2S_2O_8$ in water, and dilute to 100 mL.

8.8 *Analytical Reagents*:

8.8.1 *Hydrochloric Acid Solution (10%$^{V}/_{V}$)*—Add 100 mL concentrated HCl to water, and dilute to 1 L.

8.8.2 *Stannous Chloride Solution (10%$^{W}/_{V}$)*–Dissolve 100 g in 10%$^{V}/_{V}$ HCl, and dilute with 10%$^{V}/_{V}$ HCl to 1 L. Difficulty in dissolving the stannous chloride can be overcome by dissolving in a more concentrated HCl solution (such as 100 mL of 50%$^{V}/_{V}$ HCl) and diluting to 1 L with water. Note that care must be taken when adding water to a strong acid solution. Add a lump of mossy tin (~0.5 g) to this solution.

8.9 *Mercury Standards*:

8.9.1 *10 mg/L Hg Stock Solution*—Dilute 1 mL of 1000 mg/L Hg standard solution to 100 mL with 10%$^{V}/_{V}$ HCl.

8.9.2 *10 µg/L Hg Stock Solution*—Dilute 1 mL of 10 mg/L Hg stock solution to 100 mL with 10%$^{V}/_{V}$ HCl.

8.9.3 *Working Hg Standards*—Prepare working standards of 1.0, 5.0, 10.0, and 20.0 µg/L Hg from the 100-µg/L stock solution by diluting 1, 5, 10, and 20 mL each to 100 mL with 10%$^{V}/_{V}$ HCl.

Note 1—If samples to be analyzed are less than 1.0 µg/L Hg, working standards should be prepared at 0.05, 0.1, 0.5, and 1.0 µg/L Hg from a 10-µg/L Hg standard solution.

8.9.4 *Quality Control Standard (QC)*—A quality control standard is prepared from a separate Hg standard solution. The QC standard should be prepared at a concentration of approximately one-half the calibration range.

8.10 *Glassware Cleaning Reagents*—Prior to any fieldwork, all glassware should be cleaned according to the guidelines outlined in EPA Water and Waste 600/4-79-020, Section 4, pages 4–5.

9. Hazards

9.1 *Warning*:

9.1.1 Pressure may build up in the solution storage bottle because of a potential reaction between potassium permanganate and acid. Therefore, these bottles should not be fully filled and should be vented to relieve excess pressure and prevent explosion. Venting must be in a manner that will not allow contamination of the solution.

9.1.2 Hazards to personnel exist in the operation of the cold-vapor atomic absorption spectrophotometer. Refer to the manufacturer's instruction manual before operating the instrument.

9.1.3 Sample digestion with hot concentrated acids creates a safety problem. Observe appropriate laboratory procedures for working with concentrated acids.

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9.2 *Precaution:*

9.2.1 The determination of microquantities of mercury species requires meticulous attention to detail. Good precision is generally unattainable without a high level of experience with stack-sampling procedures. Precision may be improved by knowledge of, and close adherence to, the suggestions that follow.

9.2.1.1 All glassware used in the method must be cleaned thoroughly prior to going into the field, as described in Section 8.10 of this method.

9.2.1.2 Use the same reagents and solutions in the same quantities for a group of determinations and the corresponding solution blank. When a new reagent is prepared or a new stock of filters is used, a new blank must taken and analyzed.

10. Sampling

10.1 *Preparation for Test:*

10.1.1 *Preliminary Stack Measurements*—Select the sampling site, and determine the number of sampling points, stack pressure, temperature, moisture, dry molecular weight, and range of velocity head in accordance with procedures of ASTM Test Method D 3154 or EPA Methods 1 through 4.

10.1.2 Select the correct nozzle diameter to maintain isokinetic sampling rates based on the range of velocity heads determined in 10.1.1.

10.1.3 Ensure that the proper differential pressure gauge is selected for the range of velocity heads (refer to EPA Method 2, Section 2.2).

10.1.4 It is suggested that an EPA Method 17 configuration be used; however, if an EPA Method 5 setup is to be used, then select a suitable probe length such that all traverse points can be sampled. Consider sampling from opposite sides of the stack to minimize probe length when a large duct or stack is sampled.

10.1.5 *Sampling Time and Volume*—The total sampling time for this method should be at least 2 but not more than 3 hours. Use a nozzle size that will guarantee an isokinetic gas sample volume between 1.0 dry cubic meters corrected to standard conditions (dscm) and 2.5 dscm. If traverse sampling is done (necessary for sampling at electric utilities), use the same points for sampling that were used for the velocity traverse as stated in Section 10.1.1 of this method. Each traverse point must be sampled for a minimum of 5 minutes.

11. Preparation of Apparatus

11.1 *Pretest Preparation:*

11.1.1 Weigh several 200- to 300-g portions of silica gel in airtight containers to the nearest 0.5 g. Record the total weight of the silica gel plus container on each container. Alternatively, the silica gel can be weighed directly in the impinger immediately prior to the train being assembled.

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11.1.2 Desiccate the sample filters at 20° ± 5.6°C (68° ± 10°F) and ambient pressure for 24 to 36 hours, weigh at intervals of at least 6 hours to a constant weight (i.e., <0.5-mg change from previous weighing), and record results to the nearest 0.1 mg. Alternatively, the filters may be oven-dried at 105°C (220°F) for 2 to 3 hours, desiccated for 2 hours, and weighed.

11.1.3 Clean all sampling train glassware as described in Section 8.10 before each series of tests at a single source. Until the sampling train is assembled for sampling, cover all glassware openings where contamination can occur.

11.2 *Preparation of Sampling Train:*

11.2.1 Assemble the sampling train as shown in Figure 1.

11.2.2 Place 100 mL of the KCl solution (see Section 8.5.1 of this method) in each of the first, second, and third impingers, as indicated in Figure 1.

11.2.3 Place 100 mL of the HNO_3–H_2O_2 solution (Section 8.5.2 of this method) in the fourth impinger, as indicated in Figure 1.

11.2.4 Place 100 mL of the H_2SO_4–$KMnO_4$ absorbing solution (see Section 8.5.3 of this method) in each of the fifth, sixth, and seventh impingers, as indicated in Figure 1.

11.2.5 Transfer approximately 200 to 300 g of silica gel from its container to the last impinger, as indicated in Figure 1.

11.2.6 Prior to final train assembly, weigh and record the weight of each impinger. This information is required to calculate the moisture content of the sampled flue gas.

11.2.7 To ensure leak-free sampling train connections and to prevent possible sample contamination problems, use Teflon tape, Teflon-coated O-rings, or other noncontaminating material.

11.2.8 Place a weighed filter in the filter holder using a tweezer or clean disposable surgical gloves.

11.2.9 Install the selected nozzle using a noncontaminating rubber-type O-ring or equivalent when stack temperatures are less than 260°C (500°F) and an alternative gasket material when temperatures are higher. Other connecting systems, such as Teflon ferrules or ground glass joints, may also be used on probe and nozzle.

11.2.10 Mark the probe with heat-resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

11.2.11 Place crushed or cubed ice around the impingers.

11.2.12 *Leak-Check Procedures.* Follow the leak-check procedures given in 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 (Posttest Leak Checks) of EPA Method 5 or 17.

Note 2—If the flue gas temperature at the sampling location is greater than 260°C (above the temperature where Teflon or rubber-type seals can be used), the posttest leak check is determined beginning at the front end of the probe (does not include nozzle or sample filter holder for EPA Method 17).

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12. Calibration and Standardization

12.1 *Sampling Train Calibration:*

12.1.1 *Probe Nozzle*—Refer to Sections 2.1.1 of either EPA Method 5 or 17.

12.1.2 *Pitot Tube*—Refer to Section 4 of EPA Method 2.

12.1.3 *Metering System*—Refer to Section 5.3 of either EPA Method 5 or 17.

12.1.4 *Probe Heater*—Refer to Section 7.1.7.1 and 7.1.7.2 of this method.

12.1.5 *Temperature Gauges*— Refer to Section 4.3 of EPA Method 2.

12.1.6 *Leak Check of the Metering System*—Refer to Section 5.6 of EPA Method 5 or Section 5.5 of EPA Method 17.

12.1.7 *Barometer*—Calibrate the barometer to be used against a mercury barometer.

12.2 *Atomic Absorption or Atomic Fluorescence Spectrometer Calibration*—Perform instrument setup and optimization according to the manufacturer's specifications. Cold-vapor generation of mercury is performed via addition of stannous chloride solution to reduce oxidized mercury to its elemental state. The mercury-laden solution is then purged with a carrier gas into the atomic absorption cell. This procedure is used to calibrate the instrument using 10%$^{v}/_{v}$ HCl as the blank along with the standards described in Section 8.9.3. Calibration is verified by analyzing the QC standard prepared according to Section 8.9.4 of this method.

13. Procedures

13.1 *Sampling Train Operation:*

13.1.1 Maintain an isokinetic sampling rate within 10% of true isokinetic. For an EPA Method 5 configuration, maintain sample filter exit gas stream temperatures and probe within ±15°C of the flue gas temperature at the sampling location. However, at no time, regardless of the sample configuration, must the sample filter, probe, or connecting umbilical cord temperature be lower than 120°C.

13.1.2 Record the data, as indicated in Figure 2, at least once at each sample point but not less than once every 5 minutes.

13.1.3 Record the dry gas meter reading at the beginning of a sampling run, the beginning and end of each sampling time increment, before and after each leak check, and when sampling is halted.

13.1.4 Level and zero the manometer. Periodically check the manometer level and zero, because it may drift during the test period.

13.1.5 Clean the port holes prior to the sampling run.

13.1.6 Remove the nozzle cap. Verify that the filter and probe heating systems are up to temperature and that the pitot tube and probe are properly positioned.

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Note 3—For an EPA Method 5 configuration, prior to starting the gas flow through the system, the sample filter exit gas temperature may not be at the hot box temperature. However, if the system is set up correctly, once flow is established, the sample filter exit gas temperature will quickly come to an equilibrium.

13.1.7 Start the pump. Position the nozzle at the first traverse point with the nozzle tip pointing in the direction of flow. Seal the openings around the probe and port hole to prevent unrepresentative dilution of the gas stream. Read the pitot tube manometer, start the stopwatch, open and adjust the control value until the isokinetic sampling rate is obtained (refer to Section 4.1.5 from either EPA Method 5 or 17 for information on isokinetic sampling rate computations), and maintain the isokinetic rate at all points throughout the sampling period.

13.1.8 When sampling at one traverse point has been completed, move the probe to the next traverse point as quickly as possible. Close the coarse adjust valve, and shut the pump off when transferring the probe from one sample port to another. Exclude the time required to transfer the probe from one port to another from the total sampling time.

13.1.9 Traverse the stack cross section, as required by EPA Method 1.

13.1.10 During sampling, periodically check and, if necessary, adjust the probe and filter exit sample gas temperatures, as well as the zero of the manometer.

13.1.11 Add more ice, if necessary, to maintain a temperature of <20°C (68°F) at the condenser/silica gel outlet.

13.1.12 Replace the filter assembly if the pressure drop across the filter becomes such that maintaining isokinetic sampling is no longer possible. Conduct a leak check (refer to EPA Method 5 or 17, Section 4.1.4.2) before installing a new filter assembly. The total particulate weight and determination of particle-bound mercury includes all filter assembly catches.

13.1.13 In the unlikely event depletion of $KMnO_4$ via reduction reactions with flue gas constituents other than elemental mercury occurs, it may render it impossible to sample for the desired minimum time. This problem is indicated by the complete bleaching of the purple color of the acidified permanganate solution. If the purple color is lost in the first two H_2SO_4–$KMnO_4$ impingers, then the sample must be repeated. If the gas stream is known to contain large amounts of reducing constituents (i.e., >2500 ppm SO_2) or breakthrough has occurred in previous sampling runs, then the following modification is suggested: the amount of HNO_3–H_2O_2 (10%$^{v}/_{v}$) in the fourth impinger should be doubled, and/or a second HNO_3–H_2O_2 impinger should be used to increase the oxidation capacity for reducing gas components prior to the H_2SO_4–$KMnO_4$ impingers.

13.1.14 Use a single train for the entire sample run, except when simultaneous sampling is required in two or more separate ducts or at two or more different locations within the same duct or when equipment failure necessitates a change of trains.

13.1.15 At the end of a sample run, turn off the coarse adjust valve, remove the probe and nozzle from the stack, record the final dry gas meter reading, and conduct a posttest leak check,

as described in Section 4.1.4.3 of EPA Method 5. Also, leak-check the Pitot lines as described in EPA Method 2, Section 3.1. The lines must pass the leak check to validate the velocity head data.

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13.1.16 Calculate percent isokinetic to determine whether the run was valid or another test run should be performed (refer to Section 14.6 of this method).

13.2 *Sample Recovery:*

13.2.1 Allow the probe to cool before proceeding with sample recovery. When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle, and place a rinsed, noncontaminating 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; a vacuum can form in the filter holder, with the undesired result of drawing liquid from the impingers onto the filter.

13.2.2 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 may be present. Cap the filter inlet where the probe was fastened. Remove the umbilical cord from the last impinger, and cap the impinger. Cap the filter holder outlet and impinger inlet. Use noncontaminating caps, such as ground-glass stoppers, plastic caps, serum caps, or Teflon tape, to close these openings.

13.2.3 Alternatively, the following procedure may be used to disassemble the train before the probe and filter holder/oven are completely cooled. Initially disconnect the filter holder outlet/impinger inlet, and loosely cap the open ends. Then disconnect the probe from the filter holder or cyclone inlet, and loosely cap the open ends. Cap the probe tip, and remove the umbilical cord as previously described.

13.2.4 Transfer the probe and filter–impinger assembly to a clean area that is 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.

13.2.5 The impinger train sample recovery scheme is illustrated in Figure 3.

13.2.6 *Container 1 (Sample Filter)*—Carefully remove the sample filter from the filter holder so as not to lose any ash, weigh filter and ash, and place the filter in a labeled petri dish container. To handle the filter, use either acid-washed polypropylene or Teflon-coated tweezers or clean, disposable surgical gloves rinsed with water and dried. If it is necessary to fold the filter, make certain the particulate cake is inside the fold. Transfer any particulate matter or filter fibers that adhere to the filter holder gasket to the filter in the petri dish. A dry (acid-cleaned) nonmetallic bristle brush should be used to remove any remaining particulate matter. Do not use any metal-containing materials when recovering this train. Immediately cover and seal the labeled petri dish.

13.2.7 *Container 2/2a (All Rinses in Front of the Sample Filter)*

13.2.7.1 *Case 1: Includes Gravimetric Particulate Determination in Addition to Mercury*

Quantitatively recover particulate matter and any condensate from all components prior to the sample filter. A nonmetallic brush may be used for removing particulate matter. All front-half components (all components prior to the sample filter) are then rinsed with acetone as outlined in

EPA Method 5 or 17. The acetone rinse is then placed into a container (Container 2a) for which the tare weight has been recorded. Container 2a, with a ribbed watch glass over the top, is placed in a fume hood until the acetone has completely evaporated. After the front-half components have been rinsed with acetone, then rinsed with 0.1 N HNO_3, this rinse is placed in Container 2.

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13.2.7.2 *Case 2: Mercury Determination Only (No Acetone Rinse)*

Quantitatively recover particulate matter and any condensate from all components prior to the sample filter. A nonmetallic brush may be used for removing particulate matter. The front-half components are then rinsed with 0.1 N HNO_3, and this rinse is placed in Container 2.

13.2.8 *Container 3 (Impingers 1 through 3, KCl Impinger Contents and Rinses):*

13.2.8.1 Dry the exterior surfaces of Impingers 1, 2, and 3. Then weigh and record the weight of each impinger (to the nearest 0.5 g).

13.2.8.2 Clean the filter support, the back half of the filter housing, and connecting glassware by thoroughly rinsing with 0.1 N HNO_3. Pour the rinse into a glass sample Container 3.

13.2.8.3 Add H_2SO_4–$KMnO_4$ to each impinger until a purple color remains.

13.2.8.4 Pour all of the liquid from the three KCl impingers into Container 3.

13.2.8.5 Rinse the impingers and connecting glassware with 0.1 N HNO_3. If deposits remain on the impinger surfaces, remove them by rinsing with 10 mL 10%$^{W}/_{V}$ hydroxylamine sulfate solution. Add both these rinses to Container 3. If the solution in Container 3 becomes clear, add a small amount of the H_2SO_4–$KMnO_4$ solution until a pink or slightly purple color is obtained.

13.2.8.6 Perform a final rinse of the impingers and connecting glassware with 0.1 N HNO_3, and add to Container 4.

13.2.8.7 Do a final rinse of all glass components with water which is discarded.

13.2.8.8 Mark the height of the fluid level in Container 3, seal, and clearly label the contents.

13.2.9 *Container 4 (Impinger 4, HNO_3–H_2O_2 Impinger Contents and Rinses):*

13.2.9.1 Dry the exterior surfaces of Impinger 4. Then weigh and record the weight of this impinger (to the nearest 0.5 g).

13.2.9.1 Pour the HNO_3–H_2O_2 absorbing solution into a glass sample Container 4.

13.2.9.2 Rinse the H_2O_2–HNO_3 impinger and connecting glassware a minimum of two times with 0.1 N HNO_3, and pour the rinses into Container 4. Do a final rinse with water and discard water.

13.2.10 *Container 5 (Impingers 5 through 7, H_2SO_4–$KMnO_4$ Impinger Contents and Rinses):*

13.2.10.1 Dry the exterior surfaces of Impingers 5, 6, and 7. Then weigh and record the weight of each impinger (to the nearest 0.5 g).

13.2.10.2 Pour all of the liquid from the three H_2SO_4–$KMnO_4$ impingers into a glass sample Container 5.

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13.2.10.3 Rinse the impingers and connecting glassware with 0.1 N HNO_3. If deposits remain on the impinger surfaces, remove them by rinsing with 10 mL 10%$^{W}/_{V}$ hydroxylamine sulfate. Add these rinses to Container 5. If the solution in Container 5 becomes clear, add small amounts of H_2SO_4–$KMnO_4$ solution until a pink or slightly purple color is obtained.

13.2.10.4 Perform a final 0.1 N HNO_3 rinse of the impingers and connecting glassware follow by a water rinse. The 0.1 N HNO_3 rinse is added to Container 5, and the water rinse is discarded.

13.2.10.5 Mark the height of the fluid level, seal the container, and clearly label the contents.

Note 4—As stated earlier in the warning in Section 9.1.1, pressure can build up in the sample storage flask because of the potential reaction of $KMnO_4$ with acid. Do not fill the container completely, and take precautions to relieve excess pressure.

13.2.11 *Container 6 (Impinger 8, Silica Gel Impinger Contents)*:

13.2.11.1 Dry the exterior surfaces of Impinger 8. Then weigh and record the weight of this impinger (to the nearest 0.5 g).

13.2.11.2 Note the color of the indicating silica gel to determine whether it has been completely spent, and make a notation of its condition. If spent, the silica gel must be either regenerated or disposed of.

13.2.12 *Solution Blanks (Containers 7–11)*

Solution blanks are taken each time new reagents are prepared.

13.2.12.1 *Container 7 (0.1 N HNO_3 Blank)*—Place 50 mL of the 0.1 N HNO_3 solution used in the sample recovery process into a properly labeled container. Seal the container.

13.2.12.2 *Container 8 (1 N KCl Blank)*—Place 50 mL of the 1 N KCl solution used as the impinger solution into a properly labeled container. Seal the container.

13.2.12.3 *Container 9 (5%$^{V}/_{V}$ HNO_3–10%$^{V}/_{V}$ H_2O_2 Blank)*—Place 50 mL of the HNO_3–H_2O_2 solution used as the nitric acid impinger reagent into a properly labeled container. Seal the container.

13.2.12.4 *Container 10 (H_2SO_4–$KMnO_4$ Blank)*—Place 50 mL of the H_2SO_4–$KMnO_4$ solution used as the impinger solution in the sample recovery process into a properly labeled container. Refer to **Note 4** in Section 13.2.10.5 of this method.

13.2.12.5 *Container 11 (10% $^{W}/_{V}$ Hydroxylamine Sulfate Blank)*—Place 100 mL of hydroxylamine sulfate solution into a properly labeled sample container. Seal the container.

13.2.13 *Container 12 (Sample Filter Blank)*—Once during each field test, place into a properly labeled petri dish three unused blank filters from the same lot as the sampling filters. Seal the petri dish.

13.2.14 After all impingers and connectors have been properly rinsed and the solutions recovered, the glassware should be cleaned according to the procedures in Section 8.10 or triple-rinsed with 10%$^{V}/_{V}$ HNO_3 followed by a rinsing with deionized (DI) water. If a new source is to be sampled or if there are any brown stains on the glassware, then the glassware must be cleaned according to procedures in Section 8.10 of this method. If multiple sites are to sampled during a single mobilization, an exception to this procedure will be allowed. In this case, a triple rinsing of the glassware with 10%$^{V}/_{V}$ HNO_3 solution followed by a DI water rinse prior to sampling can be used as an alternative to the procedures in Section 8.10. However, if there are any brown stains on the glassware, then the glassware must be cleaned according to procedures in Section 8.9 of this method.

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13.3 *Sample Preparation:*

13.3.1 *Ash Sample (Containers 1 and 2)*

13.3.1.1 *Case 1: Includes Gravimetric Particulate Determination in Addition to Mercury*—The gravimetric particulate loading is determined from the mass of the ash on the filter and the residual particulate from the acetone rinse (Container 2a), as outlined in EPA Method 5 or 17. If a large amount of ash is on the filter, carefully remove the ash to create a raw ash sample from which a representative weighed aliquot can be taken for digestion. If the mass of ash collected on the filter is small (less than 0.5 g), digest the entire filter along with the ash. Rinse the residual particulate from Container 2a using 0.1 N HNO_3. This rinse is then added to Container 2. The ash material is then digested using the procedures described in Section 13.3.2 of this method. The same procedure is used to determine the mercury on the sample filter blank.

Use a modification of EPA SW 846 7470 to digest the sample in Container 2 prior to analysis. The main modification is that the volumes of reagents and sample have been reduced tenfold to reduce waste. This reduction in reagent volume is acceptable because modern dedicated mercury analyzers do not require the large volumes that previous manual methods required. Transfer a 10-mL aliquot of the sample to a digestion tube with a screw cap.

13.3.1.2 *Case 2: Mercury Determination Only*—The same procedures are followed as described previously in Section 13.3.1.1 with the exception that there is no Container 2a.

13.3.2 *Ash Digestion*—Accomplish the complete dissolution of ash by one of the following methods or an equivalent alternative method. The following methods are for the dissolution of inorganic samples, such as ash or sediments, when an analysis of trace elements including mercury is done.

13.3.2.1 *Microwave Digestion*—The use of this method assumes proper training in microwave digestion techniques. In addition, this method is tailored for a CEM (continuous emission monitor) MDS-2100 microwave system and may need to be modified for other systems. A 0.5-g ash sample, accurately weighed to 0.0001 g, is placed in a Teflon microwave digestion vessel with 3 mL of concentrated HF, 3 mL of concentrated HNO_3, and 3 mL of concentrated HCl. The vessel is sealed and placed in the microwave (along with other vessels). The vessels are slowly heated to a pressure of 347 kPa (50 psi), which is held for 5 minutes, followed by heating to a pressure of 550 kPa (80 psi), which is held for 20 minutes. The vessels are allowed to cool to room temperature before venting. 15 mL of 4%$^{W}/_{V}$ boric acid is added to each vessel. The vessels are sealed and placed in the microwave again. The vessels are slowly heated back to a pressure of

347 kPa (50 psi) and held for 10 minutes. The vessels are again allowed to cool to room temperature before venting. The contents of each vessel are quantitatively transferred to a 50-mL PMP or polypropylene (PP) volumetric flask and diluted; note that care must be taken in adding water to a strong acid solution.

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13.3.2.2 *Conventional Digestion*—The use of this method assumes proper training in Teflon bomb digestion techniques. Place a 0.5-g ash sample, accurately weighed to 0.0001 g, in a Teflon digestion vessel with 7 mL of concentrated HF and 5 mL of aqua regia. Seal the vessel, and place it in an oven or water bath at 90°C for a minimum of 8 hours (these may be heated overnight). Cool the vessel to room temperature before venting. Add 3.5 g of boric acid and 40 mL of water to each vessel. Seal the vessels, and place them in the oven or water bath for an additional 1 hour. Cool the vessels again to room temperature before venting. Quantitatively transfer the contents of each vessel to a 100-mL PMP, PP, or glass volumetric flask and dilute. Note that care must be taken in adding water to a strong acid solution.

13.3.3 *Preparation of Aqueous KCl Impinger Solution (Containers 3 and 8)*—Dilute sample in a 500-mL volumetric flask to volume with water, and mix. Use a modification of EPA SW 846 7470 to digest the sample prior to analysis. The main modification is that the volumes of reagents and sample have been reduced tenfold to reduce waste. This reduction in reagent volume is acceptable because modern dedicated mercury analyzers do not require the large volumes that previous manual methods required. Transfer a 10-mL aliquot of the sample to a digestion tube with a screw cap. Add 0.5 mL of concentrated H_2SO_4, 0.25 mL of concentrated HNO_3, and 1.5 mL of 5%$^{V}/_{V}$ $KMnO_4$ solution. Mix the solution, and allow it to stand for 15 minutes. Add 0.75 mL of 5%$^{V}/_{V}$ $K_2S_2O_8$ solution, and loosely cap the tube. Place the tube in a dry block heater or water bath equipped with a temperature probe, and heat to 95°C. Do not allow the temperature to exceed 95°C. Hold the sample at 95°C for 2 hours before allowing it to cool to room temperature. The purple color from the added $KMnO_4$ solution must remain throughout the digestion. Clearing of the solution during the heating indicates the depletion of $KMnO_4$. Prior to analysis, add 1 mL of 10%$^{W}/_{V}$ of solid hydroxylamine sulfate solution to the sample. The sample solution should remain clear after addition of hydroxylamine sulfate.

13.3.4 *Preparation of HNO_3–H_2O_2 Impinger Solution (Containers 4 and 9)*—Dilute sample in a 250-mL volumetric flask to volume with water, and mix. Treat the sample with a modified version of EPA SW 846 7470. Modifications to the method are necessary to properly treat the H_2O_2-containing impinger solution before the analysis with CVAAS. The modifications include the addition of HCl, the use of an ice bath during the $KMnO_4$ addition, and the slow addition of the $KMnO_4$. Transfer a 5-mL aliquot of the sample to a digestion tube with a screw cap. Add 0.25 mL of concentrated HCl, place the tube in an ice bath, and allow it to cool for 15 minutes. The destruction of H_2O_2 is accomplished by slow addition of saturated $KMnO_4$ solution in 0.25-mL increments along the inside of the digestion tube. The violence of this reaction requires careful, slow addition of the $KMnO_4$ for safety reasons and to avoid loss of analyte. Cool the sample for 15 minutes in between each addition, and mix the sample prior to each addition. After the first five additions, increase the increments to 0.5 mL. Carry out the addition of $KMnO_4$ until the solution remains purple, indicating complete reaction of the H_2O_2. Record the volume of saturated $KMnO_4$ solution added to the sample. Add 0.75 mL of 5%$^{W}/_{V}$ $K_2S_2O_8$ solution to the sample, and then cap the tube loosely. Place the tubes in a dry block heater or water bath equipped with a temperature probe, and heat to 95°C. Do not allow the

temperature to exceed 95°C. Maintain the sample at 95°C for 2 hours before allowing it to cool to room temperature. Note that the purple color due to $KMnO_4$ must remain throughout the digestion. Clearing of the solution during the heating indicates the depletion of $KMnO_4$. Before doing the analysis, add 1mL 10%$^{W}/_{V}$ of solid hydroxylamine sulfate solution to the sample. The sample should then become clear.

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13.3.5 *Preparation of H_2SO_4-$KMnO_4$ Impinger Solution (Container 5 and 10)*—Prepare the solution immediately prior to analysis. Dissolve by incrementally adding approximately 500 mg of solid hydroxylamine sulfate into the sample until a clear, colorless solution persists. Add the hydroxylamine slowly because of the violence of this reaction. Dilute the sample in a 500-mL volumetric flask to volume with water, and mix. This procedure assumes that organics have been trapped in impingers previous to the permanganate impingers in the sampling train or oxidized by contact with the series of impingers in the sampling train. Treatment of the sample as outlined allows an aliquot representative of the entire impinger contents to be taken for analysis.

13.3.6 *Simplification of the Digestion*—If an acetone rinse was not used for gravimetric particulate determination, then the digestion procedure for the HNO_3–H_2O_2 impinger solution may be simplified by omitting the persulfate digest (the addition of $K_2S_2O_8$ and heating). The persulfate digest is performed for the purpose of oxidizing certain organics. Because this method is specific to coal combustion systems where organic compounds are usually insignificant,[8] this digest may be omitted because the H_2O_2 is sufficient to oxidize most compounds. The decision to omit this procedure should be made based on the gas stream being sampled and/or verification that organics resistant to H_2O_2 oxidation are not present. If unsure whether organics are present or if an acetone rinse has been used, then the total digestion procedure is required.

13.3.7 *0.1 N HNO_3 and 10%$^{W}/_{V}$ Hydroxylamine Sulfate Rinse Solutions (Containers 7 and 11)*—These solutions can be analyzed directly for mercury without any preparation steps.

13.4 *Sample Analysis*—Analyze all of the prepared solutions by CVAAS or CVAFS following the guidelines specified by the instrument manufacturer.

13.4.1 *QA/QC*—For this method, it is important that both the sampling team and analytical people be very well trained in the procedures. This is a complicated method that requires a high-level of sampling and analytical experience. For the sampling portion of the QA (quality assurance)/QC procedure, both solution and field blanks are required. It should be noted that if high-quality reagents are used and care is taken in their preparation and in the train assembly, there should be little, if any, mercury measured in either the solution or field blanks.

As stated in Section 13.2.12 of this method, solution blanks will be taken and analyzed every time a new batch of solution is prepared. If mercury is detected in these solution blanks, the concentration is subtracted from the measured sample results. The maximum amount that can be subtracted is either 10% of the measured result or 10 times the instrument detection limit,

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[8] "A Comprehensive Assessment of Toxic Emissions from Coal-Fired Power Plants: Phase I Results from the U.S. Department of Energy Study," Prepared for the U.S. Department of Energy Federal Energy Technology Center, Contract No. DE-FC21-93MC30097, Energy & Environmental Research Center, University of North Dakota, Grand Forks, ND, 1996.

whichever is less. If the solutions blanks are greater than this general guideline, then the results are not valid.

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A field blank is performed by assembling a sample train, transporting to the sampling location during the sampling period, and recovering it as a regular sample. These data are used to ensure that there is no contamination as a result of the sampling activities. A minimum of one field blank at each sampling location must be completed for each test site. Any mercury detected in the field blanks cannot be subtracted from the results. Whether or not the mercury detected in the field blanks is significant, is determined on the QA/QC procedures established prior to the testing. This, of course, is established on a case-by-case basis.

The QA/QC for the analytical portion of this method is that every sample is to be analyzed in duplicate with every tenth sample analyzed in triplicate. These results must be within 10% of each other. If this is not the case, then the instrument must be recalibrated and the samples reanalyzed. In addition, after every ten samples, a known spike sample must be analyzed. For the ash samples, a certified reference ash sample (may be purchased from NIST) is to be digested and analyzed at least once during the test program. It is also suggested that the QA/QC procedures developed for a test program include submitting, on occasion, spiked mercury samples to the analytical laboratory, by either the prime contractor if different from the laboratory or an independent organization.

14. Flue Gas Calculations

14.1 *Dry Gas Volume*—Calculate the dry gas sample volume, $V_{m(std)}$, at standard conditions using Equation 1.

$$V_{m(std)} = V_m Y \left(\frac{T_{std}}{T} \right) \left| \frac{P_{bar} + \frac{\Delta H}{13.6}}{P} \right| = K_1 V_m Y \frac{P_{bar} + (\Delta H/13.6)}{T} \qquad \text{[Eq. 1]}$$

where:

P_{bar} = barometric pressure at the sampling site, mm Hg (in. Hg)
P_{std} = standard absolute pressure, 760 mm Hg (29.92 in. Hg)
T_m = absolute average dry gas meter temperature (refer to Figure 2), K (°R)
T_{std} = standard absolute temperature, 293 K (528°R)
V_m = volume of gas sample as measured by dry gas meter, dcm (dscf)
$V_{m(std)}$ = volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf)
Y = dry gas meter calibration factor
ΔH = average pressure differential across the orifice meter (refer to Figure 2), mm H_2O (in. H_2O)
K_1 = 0.3858 K/mm Hg (17.64°R/in. Hg).

Note 5—Equation 1 can be used as written unless the leakage rate observed during any of the mandatory leak checks (i.e., leak checks conducted prior to component changes or following the test) exceeds the maximum acceptable leakage rate, L_a, equal to 0.00057 m^3/min (0.02 cfm) or 4% of the average sampling rate, whichever is less. If the leakage rate observed during the

posttest leak check, L_p, or an individual leakage rate observed during the leak check conducted prior to the "ith" component change (I = 1, 2, 3, . . .n), L_i, exceeds L_a, then Equation 1 must be modified as follows:

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(a) **Case I**. No component changes made during sampling run. In this case, replace V_m with the expression:

$$[V_m - (L_p - L_a)\theta]$$

where:

L_p = leakage rate observed during the posttest leak check, m^3/min (cfm)

L_a = maximum acceptable leakage rate for either a pretest leak check or for a leak check following a component change—equal to 0.00057 m^3/min (0.02 cfm) or 4% of the average sampling rate, whichever is less

θ = total sampling time, minutes

(b) **Case II**. One or more component changes made during the sampling run. In this case, replace V_m with the expression:

$$\left[V_m - (L_1 - L_a)\theta_1 - \sum_{i=1}^{n} (L_i - L_a)\theta_i - (L_p - L_a)\theta_p \right]$$

where:

θ_i = sampling time interval, from the beginning of a run until the first component change, minutes

and substitute only for those leakage rates (L_i or L_p) that exceed L_a.

14.2 *Volume of Water Vapor*—Calculate the volume of water vapor of the stack gas using Equation 2.

$$V_{w(std)} = \frac{W_{lc}\ R\ T_{std}}{M_w\ P_{std}} = K_2\ W_{lc} \qquad \text{[Eq. 2]}$$

where:

M_w = molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole)

R = ideal gas constant, 0.06236 mm Hg-m^3/K-g-mole (21.85 in. Hg-ft^3/°R-lb-mole)

W_{lc} = total weight of liquid collected in impingers and silica gel (refer to Figure 2), g

$V_{w(std)}$ = volume of water vapor in the gas sample, corrected to standard conditions, scm (scf)

K_2 = 0.001336 m^3/mL (0.04707 ft^3/mL).

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14.3 *Volume of Moisture*—Calculate the moisture content, B_{ws}, of the stack gas using Equation 3.

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}} \qquad \text{[Eq. 3]}$$

where:

B_{ws} = water vapor in the gas stream, proportion by volume

14.4 *Stack Gas Velocity*—Calculate the stack gas velocity using Equation 4:

where:

v_s = stack gas velocity, m/sec (ft/sec)

T_s = absolute stack temperature, K (°R)

P_s = absolute stack gas pressure, mm Hg (in. Hg)

M_s = molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole)

C_p = Pitot tube coefficient, dimensionless

Δp = velocity head of stack gas, mm H_2O (in. H_2O)

K_p = Pitot tube constant, where K_p is defined as follows:

$$K_p = 34.97 \frac{m}{\sec}\left[\frac{(g/g\text{-}mole)\ (mm\ Hg)}{(K)\ (mm\ H_2O)}\right]^{1/2} \qquad \text{Metric System}$$

$$v_s = K_p C_p \left(\sqrt{\Delta p}\right)_{avg} \sqrt{\frac{T_{s(avg)}}{P_s M_s}} \qquad \text{[Eq. 4]}$$

$$K_p = 85.49 \frac{ft}{\sec}\left[\frac{(lb/lb\text{-}mole)\ (in.\ Hg)}{(°R)\ (in.\ H_2O)}\right]^{1/2} \qquad \text{U.S. Customary System}$$

14.5 *Stack Gas Dry Volumetric Flow Rate*—Calculate the stack gas dry volumetric flow rate, Q_{sd}, using Eq. 5.

$$Q_{sd} = 3600(1 - B_{ws})v_s A \left(\frac{T_{std}}{T_{s(avg)}}\right)\left(\frac{P_s}{P_{std}}\right) \qquad \text{[Eq. 5]}$$

where:

A = cross-sectional area of stack, m^2 (ft^2)

T_{std} = standard absolute temperature, 293 K (528°R)

P_{std} = standard absolute pressure, 760 mm Hg (29.92 in. Hg).

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To convert Q_{sd} from dscm/hr (dscf/hr) to dscm/min (dscf/min), divide Q_{sd} by 60

14.6 *Isokinetic Variation*—Calculate the variation from isokinetic sampling rate, I, from raw data using Equation 6:

$$I = \frac{100\ T_s[K_3 V_{lc} + (V_m Y/T_m)(P_{bar} + \Delta H/13.6)]}{60\theta v_s P_s A_n} \qquad \text{[Eq. 6]}$$

where:

K_3 = 0.003454 mm Hg-m^3/mL-K (0.002669 in. Hg-ft^3/mL-°R) or from intermediate values using Equation 7:

$$I = \frac{100 T_s V_{m(std)} P_{std}}{60 T_{std} v_s \theta A_n P_s (1 - B_{ws})} = \frac{K_4 T_s V_{m(std)}}{P_s v_s A_n \theta (1 - B_{ws})} \qquad \text{[Eq. 7]}$$

where:

K_4 = 4.320 for metric units (0.09450 for U.S. Customary units)

Note 6—If 90% ≤ I ≤ 110%, then the results are acceptable. If the criteria for I are not met and the amount of Hg captured in the ash is significant (>1 µg/dscm), then the particle-bound results are not valid, and the test should be repeated.

15. Calculations for Particle-Bound, Oxidized, Elemental, and Total Mercury Concentrations:

15.1 *Particle-Bound Mercury*

15.1.1 *Case 1: Amount of Ash on the Filter is Greater Than 0.5 g*—Calculate the concentration of mercury in µg/g in the ash sample (Hg_{ash}) using Equation 8:

$$Hg_{ash},\ \mu g/g = (IR)(DF) \qquad \text{[Eq. 8]}$$

where:

IR = instrument reading, µg/L

DF = dilution factor = (total digested volume, L)/(mass of ash digested, g)

Calculate the amount of mercury in the probe rinse (Hg_{pr}, Container 2) in µg using Equation 9:

$$Hg_{pr},\ \mu g = (IR)(V_1) \qquad \text{[Eq. 9]}$$

where:

IR = instrument reading, µg/L

V_1 = total volume of probe rinse sample from which sample aliquot was taken, L.

Calculate the amount of mercury on the sample filter blank (Hg_{fb}) in the same way using Equation 10.

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$$Hg_{fb}, \mu g = (IR)(V_2) \quad \text{[Eq. 10]}$$

where:

IR = instrument reading, µg/L

V_2 = total volume of sample filter blank digest, L.

The total amount of particle-bound mercury (Hg_{tp}) then is determined using Equation 11:

$$Hg\ (particle), \mu g = (Hg_{ash})(W_{ash}) - Hg_{fb} + Hg_{pr} \quad \text{[Eq. 11]}$$

where:

W_{ash} = the total ash weight on filter, g

The concentration of particle-bound mercury (µg/dscm) in the gas stream is then determined using Equation 12:

$$Hg^{tp}, \mu g/dscm = Hg\ (particle)/V_{m(std)} \quad \text{[Eq. 12]}$$

where:

$V_{m(std)}$ is the total volume of dry gas sampled at standard (normal) conditions, dscm

15.1.2 *Case 2: Amount of Ash on the Filter is Less Than 0.5 g*—The calculation is the same as in Case 1 except the entire sample (ash and filter) is digested; therefore, DF in Equation 8 is defined only by the total digested volume. Equations 9–11 remain the same.

15.2 *Oxidized Mercury*

15.2.1 *KCl Solution (Impingers 1–3)*—Calculate the concentration of mercury in µg/L in the KCl impinger solutions using Equation 13:

$$Hg_{KCl}, \mu g/L = (IR)(DF) \quad \text{[Eq. 13]}$$

where:

IR = instrument reading, µg/L

DF = dilution factor = $\frac{V_D + V(H_2SO_4) + V(HNO_3) + V(KMnO_4) + V(K_2S_2O_8) + V(NH_2OH)}{V_D}$

V_D = total digested volume, 10 mL

$V(H_2SO_4)$ = volume of added concentrated H_2SO_4, 0.5 mL

$V(HNO_3)$ = volume of added concentrated HNO_3, 0.5 mL

$V(KMnO_4)$ = volume of added 5%$^W/_V$ $KMnO_4$, 1.5 mL

$V(K_2S_2O_8)$ = volume of added 5%$^W/_V$ $K_2S_2O_4$, 0.75 mL

$V(NH_2OH$ = volume of added 10%$^W/_V$ hydroxylamine sulfate, 1.0 mL

The amount of mercury in the KCl solution blank is calculated in the same way.

15.2.2 *Total Oxidized Mercury (Hg_O)*—is defined by method as the mercury measured in the KCl sample minus the mercury measured in the KCl solution blanks, as shown in Equation 14:

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$$Hg_O,\ \mu g = (Hg_{KCl})(V_3) - (Hg_{Ob})(V_3) \qquad \text{[Eq. 14]}$$

where:

Hg_{KCl} = Mercury concentration measured in KCl aliquot, µg/L
V_3 = Total volume of aqueous KCl from which sample aliquot was taken, L
Hg_{Ob} = Mercury concentration measured in KCl solution blank aliquot, µg/L

The concentration of Hg^{2+} (µg/dscm) in the gas stream is then determined using Equation 15:

$$Hg^{2+},\ \mu g/dscm = Hg_O/V_{m(std)} \qquad \text{[Eq. 15]}$$

Where:

$V_{m(std)}$ is the total volume of dry gas sampled at standard conditions, dscm

15.3 *Elemental Mercury*

15.3.1 *HNO_3–H_2O_2 Solution (Impinger 4)*—Calculate the concentration of mercury in µg/L in the HNO_3–H_2O_2 impinger solution using Equation 16:

$$Hg_{H2O2},\ \mu g/L = (IR)(DF) \qquad \text{[Eq. 16]}$$

where:

IR = instrument reading, µg/L
DF = dilution factor = $\dfrac{V_D + V(HCl) + V(KMnO_4) + V(K_2S_2O_8) + V(NH_2OH)}{V_D}$

V_D = total digested volume, 5 mL
V(HCl) = volume of added concentrated HCl, 0.25 mL
$V(KMnO_4)$ = volume of added saturated $KMnO_4$, mL (volume need to turn sample to a purple color)
$V(K_2S_2O_8)$ = volume of added 5%$^W/_V$ $K_2S_2O_4$, 0.75 mL (if used)
$V(NH_2OH$ = volume of added 10%$^W/_V$ hydroxylamine sulfate, 1.0 mL

The amount of mercury in the HNO_3–H_2O_2 solution blank is calculated in the same way.

15.3.2 *H_2SO_4–$KMnO_4$ Solution (Impingers 5–7)*—Calculate the concentration of mercury in µg/L in the H_2SO_4–$KMnO_4$ impinger solutions using Equation 17:

$$\text{Mercury},\ \mu g/L = IR \qquad \text{[Eq. 17]}$$

where:

IR = instrument reading, µg/L

Note 7—There is no dilution factor since no addition is made to the solution after the aliquot is taken for analysis.

The concentration of mercury in the H_2SO_4–$KMnO_4$ solution blank is calculated in the same way.

15.3.3 *Total Elemental Mercury (Hg_E)*—is defined by method as the mercury measured in the H_2SO_4–$KMnO_4$ impingers plus the mercury in the HNO_3–H_2O_2 impingers minus the solution blanks as shown in Equation 18:

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$$Hg_E,\ \mu g = (Hg_{H2O2})(V_4) - (Hg_{Eb1})(V_4) + (Hg_{KMnO4})(V_5) - (H_{Eb2})(V_5) \qquad \text{[Eq. 18]}$$

where:

Hg_{H2O2} = Mercury concentration measured in HNO_3–H_2O_2 aliquot, µg/L
V_4 = Total volume of aqueous HNO_3–H_2O_2 from which sample aliquot was taken, L
Hg_{Eb1} = Mercury concentration measured in HNO_3–H_2O_2 solution blank aliquot, µg/L
Hg_{KMnO4} = Mercury concentration measured H_2SO_4–$KMnO_4$ aliquot, µg/L
V_5 = Total volume of aqueous H_2SO_4–$KMnO_4$ from which sample aliquot was taken, L
Hg_{Eb2} = Mercury concentration measured in H_2SO_4–$KMnO_4$ solution blank aliquot, µg/L

The concentration of Hg^{2+} (µg/dscm) in the gas stream is then determined using Equation 19:

$$Hg^0,\ \mu g/dscm = Hg_E/V_{m(std)} \qquad \text{[Eq. 19]}$$

Where:
$V_{m(std)}$ is the total volume of dry gas sampled at standard conditions, dscm

15.4 *Total Mercury*—Is defined by the method as the sum of the particulate bound mercury, oxidized mercury, and elemental mercury as shown in Equation 20:

$$Hg(total),\ \mu g/dscm = Hg^{tp} + Hg^{2+} + Hg^0 \qquad \text{[Eq. 20]}$$

16. Precision and Bias

16.1 *Precision*

16.1.1 Formal evaluation of the Ontario Hydro method was completed with dynamic spiking of Hg^0 and $HgCl_2$ into a flue gas stream.[9] The results are shown in Table 1. The relative standard deviation for gaseous elemental mercury and oxidized mercury was found to be less than 11% for mercury concentrations greater than 3 µg/Nm^3 and less than 34% for mercury concentrations less than 3 µg/Nm^3. In all cases, the laboratory bias for these tests based on a calculated correction factor was not statistically significant. These values were within the acceptable range, based on the criteria established in EPA Method 301 (% RSD less than 50%).

16.1.2 The precision of particle-bound, oxidized, and elemental mercury sampling method data is influenced by many factors: flue gas concentration, source, procedural, and equipment variables. Strict adherence to the method is necessary to reduce the effect of these variables. Failure to assure a leak-free system, failure to accurately calibrate all indicated system

[9] EPRI. "Evaluation of Flue Gas Mercury Speciation Methods," EPRI TR-108988, Electric Power Research Institute, Palo Alto, CA, Dec. 1997.

components, failure to select a proper sampling location, failure to thoroughly clean all glassware and failure to follow prescribed sample recovery, preparation, and analysis procedures can seriously affect the precision of the results.

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16.2 *Bias*

16.2.1 Gaseous mercury species in flue gases that are capable of interacting with fly ash particles collected in the front half of the sampling train can produce a positive particle-bound mercury bias.

16.2.2 Particle-bound mercury existing in the flue gas may vaporize after collection in the front half of the sampling train because of continued exposure to the flue gas sample stream and reduced pressures during the sampling period. Such vaporization would result in a negative particle-bound mercury bias.

Table 1

Results from Formal EPA Method 301 Evaluation Tests for the Ontario Hydro Method*

	Total Vapor-Phase Mercury			**Oxidized Mercury**			**Elemental Mercury**		
Ontario Hydro Method**	Mean, $\mu g/Nm^3$	Std. Dev.	RSD, %	Mean, $\mu g/Nm^3$	Std. Dev.	RSD, %	Mean, $\mu g/Nm^3$	Std. Dev.	RSD, %
Baseline	23.35	2.05	8.79	21.24	2.13	10.02	2.11	0.65	30.69
Hg^0 Spike (15.0 $\mu g/Nm^3$)	38.89	2.00	5.13	23.32	2.08	8.94	15.57	1.09	6.97
$HgCl_2$ Spike (19.9 $\mu g/Nm^3$)	42.88	2.67	6.23	40.22	2.87	7.14	2.66	0.89	33.31

* For each mean result, there were 12 replicate samples (four quadtrains)
** The correction factor in all cases was not statically significant and is not shown.

17. Keywords—Air toxics, mercury, sampling, speciation

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Plant.....

Location.....

Operator.....

Date.....

Run No. .....

Sample Box No. .....

Meter Box No. .....

Meter ΔH @.....

C factor.....

Pitot tube coefficient, C_p.....

Schematic of Stack Cross Section

Ambient Temperature .....

Barometric Pressure .....

Assumed Moisture, % .....

Probe Length, m (ft) .....

Nozzle Identification No. .....

Average Calibrated Nozzle Diameter, cm (in.) .....

Probe Heater Setting .....

Leak Rate, m^3 min (cfm) .....

Static Pressure, mm Hg (in. Hg) .....

Filter No. .....

Traverse Point Number	Sampling Time	Vacuum	Stack Temp.	Velocity Head	Pressure Differential Across	Gas Sample Volume	Gas Sample Temp at Dry Gas Meter		Filter Exit Temp.	Probe Exit Temp	Final Impinger Exit Temp
	min	mm Hg (in. Hg)	(T_s), °C (°F)	(ΔP_s) mm H_2O (in. H_2O)	mm H_2O (in. H_2O)	m^3 (ft^3)	Inlet °C (°F)	Outlet °C (°F)	°C (°F)	°C (°F)	°C (°F)
Total											
Average											

FIG. 2. Mercury-Sampling Field Data Report

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1. Rinse filter holder and connector with 0.1N HNO_3.
2. Add $H_2SO_4/KMnO_4$ to each impinger bottle until purple color remains.
3. Rinse with 0.1N HNO_3.
4. Rinse with 8N HCl if brown residue remains.
5. Final rinse with 0.1N HNO_3.

Rinse Bottles Sparingly with
- 0.1N HNO_3
- 8N HCl
- 0.1N HNO_3

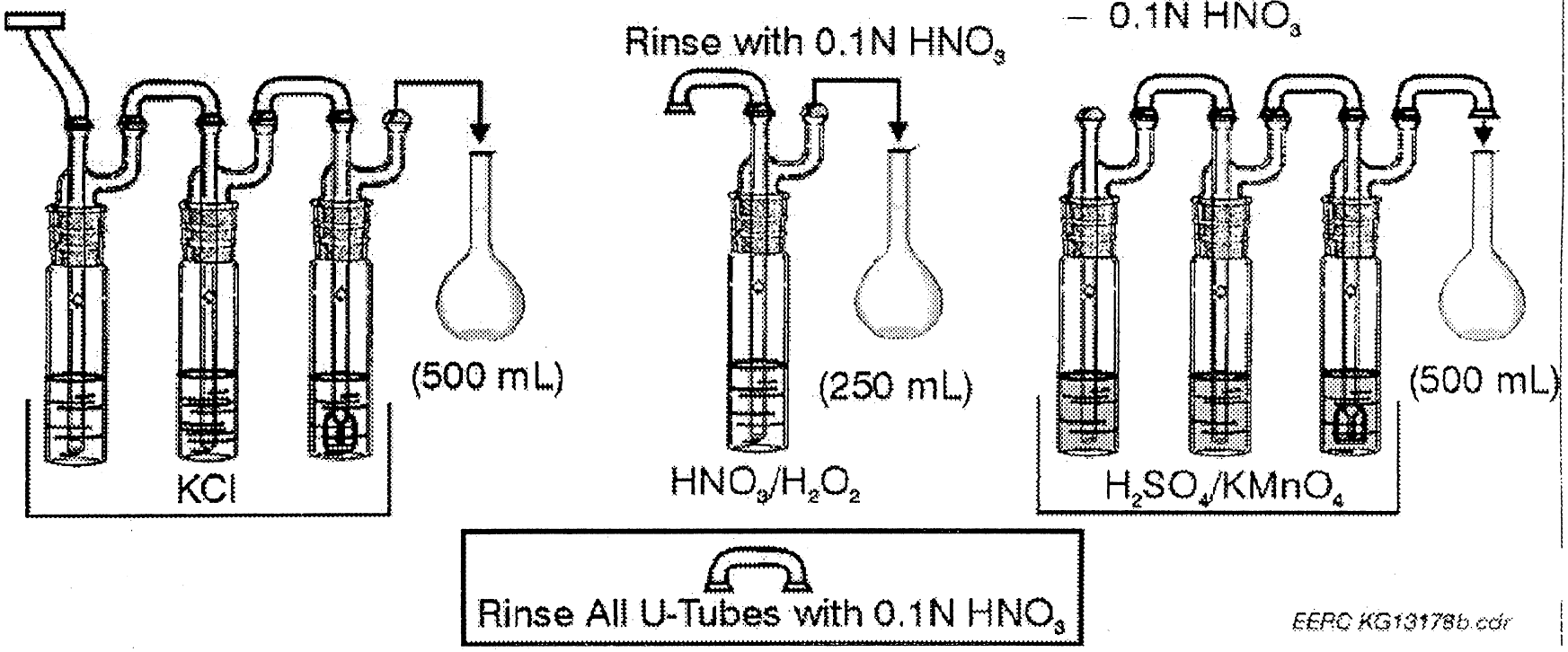

FIG. 3. Sample Recovery Scheme for the Mercury-Sampling Train

BIBLIOGRAPHY OF EPA METHODS REFERENCED

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(2) EPA Methods 6010, 6020, 7000, 7041, 7060, 7131, 7421, 7470, 7740, and 7841, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* SW-846, Third Edition. September 1988. Office of Solid Waste and Emergency Response, U. S. Environmental Protection Agency, Washington, D.C. 20460.

(3) EPA Methods 1 through 5, *Code of Federal Regulations*, Title 40, Part 60, Appendix A, July 1, 1991.

(4) EPA Method 101A, *Code of Federal Regulations*, Title 40, Part 61, Appendix B, July 1, 1991.

(5) EPA Method 29, *Emission Measurement Technical Information Center*, EMTIC TM-029, April 25, 1996.

(6) U.S. Environmental Protection Agency "Method 301 - Field Validation of Pollutant Measurement Method from Various Waste Media," In *Code of Federal Regulations*, Title 40, Parts 61 to 80. Washington, DC, USA, Office of the Federal Register, Part 63, appendix A, pp 324-331, July 1993.

Designation: D 2234 – 99

Standard Practice for Collection of a Gross Sample of Coal[1]

This standard is issued under the fixed designation D 2234; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

Data obtained from coal samples are used in establishing price, controlling mine and cleaning plant operations, allocating production costs, and determining plant or component efficiency. The task of obtaining a sample of reasonable weight to represent an entire lot presents a number of problems and emphasizes the necessity for using standard sampling procedures.

Coal is one of the most difficult of materials to sample, varying in composition from noncombustible particles to those which can be burned completely, with all gradations in between. The task is further complicated by the use of the analytical results, the sampling equipment available, the quantity to be represented by the sample, and the degree of precision required.

This practice gives the overall requirements for the collection of coal samples. The wide varieties of coal-handling facilities preclude the publication of detailed procedures for every sampling situation. The proper collection of the sample involves an understanding and consideration of the physical character of the coal, the number and weight of increments, and the overall precision required.

1. Scope

1.1 This practice covers procedures for the collection of a sample under various conditions of sampling. The sample is to be crushed and further prepared for analysis in accordance with Method D 2013. However, the procedures for dividing large samples before any crushing are given in this practice.

1.2 This practice describes general and special purpose sampling procedures for coals *(1)* by size and condition of preparation (for example, mechanically cleaned coal or raw coal) and *(2)* by sampling characteristics.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 121 Terminology of Coal and Coke

D 2013 Method of Preparing Coal Samples for Analysis[2]

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods[3]

E 456 Terminology Relating to Quality and Statistics[2]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *accuracy:*

3.1.1.1 *generally*—a term used to indicate the reliability of a sample, a measurement, or an observation.

3.1.1.2 *specifically*—a measure of closeness of agreement between an experimental result and the true value. Example: the observed and true sulfur content of a coal consignment. This measure is affected by chance errors as well as by bias.

3.1.2 *cross-belt sampler*—a sampling machine designed to extract an increment directly from a conveyor belt surface by taking a sweep through the material on the conveyor.

3.1.3 *falling-stream sampler*—a sampling machine designed to extract an increment from a falling stream of coal at the discharge end of a conveyor or chute by moving through the falling stream of material.

3.1.4 *gross sample*—a sample representing one lot of coal and composed of a number of increments on which neither reduction nor division has been performed.

3.1.5 *increment*—a small portion of the lot collected by one operation of a sampling device and normally combined with other increments from the lot to make a gross sample.

3.1.6 *representative sample*—a sample collected in such a manner that every particle in the lot to be sampled is equally represented in the gross or divided sample.

3.1.7 *sample*—a quantity of material taken from a larger quantity for the purpose of estimating properties or composition of the larger quantity.

3.1.8 *size consist*—the particle size distribution of a coal.

4. Summary of Practice

4.1 The general-purpose sampling procedures are intended to provide, in 19 of 20 cases, dry ash results that are within an interval of ±1/10 of the average dry ash results that would be obtained in hypothetical repeated sampling.

4.2 Special-purpose sampling procedures apply to the sampling of coal when other precision limits are required, or when

[1] These methods are under the jurisdiction of ASTM Committee D-5 on Coal and Coke and are the direct responsibility of Subcommittee D05.23 on Sampling.

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[2] *Annual Book of ASTM Standards*, Vol 05.05.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

other constituents are used to specify precision, or for performance tests.

4.3 For coals of known size and condition of preparation, tables are given for the determination of the number and weight of increments required for a gross sample for both general and special-purpose sampling.

4.4 The procedures appear in the following order:

Test Method	Section
Sampling of Coals Based on Size and Condition of Preparation	8.1
General-Purpose Sampling Procedure	8.1.1
Number and Weight of Increments	8.1.1.2
Number of Gross Samples	8.1.1.4
Special-Purpose Sampling	8.1.2
Number and Weight of Increments	8.1.2.2
Number of Gross Samples	8.1.2.3
Sampling of Coals Based on Known Sampling Characteristics	8.2
Principles of Sampling by Sampling Characteristics	8.2.1
General-Purpose Sampling	8.2.2
Number and Weight of Increments	8.2.2.1
Number of Gross Samples	8.2.2.2
Special-Purpose Sampling	8.2.3
Number and Weight of Increments and Number of Gross Samples	8.2.3.2
Division of the Gross Samples Before Crushing	8.3
Sampling of Coal for Total Moisture Determination	8.4
Types of Moisture Samples	8.4.1
Entire Gross Samples	8.4.1.1
Special Moisture Subsamples	8.4.1.2
Other Subsamples for Moisture Testing	8.4.1.3
Special Precautions	8.4.2
Weight of Increments	8.4.3
Number of Increments	8.4.4
Moisture Sampling Based on Known Sampling Characteristics	8.4.4.1
Moisture Sampling Based Only on Size	8.4.4.2

5. Significance and Use

5.1 It is intended that this practice be used to provide a representative sample of the coal from which it is collected. Because of the variability of coal and the wide variety of sampling equipment, caution should be used in all stages of sampling from system specifications and equipment procurement to equipment acceptance testing and actually taking the final sample.

5.2 After further processing (Method D 2013), the sample may be analyzed for a number of different parameters. These parameters may affect the lot's value, its ability to meet specifications, its environmental impact, as well as other properties.

6. Increment Collection Classification

6.1 The type of selection, the conditions under which individual increments are collected, and the method of spacing of increments from the coal consignment or lot are classified according to the following descriptions and Table 2. These designations are to be used for sampling specifications and for descriptions of sampling programs and sampling equipment.

6.2 *Types of Increments*—The types of selection of increments are based on whether or not there is human discretion in the selection of the pieces of coal or portions of the coal stream.

6.2.1 *Type I,* in which specific pieces or portions are not subject to selection on a discretionary basis. This includes that in which the increment is collected in precise accord with previously assigned rules on timing or location that are free of any bias. Type I selection increments generally yield more accurate results.

6.2.2 *Type II,* in which some measure of human discretion is exercised in the selection of specific pieces of coal or of specific portions of the stream, pile, or shipment.

6.3 *Conditions of Increment Collection*—The conditions under which individual increments are collected are the conditions of the main body of coal relative to the portion withdrawn. Four conditions are recognized:

6.3.1 *Condition A (Stopped-Belt Cut),* in which a loaded conveyor belt is stopped and a full cross-section cut with parallel sides is removed from the coal stream. The distance between the parallel faces shall not be less than three times the normal top size of the coal.

6.3.2 *Condition B (Full-Stream Cut),* in which a full cross-section cut is removed from a moving stream of coal.

6.3.3 *Condition C (Part-Stream Cut),* in which a portion, not a full cross section, is removed from a moving stream of coal.

6.3.4 *Condition D (Stationary Coal Sampling),* in which a portion of coal is collected from a pile, a rail car, a barge, or a shiphold.

6.4 *Spacing of Increments*—The spacing of increments pertains to the kind of intervals between increments. Two spacing methods are recognized: systematic and random. Systematic spacing is usually preferable.

6.4.1 *Systematic Spacing 1,* in which the movements of individual increment collection are spaced evenly in time or in position over the lot.

6.4.2 *Random Spacing 2,* in which the increments are spaced at random in time or in position over the lot.

7. Organization and Planning of Sampling Operations

7.1 *Precaution*—It is imperative that every gross sample be collected carefully and conscientiously and in strict accordance with the procedures prescribed in this practice; for if the sampling is done improperly, the sample will be in error, and it may be impossible or impracticable to take another sample. However, if the analysis is in error, another analysis can easily be made of the original sample, except for moisture.

7.2 *Selection of Appropriate Sampling Procedure*—Variations in coal-handling facilities make it impossible to publish rigid rules covering every sampling situation in complete and exact details. Proper sampling involves an understanding and proper consideration of the minimum number and weight of increments, the size consist of the coal, the condition of preparation of the coal, the variability of the constituent sought, and the degree of precision required.

7.2.1 *Number and Weight of Increments*—The number and weight of increments required for a given degree of precision depends upon the variability of the coal. This variability increases with an increase in free impurity. A coal high in inherent impurity and with comparatively little free impurity may exhibit much less variability than a coal with a low inherent impurity and a relatively high proportion of free impurity. For most practical purposes, an increase in the ash content of a given coal usually indicates an increase in variability. It is imperative that not less than the minimum

TABLE 1 Increment Types, Conditions, and Spacing

Condition of Increment Collection from the Main Body of Coal	Types of Increment			
	Type I No Human Discretion Is Used		Type II Human Discretion Is Used	
	Spacing of Increments		Spacing of Increments	
	1. Systematic	2. Random	1. Systematic	2. Random
Condition A, stopped belt cut	I-A-1	I-A-2	II-A-1	II-A-2
Condition B, full-stream cut	I-B-1	I-B-2	II-B-1	II-B-2
Condition C, part-stream cut	I-C-1	I-C-2	II-C-1	II-C-2
Condition D, stationary sampling	I-D-1	I-D-2	II-D-1	II-D-2

specified number of increments of not less than the minimum specified weight be collected from the lot. For Condition D, the increments shall be of equal weight.

7.2.2 *Increment Collection Method to Be Used*—To obtain complete representation of all sizes, it is most desirable that the sample increments be withdrawn from the full cross section of the stream. The best possible increment is a full cross-section cut removed from a stopped belt, Classification I-A-1 in Table 1. The best possible increment from a flowing stream of coal is one obtained by moving a cutter device entirely across the stream at a uniform speed, the same for each increment, into one side of the stream and out of the other, without allowing the receptacle to overflow (Classification I-B-1 in Table 1). Classification methods given in Table 1 are listed in order of decreasing reliability. The highest possible classification method, wherever feasible, should be used. Details of sampling procedures should be agreed upon in advance by all parties concerned. Whenever circumstances dictate utilization of increment collection classifications "Condition C" or "Condition D" or "Type II," details of sampling procedure shall be agreed upon in advance by all parties concerned.

7.3 *Distribution of Increments*—It is essential that the increments be distributed throughout the lot to be sampled. This distribution is related to the entire volume of the lot, not merely its surface or any linear direction through it or over it. If circumstances prevent the sampler from applying this principle, the lot is sampled only in part, and the gross sample is representative only of this part. The spacing of the increments shall be varied if the possibility exists that increment collection may get "in phase" with the sequence of coal variability. Example: routine sampling of commercial coal from a continuous stream (conveyor belt) in which increment collection is automatic and its sequence coincides with the "highs" or "lows" in the content of fines.

7.4 *Dimensions of Sampling Device*—The opening of the sampling device shall be no less than 2.5 times the nominal top size of the coal and no less than 31.8 mm (1.25 in.). The sampling device shall be of sufficient capacity to completely retain or entirely pass the increment without spillage at the maximum rate of coal flow.

7.5 *Characteristics and Movement of Sampling Device*—In sampling from moving streams of coal, the sampling device shall be designed to collect each increment with no selective rejection of material by size and with no contamination by nonsample material.

7.5.1 *Falling-Stream Sampler*—In collecting an increment, the falling-stream cutter should move at a constant velocity through the falling stream of coal. Falling-stream cutter speeds of 18 in./s (457 mm/s) or less have been found to produce acceptable results.

7.5.2 *Cross-Belt Sampler*—The cross-belt cutter should be designed and operated at a velocity across the conveyor surface that is high enough to prevent selective rejection of material by size. The velocity and design of the cutter should also prevent contamination of the sample with material not collected within the cutter. The sampling machine should be designed to assure a complete increment extraction, and the arc of travel of the sweep-arm cutter should closely fit the configuration of the conveyor belt.

7.6 *Preservation of Moisture*—The increments obtained during the sampling period shall be protected from changes in composition as a result of exposure to rain, snow, wind, sun, contact with absorbent materials, and extremes of temperature. The circulation of air through equipment must be reduced to a minimum to prevent both loss of fines and moisture. Samples in which moisture content is important shall be protected from excessive air flow and then shall be stored in moisture-tight containers. Metal cans with airtight lids, or heavy vapor-impervious bags, properly sealed, are satisfactory for this purpose.

7.7 *Contamination*—The sampling arrangement shall be planned so that contamination of the increments with foreign material or unrelated coal does not create bias of practical consequence.

7.8 *Mechanical System Features*—It is essential that mechanized systems as a whole, including sampling machines, chutes, feed conveyors, crushers and other devices, be self-cleaning and non-clogging and be designed and operated in a manner that will facilitate routine inspection and maintenance.

7.9 *Personnel*—Because of the many variations in the conditions under which coal must be sampled, and in the nature of the material being sampled, it is essential that the samples be collected under the direct supervision of a person qualified by training and experience for this responsibility. Where human labor is employed to collect the increments, it is essential that samples be collected by a trained and experienced sampler or under the direct personal observation of such a person. This includes sampling for the purpose of determining sampling characteristics of a coal or characteristics of a particular sampling apparatus.

7.10 *Criteria of Satisfactory Performance*—A satisfactory sampling arrangement is one that takes an unbiased sample at the desired degree of precision of the constituent for which the sample is to be analyzed. One fundamental characteristic of such an arrangement is that the size consist of the sample will adequately represent the true size consist of the coal. Sampling

systems shall be tested initially and at regular intervals to determine whether the sample adequately represents the coal. In addition, sampling systems should be given a rough performance check as a matter of routine. This is done by comparing the weight or volume of collected sample with that of the total flow of coal to ensure a constant sampling ratio.

7.11 *Relative Location of Sampling and Weighing*—It is preferable that coal be weighed and sampled at the same time. If there is a lapse in time between these two events, consideration should be given by both the purchaser and the seller to changes in moisture during this interval and the consequent shift in relationship of moisture to the true quality of the coal at the instant when ownership of the coal transfers from one to the other.

8. Procedures

8.1 *Sampling of Coals Based on Size and Condition of Preparation:*

8.1.1 *General-Purpose Sampling:*

8.1.1.1 The general-purpose sampling procedures are intended to provide, in 19 of 20 cases, dry ash results that are within the interval of ±1/10 of the average dry ash results that would be obtained in hypothetical repeated sampling. Under some conditions, as detailed in 7.2.1 and 7.2.2, Conditions C and D and Type II, this precision may not be obtained.

8.1.1.2 *Number and Weight of Increments*—Obtain the number and weight of increments as specified in Table 2 except as provided in 8.1.1.5(*b*). Determine the minimum number of increments from the condition of preparation, and determine the minimum weight of each increment from the top size of the coal. Classify the coals to be sampled according to the general purpose procedure into three groups by top size. Further classify each of these groups into two subgroups in accordance with the condition of preparation. These classifications are shown in Table 2.

8.1.1.3 Variations in construction of the sampling device and flow, structure, or size consist of the coal may make it impracticable to collect increments as small as the minimum weight specified in Table 2. In such cases, collect an increment of greater weight. However, do not reduce the minimum number of increments, regardless of large excesses of individual increment weights. Table 2 lists the absolute minimum number of increments for general-purpose sampling which may not be reduced except as specified in 8.1.1.5(*b*). Other considerations may make it advisable or necessary to increase this number of increments.

8.1.1.4 *Number of Gross Samples*—Under the general-purpose sampling procedure, for quantities up to approximately 1000 tons [908 metric tons] [908 Mg] it is recommended that one gross sample represent the lot. Take this gross sample in accordance with the requirements prescribed in Table 2.

8.1.1.5 For quantities over 1000 tons [908 Mg], use any of the following alternatives:

(*a*) Take separate gross samples for each 1000-ton [908-Mg] lot of coal or fraction thereof.

(*b*) Use one gross sample to represent the total tonnage provided the number of increments, as stated in Table 2, are increased as follows:

$$N_2 = N_1 \sqrt{\frac{\text{total lot size (tons or Mg)}}{\text{1000 tons or 908 Mg}}} \quad (1)$$

where:

N_1 = number of increments specified in Table 2 and
N_2 = number of increments required.

For example, a 4000-ton [3632-Mg] lot will require twice the number of increments specified in Table 2. Using this technique, it is theoretically possible to collect one gross sample to represent a lot of infinite tonnage. Practical experience, however, indicates the maximum size of a lot of coal to be represented by one gross sample should not exceed 10 000 tons [9080 Mg].

(*c*) Take separate gross samples for each 1000-ton [908-Mg] lot of coal or fraction thereof, and thoroughly mix their No. 60 sieve size analysis samples together in proportion to the tonnage represented by each sample. Make one analysis of the composite sample.

8.1.2 *Special-Purpose Sampling:*

8.1.2.1 This special-purpose sampling procedure shall apply to the sampling of coal when increased precision is required, and the only knowledge of the coal is its top size and conditions of preparation.

8.1.2.2 *Number and Weight of Increments*—Take the same number and weight of increments per gross sample as specified in Table 2, or as specified in 8.1.1.5(*b*).

8.1.2.3 *Number of Gross Samples*—To obtain increased precision for the final result for a given consignment, increase

TABLE 2 Number and Weight of Increments for General-Purpose Sampling Procedure[A]

Top Size	⅝ in. [16 mm]	2 in. [50 mm]	6 in. [150 mm][B]
	Mechanically Cleaned Coal[C]		
Minimum number of increments	15	15	15
Minimum weight of increments, lb	2	6	15
Minimum weight of increments, kg	1	3	7
	Raw (Uncleaned Coal)[C]		
Minimum number of increments	35	35	35
Minimum weight of increments, lb	2	6	15
Minimum weight of increments, kg	1	3	7

[A] Under Conditions C and D, see 7.2.1 and 7.2.2.
[B] For coals above 6-in. [150-mm] top size, the sampling procedure should be mutually agreed upon in advance by all parties concerned.
[C] If there is any doubt as to the condition of preparation of the coal (for example, mechanically cleaned coal or raw coal) the number of increments for raw coal shall apply. Similarly, although a coal has been mechanically cleaned, it may still show great variation because of being a blend of two different portions of one seam or a blend of two different seams. In such cases, the number of increments should be as specified for raw (uncleaned) coal.

the number of gross samples collected from that consignment and analyze each gross sample separately, reporting the average of results. To reduce errors to one half, that is, to "double" the precision, take four times as many gross samples. Similarly, to reduce errors to one third, to "triple" the precision, take nine times as many gross samples.

8.2 *Division of the Gross Sample Before Crushing:*

8.2.1 In the case of very large and unwieldy gross samples, it is permissible to divide the gross sample to reduce its weight, provided the following conditions are fulfilled:

8.2.1.1 If the entire gross sample is mixed in a suitable blender (double-cone or twin-shell tumbler) it is permissible to divide the sample using the schedule of Table 2. Test the divided sample for bias.

8.2.1.2 If each very large increment is reduced in quantity by secondary sampling, take at least six secondary increments from each primary increment. The method of collection of secondary increments must be proved to be free from bias. In no case shall the weight of a secondary increment be less than shown in the schedule of Table 2.

8.3 *Sampling of Coal for Total Moisture Determinations:*

8.3.1 *Types of Moisture Samples*—Moisture determinations as specified in the method to be used are to be made on the following kinds of samples.

8.3.1.1 *Entire Gross Sample*—For referee tests, air dry the entire gross sample and measure the weight loss from the entire gross sample during this drying. This procedure can be carried out on the entire gross sample as a single batch or on groups of primary increments or as separate operations on the individual primary increments; obtain, by one of these means, the total weight loss from the entire gross sample. After this air drying, the sample can be crushed or divided, or both, as required by the referee test for moisture.

8.3.1.2 *Special Moisture Subsample*—For moisture testing, a special subsample can be taken from a gross sample before any operations of air drying or crushing. Take this subsample from the gross sample in accordance with the requirements of 8.3.

8.3.1.3 *Other Subsamples for Moisture Testing*—For moisture testing, a subsample can be used that is collected after the initial crushing and dividing of a gross sample. The procedures for the crushing and dividing, and for this subsequent subsampling for moisture, are given in Method D 2013.

8.3.2 *Special Precautions*—Collect samples and subsamples for moisture in such a manner that there is no unmeasured loss of moisture of significant amount. Make adequate weighings before and after drying or other operations to measure all significant weight losses.

8.3.3 *Weight of Increments*—The minimum weight of each increment must be that which is sufficient as to be free of bias. This depends on the top size of the coal in the stream being sampled, the dimensions of the collection device, and other factors of the withdrawal of the increment. Since much of the moisture tends to be distributed uniformly across the surface, moisture bias is present when the size consist of the sample is not the same as the size consist of the lot sampled. In addition, when there is no knowledge of the sampling characteristics for moisture, each increment shall not weigh less than the values in Table 2.

8.3.4 *Number of Increments*—The number of increments required for a given degree of precision depends on the weight of the increments, the distribution of the moisture, and the total amount of moisture. The distribution of moisture, however, is not easily evaluated independent of total moisture; consequently, the combined effects can be measured by determining the sampling characteristics for moisture.

8.3.4.1 *Moisture Sampling Based Only on Size*—When there is no knowledge of the sampling characteristics for moisture, collect at least the number of increments from the lot of coal as those given in Table 2. When a special moisture subsample is taken from the gross sample before any drying or crushing operations, collect the number of increments for the subsample as specified in 8.2.

9. Precision and Bias

9.1 The precision of the general-purpose sampling procedure, based on size and condition of preparation, is stated in 8.1.1.1. If a different precision is required, reference 8.1.2.

ANNEX

(Mandatory Information)

A1. TEST METHOD FOR ESTIMATING THE OVERALL VARIANCE FOR INCREMENTS

A1.1 Scope

A1.1.1 This test method describes the procedure for estimating the overall variance for increments of one fixed weight of a given coal. It is applicable to mechanical sampling when there is no need to explore system and random variance components, but there is a need for obtaining the overall variance for increments (the size of increments is dictated by the sampling equipment).

A1.2 Procedure

A1.2.1.1 The following procedure should be used to determine the overall variance of increments:

A1.2.1.1 Collect two series of individual increments at widely spaced intervals, for example, a series of ten increments, two each day for five days, followed by a second

TABLE A1.1 Variance Ratio Limit Values

1	2	3
Increment per Set	Variance Ratio Limit	"C" Factor
10	3.18	1.92
20	2.17	1.53
30	1.86	1.40
40	1.70	1.33
50	1.61	1.29

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