Background Report Reference

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Title: Results the April 7, 1992 Air Emission Compliance Test on the No. 1 & 3 Boilers At The Louisiana Pacific Plant in Urania, Louisiana

Interpoll Laboratories, Inc.

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

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

RESULTS OF THE APRIL 7, 1992 AIR EMISSION COMPLIANCE TEST ON THE NO. 1 & 3 BOILERS AT THE LOUISIANA-PACIFIC PLANT IN URANIA, LOUISIANA

Submitted to:

LOUISIANA-PACIFIC CORPORATION
P.O. Box 3107
Conroe, Texas 77305

Attention:

Dr. James Boswell

Reviewed by:

Daniel J. Despen
Manager
Field Testing Support Group

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SP/slp

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APPENDICES:

ABBREVIATIONS

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

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

1 INTRODUCTION

On April 7, 1992, Interpoll Laboratories personnel conducted State particulate, sulfur dioxide, oxides of nitrogen and carbon monoxide compliance tests on the Nos. 1 & 3 Boilers at the Louisiana-Pacific Plant located in Urania, Louisiana. On-site testing was performed by M. Kaehler, D. Brennan, C. Mosser and B. Aschenbach. Coordination between testing activities and plant operation was provided by Jim Boswell and Dan Hough of Louisiana Pacific. The test was not witnessed by a member of the Louisiana Department of Natural Resources.

The No. 1 boiler is a Riley Water Tube Boiler installed in 1969. The normal steam load of the boiler is 85,000 LB/HR of saturated steam. During the test the boiler was fired with wood. Particulate emissions are controlled by a Zurn mechanical collector. Cleaned flue gas exhausts to atmosphere via a 50-foot high radial steel stack which has an inside diameter of 5 feet.

The No. 3 Boiler is a Zurn water tube boiler installed in 1978. It has a normal steam load of 50,000 LB/HR of saturated steam. During the test the boiler was fired with wood. Emissionsare controlled by a Zurn mechanical collector followed by a Zurn venturi scrubber. Flue gas exhausts to atmosphere via a 65-foot high radial steel stack which has an inside diameter of 6 feet 6 inches.

The evaluations were performed in accordance with EPA Methods 1 - 7 and 9, CFR Title 40, Part 60, Appendix A (revised July 1, 1991). A preliminary determination of the gas linear velocity profile was made before the first particulate determination at each test site to allow selection of the appropriate nozzle diameter for isokinetic sample withdrawal. An Interpoll Labs sampling train which meets or exceeds specifications in the above-cited reference was used to extract particulate samples by means of a heated glass-lined probe. Wet catch samples were collected in the back half of the Method 5 sampling train and

analyzed for condensible organics. Sulfur dioxide determinations were performed in accordance with the large impinger version of EPA Method 6.

The oxides of nitrogen samples were collected during the particulate determinations using an all-glass Method 7 sampling train. A heated stainless steel probe was used to extract the samples from the exhaust stream. A plug of glass-wool was used in the end of the probe to remove particulate material.

The NO_x samples were collected in volume-calibrated two-liter all-glass flasks. An aliquot of 25 cc of absorbing solution was added to each flask on-site; the flask was closed, inserted into the sampling train and evacuated. The probe was then purged and the sample collected over a 15 second interval. The flask was then closed, removed from the sampling train, shaken for two minutes and then secured for transport to the laboratory.

Upon arrival at the laboratory, the NO_x samples are logged in, placed in a designated area and maintained at 72 ^0F for 24 hours to allow completion of the conversion of NO to NO_2 and absorption in the acidified peroxide reagent. The flasks are then shaken to complete absorption, attached to a mercury manometer and the static pressure and temperature recorded. The samples are then recovered and analyzed by ion chromatography.

Carbon monoxide determinations were performed in accordance with EPA Method 10 (Ibid). Concentrations were determined using a non-dispersive infrared (NDIR) continuous emission monitor.

An integrated flue gas sample was extracted simultaneously with each particulate and sulfur dioxide sample using a specially designed gas sampling system. The integrated flue gas samples were collected in 44-liter Tedlar bags housed in a protective aluminum container. After sampling was complete, the bags were sealed and returned to the laboratory

for Orsat analysis. Prior to sampling, the Tedlar bags are leak checked at 15 IN.HG. vacuum with an in-line rotameter. Bags with any detectable inleakage are discarded.

Testing on the No. 1 Boiler was conducted from two test ports oriented at 90 degrees on the stack. The test ports are located 5.7 diameters downstream of the nearest flow disturbance and 2.3 diameters upstream of the stack exit. A 24-point traverse was used to extract representative particulate and sulfur dioxide samples. Each traverse point was sampled 2.5 minutes to give a total sampling time of 60 minutes per run. Four oxides of nitrogen samples were collected during each of the particulate and sulfur dioxide runs.

Testing on the No. 3 Boiler was conducted from two test ports oriented at 90 degrees on the stack. The test ports are located 2.0 diameters downstream of the nearest flow disturbance and 2.3 diameters upstream of the stack exit. A 24-point traverse was used to extract representative particulate and sulfur dioxide samples. Each traverse point was sampled 2.5 minutes to give a total sampling time of 60 minutes per run. Four oxides of nitrogen samples were collected during each of the particulate and sulfur dioxide runs.

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

2 SUMMARY AND DISCUSSION

The important results of the particulate emission tests are summarized in Tables 1 and 2. Sulfur dioxide and oxides of nitrogen results are summarized in Tables 3 and 4, respectively. Carbon monoxide results are summarized in Table 5. An overview of the average emission factors for each of the three criteria pollutants are presented below:

	Emission Factor ($LB/10^6BTU$)	
Pollutant	Boiler No. 1	Boiler No. 3
Particulate	1.34	0.24
Sulfur Dioxide	0.004	0.005
Oxides of Nitrogen	0.163	0.180

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

Table 1. Summary of the Results of the April 7, 1992 EPA Particulate Emission Compliance Test on the No. 1 Boiler Stack at the Louisiana-Pacific Plant Located in Urania, Louisiana.

ITEM	Run 1	Run 2	Run 3
Date of test	04-07-92	04-07-92	04-07-92
Time runs were done (HRS)	1245/1353	1440/1545	1635/1739
Steam flow (KLB/HR)	43	43	43
Volumetric flow			
actual (ACFM)	69525	67054	67660
standard (DSCFM)	36670	34892	35985
Gas temperature (DEG-F)	447	438	433
Moisture content (%V/V)	9.36	11.49	10.02
Gas composition (%V/V,dry)			
carbon dioxide	8.00	7.80	8.05
oxygen	12.15	12.35	12.05
nitrogen	79.85	79.85	79.90
Isokinetic variation (%)	93.9	101.4	98.1
Particulate concentration			
actual (GR/ACF)	0.124	0.298	0.246
standard (GR/DSCF)	0.235	0.573	0.463
Part. emission rate (LB/HR)	73.83	171.4	142.9
Emission factor (LB/MMBTU)	0.741	1.85	1.44

Note: Dry + Organic Wet Catch

Table 2. Summary of the Results of the April 7, 1992 EPA Particulate Emission Compliance Test on the No. 3 Boiler Stack at the Louisiana-Pacific Plant Located in Urania, Louisiana.

ITEM	Run 1	Run 2	Run 3
Date of test	04-07-92	04-07-92	04-07-92
Time runs were done (HRS)	1356/1514	1603/1706	1744/1854
Steam flow (KLB/HR)	75	75	75
Volumetric flow			
actual (ACFM)	60550	59683	58471
standard (DSCFM)	41096	40728	40501
Gas temperature (DEG-F)	184	186	185
Moisture content (%V/V)	17.17	16.49	15.30
Gas composition (%V/V,dry)			
carbon dioxide	6.45	6.20	6.35
oxygen	13.65	13.95	13.80
nitrogen	79.90	79.85	79.85
Isokinetic variation (%)	100.2	99.1	98.5
Particulate concentration			
actual (GR/ACF)	.0415	.0374	.0483
standard (GR/DSCF)	.0612	.0548	.0697
Part. emission rate (LB/HR)	21.55	19.14	24.20
Emission factor (LB/MMBTU)	0.233	0.218	0.271

Note: Dry + Organic Wet Catch

Table 3 Summary of the Results of the April 7, 1992, Sulfur Dioxide Emission Compliance Test on the No. 1 & 3 Boilers at the Louisiana-Pacific Plant in Urania, Louisiana.

Date	Time (HRS)	Concentration (ppm,d)	Emission Factor ($LB/10^6BTU$)
(No. 1 Boiler)			
4-7-92	1245-1353	1	0.004
4-7-92	1440-1545	1	0.004
4-7-92	1635-1739	1	0.004
Avg		1	0.004
(No. 3 Boiler)			
4-7-92	1356-1514	1	0.004
4-7-92	1603-1706	1	0.005
4-7-92	1744-1854	1	0.005
Avg		1	0.005

Table 4 Summary of the Results of the April 7, 1992 Oxides of Nitrogen Emission Compliance Test on the No. 1 & 3 Boilers at the Louisian-Pacific Plant in Urania, Louisiana.

Date	Time (HRS)	Concentration (ppm,d)	Emission Factor (LB/10^6BTU)
(No. 1 Boiler)			
4-7-92	1245-1353	62	0.16
4-7-92	1440-1545	59	0.16
4-7-92	1635-1739	66	0.17
Avg		62	0.16
(No. 3 Boiler)			
4-7-92	1356-1514	47	0.20
4-7-92	1603-1706	54	0.18
4-7-92	1744-1854	49	0.16
Avg		50	0.18

Table 5 Summary of the April 7, 1992 **Carbon Monoxide** Emission Compliance Test on the No. 1 & 3 Boilers at the Louisiana-Pacific Plant in Urania, Louisiana.

Date	Time (HRS)	Volumetric Flow Rate (DSCFM)	Concentration (ppm,w)	Emission Rate (LB/HR)
(No. 1 Boiler)				
4-7-92	1245-1353	36670	1029	182
4-7-92	1440-1545	34892	614	106
4-7-92	1635-1739	35985	1024	179
Avg		35849	889	156
(No. 3 Boiler)				
4-7-92	1356-1514	41096	1270	275
4-7-92	1603-1706	40728	1018	217
4-7-92	1744-1854	40501	1537	321
Avg		40775	1275	271

3 AIR EMISSION RESULTS

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

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

The emission rates were calculated using the product of the concentration times flow method. The particulate emission factor has been calculated by the dry Oxygen F-Factor Method using the latest EPA published dry F-Factor for the stated fuel.

3.1 Results of Orsat and Moisture Analysis

Test No. 13
No. 1 Boiler

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

	Run 1	Run 2	Run 3
Date of run	04-07-92	04-07-92	04-07-92
Dry basis (orsat)			
carbon dioxide.....	8.00	7.80	8.05
oxygen.....	12.15	12.35	12.05
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.85	79.85	79.90
Wet basis (orsat)			
carbon dioxide.....	7.25	6.90	7.24
oxygen.....	11.01	10.93	10.84
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	72.38	70.67	71.89
water vapor.....	9.36	11.49	10.02
Dry molecular weight.....	29.77	29.74	29.77
Wet molecular weight.....	28.67	28.39	28.59
Specific gravity.....	0.990	0.981	0.988
Water mass flow.....(LB/HR)	10617	12708	11240
FO	1.094	1.096	1.099

Test No. 14
No. 3 Boiler Stack

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

	Run 1	Run 2	Run 3
Date of run	04-07-92	04-07-92	04-07-92
Dry basis (orsat)			
carbon dioxide.....	6.45	6.20	6.35
oxygen.....	13.65	13.95	13.80
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.90	79.85	79.85
Wet basis (orsat)			
carbon dioxide.....	5.34	5.18	5.38
oxygen.....	11.31	11.65	11.69
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	66.18	66.68	67.63
water vapor.....	17.17	16.49	15.30
Dry molecular weight.....	29.58	29.55	29.57
Wet molecular weight.....	27.59	27.65	27.80
Specific gravity.....	0.953	0.955	0.960
Water mass flow.....(LB/HR)	23894	22554	20518
FO	1.124	1.121	1.118

BOILER TESTS ONLY

(- NOT APPLICABLE)

APPEARS AS REF. 6 IN THE RECONSTITUTED BACKGROUND REPORT - SHOULD BE REMOVED ALTOGETHER - CONTAINS NO DATA RELEVANT TO THE SECTION !

(OR LEAVE IN PLACE, BUT ENTER REASON FOR REJECTION, I.E., NO RELEVANT DATA)

↳ WOULD PROBABLY BE EASIER

3.2 Results of Particulate Loading Determinations

Test No. 13
No. 1 Boiler

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

	Run 1	Run 2	Run 3
Date of run	04-07-92	04-07-92	04-07-92
Time run start/end.....(HRS)	1245/1353	1440/1545	1635/1739
Static pressure.....(IN.WC)	-0.40	-0.40	-0.40
Cross sectional area (SQ.FT)	19.63	19.63	19.63
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	102.0	125.0	112.0
desiccant.....(GRAMS)	11.0	21.0	13.0
total.....(GRAMS)	113.0	146.0	125.0
Total particulate material..			
.....collected(grams)	0.7858	1.9689	1.5891
Gas meter coefficient.....	0.9991	0.9991	0.9991
Barometric pressure..(IN.HG)	29.93	29.93	29.93
Avg. orif.pres.drop..(IN.WC)	2.55	2.72	2.70
Avg. gas meter temp..(DEF-F)	79.0	85.3	83.1
Volume through gas meter....			
at meter conditions...(CF)	52.42	54.44	54.13
standard conditions.(DSCF)	51.62	53.02	52.93
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.300	.300	.300
Avg.stack gas temp ..(DEG-F)	447	438	433
Volumetric flow rate.....			
actual.....(ACFM)	69525	67054	67660
dry standard.....(DSCFM)	36670	34892	35985
Isokinetic variation.....(%)	93.9	101.4	98.1
Particulate concentration...			
actual.....(GR/ACF)	0.12384	0.29806	0.24629
dry standard.....(GR/DSCF)	0.23489	0.57303	0.46327
Particle mass rate...(LB/HR)	73.829	171.378	142.891
F-factor .....(DSCF/MMBTU)	9240	9240	9240
Emission factor...(LB/MMBTU)	0.741	1.849	1.444

Test No. 14
No. 3 Boiler Stack

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

	Run 1	Run 2	Run 3
Date of run	04-07-92	04-07-92	04-07-92
Time run start/end.....(HRS)	1356/1514	1603/1706	1744/1854
Static pressure.....(IN.WC)	-0.29	-0.29	-0.29
Cross sectional area (SQ.FT)	33.18	33.18	33.18
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	144.0	145.0	130.0
desiccant.....(GRAMS)	23.0	11.0	11.0
total.....(GRAMS)	167.0	156.0	141.0
Total particulate material..			
.....collected(grams)	0.1506	0.1324	0.1663
Gas meter coefficient.....	1.0010	1.0010	1.0010
Barometric pressure..(IN.HG)	29.93	29.93	29.93
Avg. orif.pres.drop..(IN.WC)	1.27	1.23	1.20
Avg. gas meter temp..(DEF-F)	73.8	77.1	77.1
Volume through gas meter....			
at meter conditions...(CF)	38.25	37.75	37.30
standard conditions.(DSCF)	37.99	37.26	36.81
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.306	.306	.306
Avg.stack gas temp ..(DEG-F)	184	186	185
Volumetric flow rate.....			
actual.....(ACFM)	60550	59683	58471
dry standard.....(DSCFM)	41096	40728	40501
Isokinetic variation.....(%)	100.2	99.1	98.5
Particulate concentration...			
actual.....(GR/ACF)	0.04150	0.03740	0.04827
dry standard.....(GR/DSCF)	0.06117	0.05483	0.06971
Particle mass rate...(LB/HR)	21.548	19.142	24.199
F-factor .....(DSCF/MMBTU)	9240	9240	9240
Emission factor...(LB/MMBTU)	0.233	0.218	0.271

3.3 Results of Sulfur Dioxide Determinations

Test No. 13
No. 1 Boiler Stack

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

	Run 1	Run 2	Run 3
Date of run	04-07-92	04-07-92	04-07-92
Time run start/end.....(HRS)	1245/1353	1440/1545	1635/1739
Barometric pressure..(IN.HG)	29.93	29.93	29.93
Meter temperature....(DEG-F)	79.00	85.30	83.10
Meter correction coefficient	0.9991	0.9991	0.9991
Volume through gas meter....			
at meter conditions...(CF)	52.417	54.443	54.135
standard conditions..(SCF)	51.619	53.017	52.928
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	9.36	11.49	10.02
Volumetric flow rate (DSCFM)	36670	34892	35985
Oxygen content....(%V/V DRY)	12.15	12.35	12.05
Milliequivalents of SO4 in..			
gas sample.....	0.00	0.00	0.00
Sulfur dioxide concentration			
(GR/DSCF).....	0.0012	0.0012	0.0012
(MG/DSCM).....	3	3	3
(PPM-DRY).....	1	1	1
(PPM-WET).....	1	1	1
SO2 Emission rate....(LB/HR)	0.37	0.35	0.36
Sulfur dioxide emission.....			
.....factor (LB/MMBTU)*	0.004	0.004	0.004

* F = 9240 DSCF/MMBTU

Test No. 14
No. 3 Boiler Stack

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

	Run 1	Run 2	Run 3
Date of run	04-07-92	04-07-92	04-07-92
Time run start/end.....(HRS)	1356/1514	1603/1706	1744/1854
Barometric pressure..(IN.HG)	29.93	29.93	29.93
Meter temperature....(DEG-F)	73.80	77.10	77.10
Meter correction coefficient	1.0010	1.0010	1.0010
Volume through gas meter....			
at meter conditions...(CF)	38.250	37.750	37.300
standard conditions..(SCF)	37.988	37.257	36.810
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content......(%V/V)	17.17	16.49	15.30
Volumetric flow rate (DSCFM)	41096	40728	40501
Oxygen content....(%V/V DRY)	13.65	13.95	13.80
Milliequivalents of SO4 in..			
gas sample.....	0.00	0.00	0.00
Sulfur dioxide concentration			
(GR/DSCF).....	0.0012	0.0012	0.0012
(MG/DSCM).....	3	3	3
(PPM-DRY).....	1	1	1
(PPM-WET).....	1	1	1
SO2 Emission rate....(LB/HR)	0.41	0.41	0.40
Sulfur dioxide emission.....			
.....factor (LB/MMBTU)*	0.004	0.005	0.005

* F = 9240 DSCF/MMBTU

3.4 Results of Oxides of Nitrogen Determinations

Test No. 13
No. 1 Boiler Stack

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

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run.....	04-07-92	04-07-92	04-07-92	04-07-92
Time of run.....(HRS)	1245	1300	1315	1330
Flask number.....	1	2	3	4
Volume of flask.....(ML)	2086	2063	2055	2116
Data: time of sampling				
flask temperature..(DEG-F)	75.00	75.00	78.00	76.00
bar. press.....(IN.HG)	29.95	29.95	29.95	29.95
flask vacuum.....(IN.HG)	27.40	27.35	27.30	27.45
flask abs. press...(IN.HG)	2.55	2.60	2.65	2.50
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	29.55	29.55	29.55	29.55
flask static press.(IN.HG)	-0.10	0.10	0.00	0.20
flask abs. press...(IN.HG)	29.45	29.65	29.55	29.75
Volume gas sampled....(DSML)	1839	1829	1813	1891
Moisture content.....(%V/V)	9.36	9.36	9.36	9.36
Oxygen content....(%V/V,DRY)	12.15	12.15	12.15	12.15
Nitrate in gas sample...(JG)	346.0	291.0	195.0	351.0
NO2 in gas sample.....(JG)	256.7	215.9	144.7	260.4
NOx Concentration				
(GR/DSCF).....	0.0610	0.0516	0.0349	0.0602
(MG/DSCM).....	140	118	80	138
(PPM-DRY).....	73	62	42	72
(PPM-WET).....	66	56	38	65
NOX Emission rate....(LB/HR)	19.17	16.22	10.96	18.92
NOx emission factor..... .....(LB/MMBTU)*	0.192	0.163	0.110	0.190

* F = 9240 DSCF/MMBTU

Test No. 13
No. 1 Boiler Stack

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

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run.....	04-07-92	04-07-92	04-07-92	04-07-92
Time of run.....(HRS)	1440	1455	1510	1525
Flask number.....	5	6	7	8
Volume of flask.....(ML)	2057	2100	2081	2088
Data: time of sampling				
flask temperature..(DEG-F)	75.00	78.00	78.00	74.00
bar. press.....(IN.HG)	29.95	29.95	29.95	29.95
flask vacuum.....(IN.HG)	27.20	27.35	27.45	27.25
flask abs. press...(IN.HG)	2.75	2.60	2.50	2.70
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	29.55	29.55	29.55	29.55
flask static press.(IN.HG)	-1.10	-1.70	0.30	-0.60
flask abs. press...(IN.HG)	28.45	27.85	29.85	28.95
Volume gas sampled....(DSML)	1733	1739	1866	1796
Moisture content.....(%V/V)	11.49	11.49	11.49	11.49
Oxygen content....(%V/V,DRY)	12.35	12.35	12.35	12.35
Nitrate in gas sample...(JG)	288.0	265.0	281.0	257.0
NO2 in gas sample.....(JG)	213.7	196.6	208.5	190.7
NOx Concentration				
(GR/DSCF).....	0.0539	0.0494	0.0488	0.0464
(MG/DSCM).....	123	113	112	106
(PPM-DRY).....	64	59	58	56
(PPM-WET).....	57	52	52	49
NOX Emission rate....(LB/HR)	16.12	14.78	14.60	13.87
NOx emission factor..... .....(LB/MMBTU)*	0.174	0.159	0.158	0.150

* F = 9240 DSCF/MMBTU

Test No. 13
No. 1 Boiler Stack

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

	Run 3A	Run 3B	Run 3C	Run 3D
Date of run.....	04-07-92	04-07-92	04-07-92	04-07-92
Time of run.....(HRS)	1635	1650	1705	1720
Flask number.....	9	10	11	12
Volume of flask.....(ML)	2080	2063	2062	2111
Data: time of sampling				
flask temperature..(DEG-F)	76.00	79.00	75.00	74.00
bar. press.....(IN.HG)	29.95	29.95	29.95	29.95
flask vacuum.....(IN.HG)	27.15	27.10	27.30	27.45
flask abs. press...(IN.HG)	2.80	2.85	2.65	2.50
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	29.55	29.55	29.55	29.55
flask static press.(IN.HG)	-0.80	-0.70	-0.70	-0.90
flask abs. press...(IN.HG)	28.75	28.85	28.85	28.65
Volume gas sampled....(DSML)	1770	1759	1771	1809
Moisture content.....(%V/V)	10.02	10.02	10.02	10.02
Oxygen content....(%V/V,DRY)	12.05	12.05	12.05	12.05
Nitrate in gas sample...(JG)	296.0	328.0	297.0	288.0
NO2 in gas sample.....(JG)	219.6	243.4	220.4	213.7
NOx Concentration				
(GR/DSCF).....	0.0542	0.0604	0.0544	0.0516
(MG/DSCM).....	124	138	124	118
(PPM-DRY).....	65	72	65	62
(PPM-WET).....	58	65	59	56
NOX Emission rate....(LB/HR)	16.73	18.64	16.78	15.92
NOx emission factor..... .....(LB/MMBTU)*	0.169	0.188	0.170	0.161

* F = 9240 DSCF/MMBTU

Test No. 14
No. 3 Boiler Stack

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

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run.....	04-07-92	04-07-92	04-07-92	04-07-92
Time of run.....(HRS)	1359	1408	1419	1437
Flask number.....	13	14	15	16
Volume of flask.....(ML)	2060	2048	2045	2067
Data: time of sampling				
flask temperature..(DEG-F)	52.00	55.00	58.00	60.00
bar. press.....(IN.HG)	28.90	28.90	28.90	28.90
flask vacuum.....(IN.HG)	27.35	27.40	27.45	27.45
flask abs. press...(IN.HG)	1.55	1.50	1.45	1.45
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	29.55	29.55	29.55	29.55
flask static press.(IN.HG)	-0.40	-0.10	-0.20	-0.20
flask abs. press...(IN.HG)	29.15	29.45	29.35	29.35
Volume gas sampled....(DSML)	1858	1872	1866	1887
Moisture content.....(%V/V)	17.17	17.17	17.17	17.17
Oxygen content....(%V/V,DRY)	13.65	13.65	13.65	13.65
Nitrate in gas sample...(JG)	218.0	232.0	209.0	239.0
NO2 in gas sample.....(JG)	161.8	172.1	155.1	177.3
NOx Concentration				
(GR/DSCF).....	0.0380	0.0402	0.0363	0.0411
(MG/DSCM).....	87	92	83	94
(PPM-DRY).....	46	48	43	49
(PPM-WET).....	38	40	36	41
NOX Emission rate....(LB/HR)	13.40	14.16	12.79	14.47
NOx emission factor..... .....(LB/MMBTU)*	0.145	0.153	0.138	0.156

* F = 9240 DSCF/MMBTU

Test No. 14
No. 3 Boiler Stack

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

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run.....	04-07-92	04-07-92	04-07-92	04-07-92
Time of run.....(HRS)	1611	1623	1640	1656
Flask number.....	17	18	19	20
Volume of flask.....(ML)	2054	2045	2069	2060
Data: time of sampling				
flask temperature..(DEG-F)	62.00	63.00	62.00	62.00
bar. press.....(IN.HG)	28.90	28.90	28.90	28.90
flask vacuum.....(IN.HG)	27.45	27.35	27.10	27.15
flask abs. press...(IN.HG)	1.45	1.55	1.80	1.75
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	29.55	29.55	29.55	29.55
flask static press.(IN.HG)	-0.30	-0.50	-0.20	-0.20
flask abs. press...(IN.HG)	29.25	29.05	29.35	29.35
Volume gas sampled....(DSML)	1868	1840	1865	1860
Moisture content.....(%V/V)	16.49	16.49	16.49	16.49
Oxygen content....(%V/V,DRY)	13.95	13.95	13.95	13.95
Nitrate in gas sample...(JG)	223.0	232.0	279.0	302.0
NO2 in gas sample.....(JG)	165.5	172.1	207.0	224.1
<u>NOx Concentration</u>				
(GR/DSCF).....	0.0387	0.0409	0.0485	0.0526
(MG/DSCM).....	89	94	111	120
(PPM-DRY).....	46	49	58	63
(PPM-WET).....	39	41	48	53
NOX Emission rate....(LB/HR)	13.51	14.27	16.94	18.38
NOx emission factor..... ....(LB/MMBTU)*	0.154	0.162	0.193	0.209

* F = 9240 DSCF/MMBTU

Test No. 14
No. 3 Boiler Stack

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

	Run 3A	Run 3B	Run 3C	Run 3D
Date of run.....	04-07-92	04-07-92	04-07-92	04-07-92
Time of run.....(HRS)	1750	1802	1821	1836
Flask number.....	21	22	23	24
Volume of flask.....(ML)	2068	2031	2056	2031
Data: time of sampling				
flask temperature..(DEG-F)	63.00	62.00	62.00	63.00
bar. press.....(IN.HG)	28.90	28.90	28.90	28.90
flask vacuum.....(IN.HG)	27.40	27.40	27.45	27.50
flask abs. press...(IN.HG)	1.50	1.50	1.45	1.40
Data: Time of Flask Opening				
flask temperature..(DEG-F)	72.00	72.00	72.00	72.00
lab. bar. press....(IN.HG)	29.55	29.55	29.55	29.55
flask static press.(IN.HG)	-0.10	-0.20	-0.10	0.00
flask abs. press...(IN.HG)	29.45	29.35	29.45	29.55
Volume gas sampled....(DSML)	1892	1851	1884	1871
Moisture content.....(%V/V)	15.30	15.30	15.30	15.30
Oxygen content....(%V/V,DRY)	13.80	13.80	13.80	13.80
Nitrate in gas sample...(JG)	259.0	227.0	239.0	226.0
NO2 in gas sample.....(JG)	192.2	168.4	177.3	167.7
NOx Concentration				
(GR/DSCF).....	0.0444	0.0398	0.0411	0.0392
(MG/DSCM).....	102	91	94	90
(PPM-DRY).....	53	48	49	47
(PPM-WET).....	45	40	42	40
NOX Emission rate....(LB/HR)	15.41	13.81	14.28	13.60
NOx emission factor..... .....(LB/MMBTU)*	0.173	0.155	0.160	0.152

* F = 9240 DSCF/MMBTU

3.5 Result of Carbon Monoxide Determinations

Test No. 13
No. 1 Boiler Stack

Results of CO Determinations ----------Method 10

	Run 1	Run 2	Run 3
Date of run	04-07-92	04-07-92	04-07-92
Time run start/end.....(HRS)	1245-1353	1440-1545	1635-1739
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	9.36	11.49	10.02
O2 Concentration.....(%V/V)	12.15	12.35	12.05
Volumetric flow rate (DSCFM)	36670	34892	35985
CO concentration.....			
(GR/DSCF).....	0.5781	0.3531	0.5796
(MG/DSCM).....	1323.	808.51	1326.
(PPM-WET).....	1029.	614.26	1024.
(PPM-DRY).....	1136.	694.00	1139.
(PPM-DRY @ 7% O2).....	1797.	1123.	1781.
CO emission rate.....(LB/HR)	181.681	105.610	178.758

CO = Carbon monoxide

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

Test No. 14
No. 3 Boiler Stack

Results of CO Determinations ----------Method 10

	Run 1	Run 2	Run 3
Date of run	04-07-92	04-07-92	04-07-92
Time run start/end.....(HRS)	1356-1514	1603-1706	1744-1854
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	17.17	16.49	15.30
O2 Concentration.....(%V/V)	13.65	13.95	13.80
Volumetric flow rate (DSCFM)	41096	40728	40501
CO concentration.....			
(GR/DSCF).....	0.7806	0.6208	0.9236
(MG/DSCM).....	1787.	1421.	2114.
(PPM-WET).....	1270.	1018.	1537.
(PPM-DRY).....	1534.	1220.	1815.
(PPM-DRY @ 7% O2).....	2921.	2422.	3529.
CO emission rate.....(LB/HR)	274.945	216.708	320.600

CO = Carbon monoxide

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

APPENDIX A

PRELIMINARY VOLUMETRIC FLOW RATE DETERMINATIONS

Test No. 13
No. 1 Boiler

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

Date of Determination.....	04-07-92
Time of Determination.....(HRS)	1128
Barometric pressure.....(IN.HG)	29.93
Pitot tube coefficient.....	.84
Number of sampling ports.....	2
Total number of points.....	24
Shape of duct.....	Round
Stack diameter.....(IN)	60
Duct area.....(SQ.FT)	19.63
Direction of flow.....	UP
Static pressure.....(IN.WC)	-.4
Avg. gas temp.....(DEG-F)	448
Moisture content.....(% V/V)	9.36
Avg. linear velocity.....(FT/SEC)	58.7
Gas density.....(LB/ACF)	.04326
Molecular weight.....(LB/LBMOLE)	29.77
Mass flow of gas.....(LB/HR)	179570
Volumetric flow rate.....	
actual.....(ACFM)	69185
dry standard.....(DSCFM)	36443

Test No. 14
No. 3 Boiler Stack

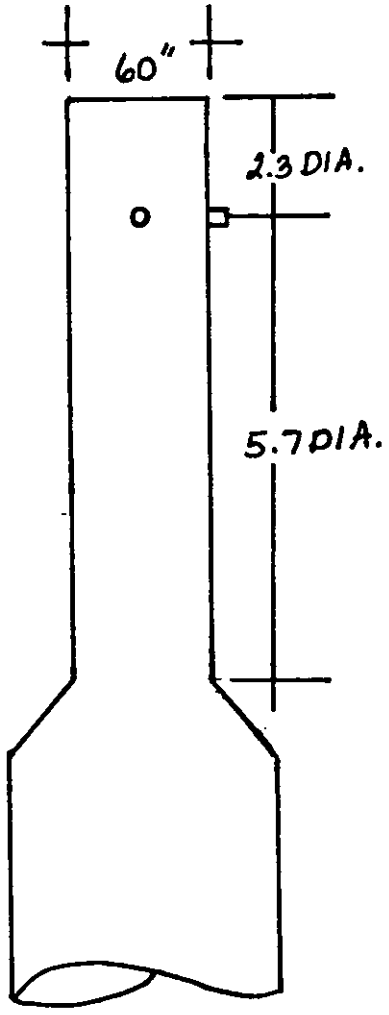
Results of Volumetric Flow Rate Determination--------Method 2

Date of Determination.....	04-07-92
Time of Determination.....(HRS)	1315
Barometric pressure.....(IN.HG)	29.93
Pitot tube coefficient.....	.84
Number of sampling ports.....	2
Total number of points.....	24
Shape of duct.....	Round
Stack diameter.....(IN)	78
Duct area.....(SQ.FT)	33.18
Direction of flow.....	UP
Static pressure.....(IN.WC)	-.29
Avg. gas temp.....(DEG-F)	187
Moisture content.....(% V/V)	17.17
Avg. linear velocity.....(FT/SEC)	30.3
Gas density.....(LB/ACF)	.05845
Molecular weight.....(LB/LBMOLE)	29.58
Mass flow of gas.....(LB/HR)	211805
Volumetric flow rate.....	
actual.....(ACFM)	60397
dry standard.....(DSCFM)	40810

APPENDIX B

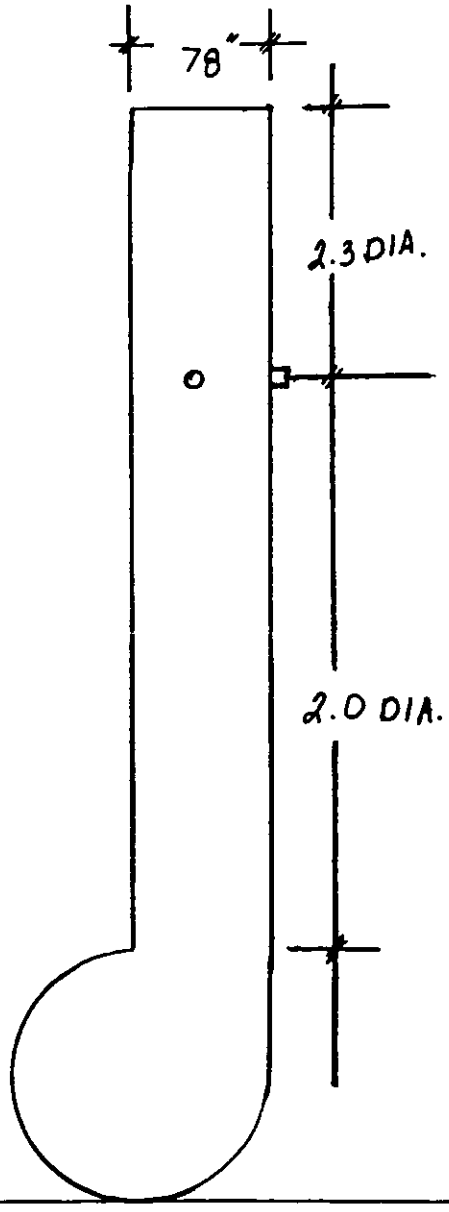
LOCATION OF TEST PORTS

NO. 1 BOILER
L-P, URANIA, LOUISIANA



NO. 3 BOILER

L-P, URANIA, LOUISIANA



NOT TO SCALE

APPENDIX C

FIELD DATA SHEETS

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job L.P. / URANIA, LA.

Source No. 1 Boiler

Test 13 Runs 1-3 Date 4/7/92

Stack dimen. 60.0 IN.

Dry bulb 450 °F Wet bulb 152 °F

Manometer: ☐ Reg. ☐ Exp. ☐ Elec.

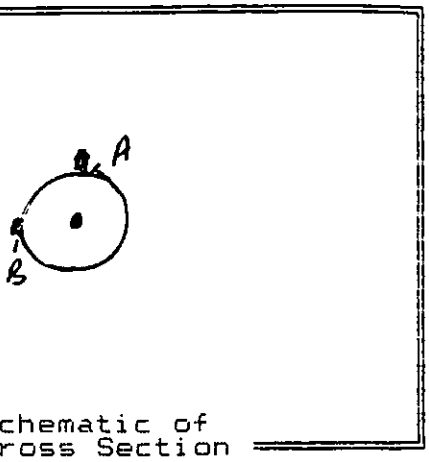
Barometric pressure 29.93 in Hg

Static pressure -.40 in WC

Operators D. BRENNAN & B. ASCHENBACH

Pitot No. 21-6 Cp .84

PM-1/SO2/NOx/CO



Schematic of Cross Section

Traverse Point No.		Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
			Port length: 3.5 in.		Time start: 1128 hrs	
B	1	.021	1.26	4.76	.60	446
	2	.067	4.02	7.52	.65	
	3	.118	7.08	10.58	.64	
	4	.177	10.62	14.12	.67	
	5	.250	15.00	18.50	.70	
	6	.356	21.36	24.86	.69	
	7	.644	38.64	42.14	.67	
	8	.750	45.00	48.50	.70	
	9	.823	49.38	52.88	.74	
	10	.882	52.92	56.42	.65	
	11	.933	55.98	59.48	.63	
	12	.979	58.74	62.24	.48	
A	1				.53	450
	2				.24	
	3				.69	
	4				.64	
	5				.66	
	6				.66	
	7				.67	
	8				.65	
	9				.63	
	10				.61	
	11				.57	
	12				.43	
				NL	.615	
Temp. meas. tool & S/N:					Time end:	hrs

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

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job C.P. / URANIA, LA. Date 4/7/92 Test 13 Run 1
Source NO. 1 BOILER No. of traverse points 24
Method 5 Filter holder: GLASS Filter type: 4" C.F.

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac)
Postest: .006 cfm at 16 in. Hg. (vac)

Particulate Catch Data:

No.s of filters used: 1, 4251

Recovery solvent(s)
■ acetone FRONT HALF
□ other(s)

No. of probe wash bottles: 1
Sample recovered by: D. BRENNAN

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	601	499	102
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1479	1458	11
Total			113

Integrated Gas Sampling Data:

Bag Pump No. B-12 Box No. 11 Bag No. 1

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

Pretest leak check: .00 cc/min at 16 in. Hg.

Time start: 1245 (HRS) Time end: 1353 (HRS)

Sampling rate: 400 cc/min Operator: D. BRENNAN

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

CF-023

CF-D11

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job C.P. / URSINIA, LA.
Source No. 1 BOILER STACK
Date 4/7/92 Test 12 Run 1

Operators D. BRENNAN + B. ASCHENBACH
Meter Box No. 3 ΔH 1.96 IN WC
Counter coeff. .9991

Pitot No. 21-C Cp .84
Bar. Press. 29.93 inHg H2O .16 x
Nozzle No. 8.5 Nozzle Dia .303 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dev. Vol. (cf)	VAC. inHg	Temperatures (°F)						Oxygen
							Stack	Probe	Oven	Impg.	Gas In	Gas Out	(v/v)
	(1245)	685.800											
A-1	2.5	687.93	.63	2.55	7.99	9.0	441	256	263	59	73	72	13.1
2	5.0	690.29	.74	2.92	6.32	10.5	453				75	72	12.9
3	7.5	692.56	.79	3.04	2.69	12.0	455	255	261	58	75	73	12.1
4	10.0	694.84	.66	2.61	4.90	10.0	453				77	73	12.3
5	12.5	697.11	.70	2.77	7.17	12.0	456	254	260	58	77	74	12.2
6	15.0	699.33	.68	2.69	9.41	10.5	455				78	74	12.9
7	17.5	701.57	.65	2.59	1.61	10.5	450	258	263	55	78	75	11.5
8	20.0	703.64	.56	2.23	3.66	9.0	452				79	75	11.6
9	22.5	705.81	.59	2.33	5.75	9.0	446	256	264	54	80	76	12.0
10	25.0	707.84	.56	2.22	7.79	9.0	445				81	76	12.8
11	27.5	709.78	.52	2.08	9.77	8.0	439	255	263	54	82	77	12.5
12	30.0	711.597	.44	1.76	1.59	7.0	438				83	77	12.3
B-1	32.5	713.64	.58	2.30	3.68	9.0	447	254	265	54	83	78	11.7
2	~~35.0~~	715.80	.63	2.52	5.86	9.5	442				83	78	13.2
3	37.5	718.01	.64	2.54	8.04	10.0	449	255	267	54	84	78	12.6
4	40.0	720.33	.72	2.85	0.36	12.5	450				84	79	11.6
5	42.5	722.57	.68	2.69	2.62	11.5	453	255	266	54	84	79	12.9
6	45.0	724.80	.67	2.66	4.86	11.5	451				84	79	12.4
7	47.5	727.26	.81	3.21	7.32	14.0	450	253	267	52	84	79	10.4
8	50.0	729.55	.69	2.76	9.60	12.5	443				84	80	12.3
9	52.5	731.86	.72	2.86	1.93	13.5	448	251	269	52	85	80	10.8
10	55.0	734.12	.64	2.59	4.14	12.0	434				85	80	12.9
11	57.5	736.33	.61	2.46	6.30	12.0	436	250	266	52	85	81	11.9
12	60.0	738.217	.50	2.02	8.26	8.5	438				86	81	12.2
	(1353)												
	θ = 60	Vm = 52.417		ΔH 2.55							Avg. = 79.0		

C-3

S-0037R

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / URANIA, LA. Date 4/7/92 Test 13 Run 2
Source NO. 1 BOILER STACK No. of traverse points 24
Method 5 Filter holder: GLASS Filter type: 4" G.F.

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac)
Postest: .012 cfm at 18 in. Hg. (vac)

Particulate Catch Data:

No.s of filters used: 1 4190

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

No. of probe wash bottles: 1
Sample recovered by: D. BRENNAN

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	626	501	125.0
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1434	1413	21.0
Total			146.0

Integrated Gas Sampling Data:

Bag Pump No. B-12 Box No. 11 Bag No. 2
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: .00 cc/min at 15 in. Hg.
Time start: 1440 (HRS) Time end: 1545 (HRS)
Sampling rate: 400 cc/min Operator: D. BRENNAN
S/N of O_2 Analyzer used to monitor train outlet: ___

CF-023

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / VIRGINIA, LA. Operators D. BRENNON & B. ASCHENBACH Pitot No. 21-6 Cp .84
Source NO. 1 BOILER STACK Meter Box No. 3 ΔH@ 1.90 (N) WC Bar. Press. 29.93 inHg H2O .10 x
Date 4/17/92 Test 13 Run 2 Cosmeter coeff. .9991 Nozzle No. 25-5 Nozzle Dia .300 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (x v/v)
	(1440)	DB 738.60											
B- 1	2.5	740.56	.47	2.15	0.63	7.0	439	251	263	46	81	80	13.0
2	5.0	742.79	.58	2.61	2.85	8.5	438				82	80	12.0
3	7.5	744.98	.54	2.43	4.99	8.0	440	250	264	47	82	80	13.1
4	10.0	747.17	.59	2.66	7.23	9.0	439				84	81	11.7
5	12.5	749.40	.57	2.56	9.43	8.5	442	246	265	47	85	81	13.2
6	15.0	751.54	.53	2.39	1.56	8.0	441				86	82	12.3
7	17.5	753.83	.63	2.84	3.88	10.0	441	247	264	47	87	82	13.4
8	20.0	756.36	.75	3.40	6.42	13.0	436				87	83	12.3
9	22.5	758.75	.66	3.01	8.81	12.0	432	249	266	47	87	83	13.3
10	25.0	761.27	.70	3.21	1.28	12.5	427				88	83	12.2
11	27.5	763.61	.60	2.77	3.58	10.5	424	249	268	45	88	84	13.0
12	30.0	765.539	.45	2.08	5.57	8.0	423				89	84	12.8
A- 1	32.5	767.70	.57	2.59	7.79	8.5	440	250	269	45	89	84	13.4
2	35.0	770.10	.67	3.05	0.20	12.5	438				89	85	11.3
3	37.5	772.55	.68	3.10	2.63	12.5	436	252	270	42	89	85	12.2
4	40.0	774.92	.64	2.91	4.99	12.0	439				89	85	11.9
5	42.5	777.39	.70	3.18	7.45	13.0	439	251	269	42	89	85	11.6
6	45.0	779.90	.68	3.09	9.87	12.5	440				89	85	12.3
7	47.5	782.25	.65	2.95	2.24	12.0	441	250	268	43	88	85	13.0
8	50.0	784.60	.63	2.85	4.57	12.0	443				89	85	12.8
9	52.5	786.94	.63	2.85	6.90	12.0	445	248	268	43	89	85	12.2
10	55.0	789.09	.58	2.62	9.14	10.5	446				89	85	12.3
11	57.5	791.20	.50	2.28	1.23	9.0	437	249	266	44	90	85	13.1
12	60.0	793.043	.35	1.61	2.98	7.0	434				90	85	12.8
	(1545)												
	θ = 60	Vm = 51.443		ΔH 2.72							Avg. = 85.3		

C-5

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / URANIA, LA. Date 4/7/92 Test 13 Run 3
Source NO. 1 BOILER No. of traverse points 24
Method 5 Filter holder: GLASS Filter type: 4" G.F.

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac)
Postest: .008 cfm at 15 in. Hg. (vac)

Particulate Catch Data:

No.s of filters used: 1
4192

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

No. of probe wash bottles: 1
Sample recovered by: D. BRENNAN

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	605	493	112
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1492	1479	13
Total			125

Integrated Gas Sampling Data:

Bag Pump No. B-12 Box No. 11 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: .00 cc/min at 17 in. Hg.
Time start: 1635 (HRS) Time end: 1739 (HRS)
Sampling rate: 400 cc/min Operator: D. BRENNAN
S/N of O_2 Analyzer used to monitor train outlet: 3

CF-023

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job LD. / URANIA, LA.
Source No. 6 Boiler Stack
Date 4/7/92 Test 13 Run 3

Operators D. BRENNAN & B. ASCHENBACH
Meter Box No. 3 ΔH 1.90 IN WC
Cassette coeff: .9991

Pitot No. 21-6 Cp .84
Bar. Press. 29.93 inHg H2O 12 x
Nozzle No. 9-5 Nozzle Dia .302 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (x v/v)
	(1635)	793.400											
A-1	2.5	795.58	.55	2.43	5.54	8.5	430	236	239	54	80	79	13.6
2	5.0	797.89	.63	2.74	7.82	10.0	433				80	79	13.9
3	7.5	800.30	.73	3.17	0.26	12.0	434	238	244	53	81	80	13.4
4	10.0	802.75	.74	3.22	2.72	12.5	434				82	80	12.8
5	12.5	805.10	.67	2.92	5.07	11.5	435	239	245	52	82	80	12.5
6	15.0	807.36	.65	2.83	7.38	10.5	435				83	81	13.7
7	17.5	809.70	.67	2.93	9.73	11.0	433	240	249	52	83	81	12.8
8	20.0	811.97	.62	2.70	1.99	10.0	438				84	81	12.4
9	22.5	814.18	.58	2.53	4.18	9.5	436	242	249	52	85	81	12.5
10	25.0	816.22	.51	2.23	6.23	8.0	436				85	81	14.1
11	27.5	818.30	.54	2.37	8.35	8.5	433	240	253	50	82	81	12.1
12	30.0	820.128	.38	DB 1.69	0.14	5.0	431				86	82	12.8
B-1	32.5	822.34	.56	2.46	2.30	10.0	433	241	251	50	86	82	12.6
2	35.0	824.53	.61	2.68	4.55	10.5	432				86	82	13.6
3	37.5	826.80	.60	2.63	6.79	10.5	435	239	255	49	86	82	12.8
4	40.0	829.15	.65	2.84	9.11	11.0	437				86	82	13.1
5	42.5	831.33	.58	2.54	1.30	10.0	436	240	256	49	86	82	13.7
6	45.0	833.40	.54	2.37	3.42	8.5	435				87	82	13.1
7	47.5	835.85	.74	3.24	5.90	13.5	435	242	258	49	87	83	12.9
8	50.0	838.24	.68	2.99	8.29	12.5	432				87	83	12.6
9	52.5	840.56	.63	2.78	0.58	11.5	431	240	260	49	86	83	13.0
10	55.0	842.99	.70	3.09	3.00	13.0	429				87	83	13.2
11	57.5	845.41	.67	2.98	5.38	13.0	424	242	259	49	86	83	13.4
12	60.0	847.535	.54	2.42	7.52	10.0	418				86	83	13.5
	(1739)												
	θ = 60	Vm = 54.135		ΔH 2.70							Avg. =	83.1	

C-7

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EPA Method 7 Sample Collection
Field Data Sheet

Job CP / Uranium Date 4-)-92 Bar. Pressure 29.85 IN.HG
Test Location No 1 Fuel Type Wood Sample Train No. Blue
Boiler Stack Technician Bob Pump No. 1

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.
1	13-1-A	1	1245	27.40	75°	☒ Yes ☐ No
2	13-1-B	2	1300	27.35	75°	☒ Yes ☐ No
3	13-1-C	3	1315	27.30	78°	☒ Yes ☐ No
4	13-1-D	4	1330	27.45	76°	☒ Yes ☐ No
5	13-2-A	5	1440	27.20	75°	☒ Yes ☐ No
6	13-2-B	6	1455	27.35	78°	☒ Yes ☐ No
7	13-2-C	7	1510	27.45	76°	☒ Yes ☐ No
8	13-2-D	8	1525	27.25	74°	☒ Yes ☐ No
9	13-3-A	9	1635	27.15	76°	☒ Yes ☐ No
10	13-3-B	10	1650	27.10	79°	☒ Yes ☐ No
11	13-3-C	11	1705	27.30	75°	☒ Yes ☐ No
12	13-3-D	12	1720	27.45	74°	☒ Yes ☐ No
13						☐ Yes ☐ No
14						☐ Yes ☐ No
15						☐ Yes ☐ No
16						☐ Yes ☐ No
17						☐ Yes ☐ No
18						☐ Yes ☐ No
19						☐ Yes ☐ No
20						☐ Yes ☐ No
21						☐ Yes ☐ No
22						☐ Yes ☐ No
23						☐ Yes ☐ No
24						☐ Yes ☐ No
25						☐ Yes ☐ No
26						☐ Yes ☐ No
27						☐ Yes ☐ No

S-263R

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job L.P. / Urania, LA

Source No. 3 Boiler / Stack

Test 14 Run 0 Date 9-1-92

Stack dimen. 78 IN.

Dry bulb 197 °F Wet bulb 135 °F

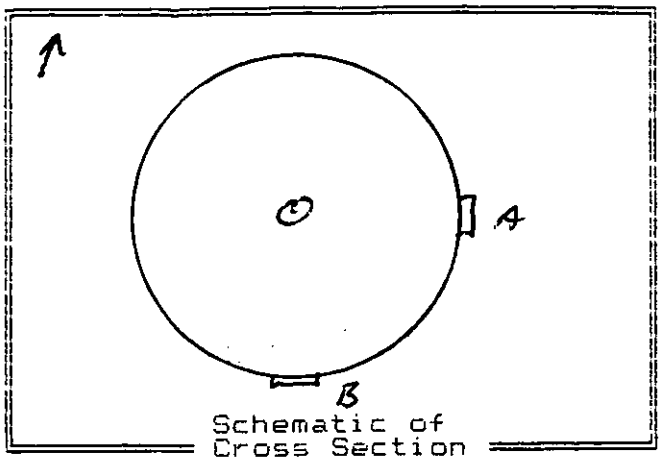
Manometer: ☒ Reg. ☐ Exp. ☐ Elec.

Barometric pressure 29.93 in Hg

Static pressure -.29 in WC

Operators McKaehler + C. Mosser

Pitot No. 29V-8 Cp .84



Schematic of Cross Section

Part / SO_2 / NO_x / CO

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length: 3.5 in.		Time start: 1315 hrs	
A-1	.021	1.64	5.14		
2	.067	5.23	8.73		
3	.118	9.20	12.70		
4	.177	13.81	17.31		
5	.250	19.50	23.00		
6	.356	27.77	31.27		
7	.644	50.23	53.73		
8	.750	58.50	62.00		
9	.823	64.19	67.69		
10	.882	68.80	72.30		
11	.933	72.77	76.27		
12	.979	76.36	79.86		
B-1				.06	
2				.15	
3				.20	
4				.19	
5				.22	197
6				.27	
7				.30	
8				.29	
9				.28	
10				.27	
11				.27	
12				.28	
Temp. meas. tool & S/N: PDT-3/IC				Time end:	hrs

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

S-392.1

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.R / Vienna, LA
Source No. 3 Boiler / Stack
Method 5 Filter holder: 4" Glass
Date 4-7-92 Test 14 Run 1
No. of traverse points 24
Filter type: 4" G.F.

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: ≤ 0.02 cfm at 10 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 4161

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

No. of probe wash bottles: 1
Sample recovered by: MKuebler + C. Mosser

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	638	494	144
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1439	1416	23
Total			167

Integrated Gas Sampling Data:

Bag Pump No. B10 Box No. 2 Bag No. 1
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 1356 (HRS) Time end: 1514 (HRS)
Sampling rate: 400 cc/min Operator: MKuebler
S/N of O_2 Analyzer used to monitor train outlet: 9

CF-023

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Uranium, LA
Source No. 3 Boiler / Stack
Date 4-7-92 Test 14 Run 1

Operators M.Kaehler & C. Mosser
Meter Box No. 4 ΔH 1.72 TN WC
Cosmeter coeff. 1.00/0

Pitot No. 29V-8 Cp .84
Bar. Press. 29.43 inHg H2O 16 x
Nozzle No. 3-5 Nozzle Dia .306 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (x v/v)
	(1356)	423.00											
B-12	2.5	424.82	.29	1.57	4.75	7	192	235	251	44	64	64	13.5
11	5	426.54	.28	1.52	6.49	6.5	184				66	64	13.1
10	7.5	428.20	.26	1.41	8.17	6	185	238	253	43	67	65	13.3
9	10	429.89	.27	1.47	9.88	6	185				69	66	13.4
8	12.5	431.57	.26	1.42	1.57	6	186	243	255	43	70	66	13.5
7	15	433.40	.30	1.64	3.38	7	184				72	67	13.7
6	17.5	435.12	.30	1.64	5.15	7	184	241	255	44	74	68	13.5
5	20	436.64	.23	1.26	6.57	6	184				75	69	13.1
4	22.5	438.14	.20	1.10	8.06	5	184	244	258	43	75	69	13.7
3	25	439.60	.19	1.05	9.52	5	183				76	70	13.5
2	27.5	440.97	.18	1.00	0.94	4.5	183	245	257	43	77	70	13.3
1	30	442.30	.17	.94	2.32	4.5	183				78	71	13.0
A-12	32.5	443.72	.18	1.00	3.75	4.5	182	242	256	44	74	71	13.5
11	35	445.15	.18	.99	5.17	4.5	185				78	72	13.7
10	37.5	446.54	.17	.94	6.55	4.5	184	240	259	44	79	73	12.9
9	40	448.00	.19	1.05	8.02	5	185				81	74	13.3
8	42.5	449.56	.21	1.17	9.56	5.5	185	243	260	44	82	75	13.6
7	45	451.39	.31	1.73	1.44	8	185				83	75	13.6
6	47.5	453.21	.29	1.62	3.25	8	186	245	256	44	83	75	13.2
5	50	454.86	.25	1.40	4.94	7	185				83	75	13.2
4	52.5	456.50	.23	1.29	6.56	6.5	184	248	255	45	84	76	13.7
3	55	458.20	.24	1.34	8.22	6.5	184				84	76	13.6
2	57.5	459.75	.21	1.18	9.75	6	184	247	253	45	84	76	13.2
1	60	461.25	.18	1.01	1.22	6	183				84	76	13.6
	(1514)												
	θ = 60	Vm = 38.25		ΔH = 1.27							Avg. = 73.8		

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / Urania, LA
Source No. 3 Boiler / Stack
Method 5 Filter holder: 4" Glass

Date 4-7-92 Test 14 Run 2
No. of traverse points 24
Filter type: 4" 6 I.F.

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: 0.02 cfm at 10 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 4191

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

No. of probe wash bottles: 1
Sample recovered by: M. Kaehler & C. Mosse

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	639	494	145
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1450	1439	11
Total			156

Integrated Gas Sampling Data:

Bag Pump No. B10 Box No. 2 Bag No. 2

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

Pretest leak check: 0 cc/min at 15 in. Hg.

Time start: 1603 (HRS) Time end: 1706 (HRS)

Sampling rate: 400 cc/min Operator: M. Kaehler

S/N of O_2 Analyzer used to monitor train outlet: 9

CF-023

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P./Urania, LA — Operators M. Kreuler & C. Messer — Pitot No. 29U-6 — Cp .84
Source No. 3 Boiler T. Stack — Meter Box No. 4 ΔH 1.75 IN WC — Bar. Press. 29.93 inHg H2O 17 x
Date 4-7-92 Test 14 Run 2 — Cosmeter coeff. 1.0016 — Nozzle No. 3-5 Nozzle Dia .306 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (v/v)
	(1603)	461.60											
A-12	2.5	463.05	.18	.98	3.00	4	185	242	258	43	70	69	14.0
11	5	464.42	.18	.97	4.40	4	184				71	70	14.0
10	7.5	465.85	.19	1.02	5.93	4	186	245	255	43	74	71	13.0
9	10	467.33	.20	1.08	7.31	4.5	185				75	71	13.4
8	12.5	468.93	.24	1.30	8.93	5.5	187	241	255	43	77	72	13.5
7	15	470.70	.29	1.57	0.71	6.5	187				78	72	13.2
6	17.5	472.48	.29	1.57	2.50	6.5	187	243	259	44	79	73	13.3
5	20	474.11	.25	1.36	4.16	6	187				80	73	13.3
4	22.5	475.65	.21	1.14	5.68	5.5	186	242	256	43	80	74	13.4
3	25	477.24	.21	1.14	7.21	5.5	186				81	74	13.7
2	27.5	478.77	.21	1.14	8.74	5.5	186	240	254	44	81	74	13.3
1	30	480.17	.17	.93	0.11	4	186				81	75	13.2
B-12	32.5	481.85	.26	1.42	1.82	6	184	239	253	44	80	74	13.5
11	35	483.59	.28	1.53	3.58	6.5	185				82	75	13.7
10	37.5	485.28	.25	1.37	5.25	6	186	243	258	44	82	75	13.8
9	40	486.93	.24	1.31	6.89	6	186				83	76	14.0
8	42.5	488.63	.26	1.42	8.59	6	188	245	256	44	83	76	13.1
7	45	490.35	.27	1.48	0.33	6.5	187				84	76	13.3
6	47.5	492.16	.29	1.59	2.13	7	187	243	259	44	84	76	13.4
5	50	493.68	.22	1.20	3.70	6	186				84	76	13.4
4	52.5	495.16	.19	1.04	5.16	5	186	247	261	45	84	76	13.5
3	55	496.60	.18	.99	6.59	4.5	186				84	76	13.8
2	57.5	498.06	.19	1.04	8.04	5	185	245	258	44	84	76	13.4
1	60	499.35	.15	.82	9.34	4	184				84	76	13.5
	(1706)												
	θ = 60	Vm = 37.75		ΔH = 1.23							Avg. = 77.1		

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job _____ Date _____ Test ____ Run ____
Source _____ No. of traverse points _____
Method _____ Filter holder: _____ Filter type: _____

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☐
Postest: ____ cfm at ____ in. Hg. (vac) ☐

Particulate Catch Data:

No.s of filters used: 4193

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

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

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	639	509	130
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1461	1450	11
Total			141

Integrated Gas Sampling Data:

Bag Pump No. _____ Box No. _____ Bag No. _____

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

Pretest leak check: _____ cc/min at _____ in. Hg.

Time start: _____ (HRS) Time end: _____ (HRS)

Sampling rate: _____ cc/min Operator: _____

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

CF-023

CF-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job: A.P. / Urania, LA Source: No. 3 Boiler / Stack Date: 4-7-92 Test: 14 Run: 3

Operators: M. Kaehler & C. Mosser Meter Box No.: 4 ^H@: 1.75 IN WC Gasmeter coeff.: 1.0010

Pitot No.: 29U-E Cp: .81 Bar. Press.: 29.93 inHg H2O: 26.5 x Nozzle No.: 3-5 Nozzle Dia: .306 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgs. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
	(1744)	499.70											
B-12	2.5	501.40	.25	1.38	1.37	6	185	238	250	44	72	71	13.5
11	5	503.07	.27	1.47	3.09	6	187				73	71	12.9
10	7.5	504.84	.27	1.47	4.81	6	185	242	253	44	75	72	13.6
9	10	506.52	.25	1.37	6.48	6	185				77	72	13.6
8	12.5	508.14	.24	1.31	8.11	6	186	245	255	43	78	73	13.6
7	15	509.90	.29	1.59	9.90	7	186				79	73	14.2
6	17.5	511.61	.26	1.43	1.61	6	186	247	251	43	80	74	13.5
5	20	513.22	.22	1.21	3.18	5.5	187				80	74	13.2
4	22.5	514.63	.18	.99	4.60	4.5	185	244	254	44	81	74	13.5
3	25	516.00	.18	.99	6.02	4.5	185				81	74	14.2
2	27.5	517.51	.18	.99	7.45	4.5	185	245	256	44	81	74	13.8
1	30	518.82	.15	.83	8.75	4	184				81	75	13.6
A-12	32.5	520.20	.17	.94	0.13	4	184	248	256	44	79	74	14.1
11	35	521.58	.17	.93	1.51	4	186				80	74	13.4
10	37.5	522.89	.16	.88	2.85	4	187	246	255	44	81	75	12.7
9	40	524.25	.18	.99	4.28	4.5	186				81	75	13.6
8	42.5	525.81	.22	1.21	5.85	6	185	245	259	44	82	75	13.7
7	45	527.51	.27	1.49	7.59	7	186				82	75	13.4
6	47.5	529.35	.28	1.54	9.37	7	186	247	258	45	83	76	13.5
5	50	530.92	.23	1.27	0.98	6.5	186				83	76	13.3
4	52.5	532.55	.22	1.22	2.56	6	184	250	257	45	83	76	14.2
3	55	534.06	.20	1.11	4.06	5.5	186				83	76	13.5
2	57.5	535.69	.21	1.16	5.61	6	184	246	254	45	83	76	13.6
1	60	537.00	.17	.94	7.00	5	184				83	76	14.2
	(1854)												
	θ = 60	Vm = 37.29		^H = 1.20							Avg. = 77.1		

S-0037R

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EPA Method 7 Sample Collection
Field Data Sheet

Job LP/URAN-A Date 4-7-91 Bar. Pressure 28.90 IN.HG.
Test Location NO. 3 BOILER STACK Fuel Type WOOD Sample Train No. NOx
Technician C. MOSSER Pump No. 13

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.
1	M-1-A	13	1359	27.35	52	☒ Yes ☐ No
2	M-1-B	14	1408	27.40	55	☒ Yes ☐ No
3	M-1-C	15	1419	27.45	58	☒ Yes ☐ No
4	M-1-D	16	1437	27.49	60	☒ Yes ☐ No
5	M-2-A	17	1611	27.45	62	☒ Yes ☐ No
6	M-2-B	18	1623	27.35	63	☒ Yes ☐ No
7	M-2-C	19	1640	27.10	62	☒ Yes ☐ No
8	M-2-D	20	1656	27.15	62	☒ Yes ☐ No
9	M-3-A	21	1750	27.40	63	☒ Yes ☐ No
10	M-3-B	22	1802	27.40	62	☒ Yes ☐ No
11	M-3-C	23	1821	27.45	62	☒ Yes ☐ No
12	M-3-D	24	1836	27.50	63	☒ Yes ☐ No
13						☐ Yes ☐ No
14	BLANKS	31				☐ Yes ☐ No
15		32				☐ Yes ☐ No
16						☐ Yes ☐ No
17						☐ Yes ☐ No
18						☐ Yes ☐ No
19						☐ Yes ☐ No
20						☐ Yes ☐ No
21						☐ Yes ☐ No
22						☐ Yes ☐ No
23						☐ Yes ☐ No
24						☐ Yes ☐ No
25						☐ Yes ☐ No
26						☐ Yes ☐ No
27						☐ Yes ☐ No

S-263R

APPENDIX D

INTERPOLL LABORATORIES ANALYTICAL DATA

TABLE OF CONTENTS

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job L.P. / Urania, LA
Team Leader D. Brennan
Date Submitted 4-7-92
Test No. 13
Date of Analysis 4-7-92

Source No. 1 Boiler
Test Site Stack
Date of Test 4-7-92
No. of Runs Completed 3
Technician Mark Bachler

Test/ Run	Sample Log Number and Type	No. of An.	Buret Readings (ml) Zero Pt.	After CO_2	After O_2	Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
13/1		1		8.00	20.15	8.00	12.15	1.094
		2						
	☐ B ☐ F	Avg						
13/2		1		7.60	20.15	7.60	12.35	1.096
		2						
	☐ B ☐ F	Avg						
13/3		1		8.05	20.10	8.05	12.05	1.099
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

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

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

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

EPA Method 3 Guidelines

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

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job L.P. / Urania LA
Team Leader M. Kaehler
Date Submitted 4-7-92
Test No. 14
Date of Analysis 4-7-92

Source No. 3 Boiler
Test Site Stack
Date of Test 4-7-92
No. of Runs Completed 3
Technician Mark Kaehler

Test/Run	Sample Log Number and Type	No. of An.	Buret Readings (ml) Zero Pt.	After CO_2	After O_2	Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_0
14/1		1		6.45	20.10	6.45	13.65	1.124
		2						
	☒ B ☐ F	Avg						
14/2		1		6.20	20.15	6.20	13.95	1.121
		2						
	☒ B ☐ F	Avg						
14/3		1		6.35	20.15	6.35	13.80	1.118
		2						
	☒ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

☐ Ambient Air QA Check
☐ Orsat Analyzer System Leak Check
☐ F_0 Within EPA M-3 Guidelines for fuel type.

Where $F_0 = \frac{20.9 - O_2}{CO_2}$

EPA Method 3 Guidelines

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

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

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Impinger Catch/Wisconsin Protocol

Job L.P. Uranium
Team Leader DB
Date Submitted 4-13-92
Test No. 13
Date of Analysis 5-5-92

Source #1 Boiler
Test Site Stack
Date of Test 4-7-92
No. of Runs Completed 3
Technician C. Helgeson

		Solvent Phase	Aqueous Phase
0	Test ____ Run 0 Field Blank Log Number ____ Comments ____	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g
1	Test 13 Run 1 Log Number 5794-57 Comments ____	Dish No. 303 Dish Tare Wt. 49.5724 g Dish+Sample Wt. 49.5780 g Sample Wt. 0.0056 g	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g
2	Test 13 Run 2 Log Number -79 Comments ____	Dish No. 304 Dish Tare Wt. 60.5528 g Dish+Sample Wt. 60.5562 g Sample Wt. 0.0034 g	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g
3	Test 13 Run 3 Log Number -82 Comments ____	Dish No. 305 Dish Tare Wt. 56.0223 g Dish+Sample Wt 56.0237 g Sample Wt. 0.0014 g	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g
4	Test ____ Run ____ Log Number ____ Comments ____	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g
5	Test ____ Run ____ Log Number ____ Comments ____	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g

Results Solvent Phase: Blank Solvent Wt. 0.0004 g

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0052	0.0030	0.0010		

Results Aqueous Phase:

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

LSC-03WYR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job L.P. Uranium
Team Leader DB
Date Submitted 4-13-92
Test No. 13
Date of Analysis 4-15-92
Transport Leakage [ ] None [ ] _____ ml

Source #1 Boiler
Test Site Stack
Date of Test 4-7-92
No. of Runs Completed 3
Technician C. Helgeson
Solvent Acetone

0	Test _____ Run 0 Field Blank Log Number _____ Vol. of Solvent _____ ml *Solvent Residue 3.33 ug/ml	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
1	Test 13 Run 1 Vol. of Solvent 120 ml Log Number 5744-55 Comments _____	Dish No. 68 Dish Tare Wt. 48.0370 g Dish+Sample Wt. 49.4327 g Sample Wt. 0.3957 g
2	Test 13 Run 2 Vol. of Solvent 120 ml Log Number -77 Comments _____	Dish No. 100 Dish Tare Wt. 45.9685 g Dish+Sample Wt. 47.5582 g Sample Wt. 1.5897 g
3	Test 13 Run 3 Vol. of Solvent 110 → 80 ml Log Number _____ Comments _____	Dish No. 204 Dish Tare Wt. 47.4651 g Dish+Sample Wt. 48.7228 g Sample Wt. 1.2577 g
4	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
5	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g

*Solvent Residue ___ ug/ml = [(Sample Wt. _____ g)(10^6)]/Vol. of Sol. _____ ml
EPA-MS Acetone Residue Blank Spec. < 7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.3953	1.5893	1.2573		

D-4

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job LP Urania, La.
Team Leader DB
Date Submitted 4-13-92
Test No. 13
Date of Analysis 4-15-92

Source No 1 Boiler
Test Site Stack
Date of Test 4-7-92
No. of Runs Completed 3
Technician C. Helgeson

0	Test 13 Run 0 Field Blank Log Number 5744-53 Comments	Filter No. 4189 Filter Type 4" GF Filter Tare Wt. .9523 g Filter+Sample Wt. .9524 g Sample Wt. 0.0001 g
1	Test 13 Run 1 Log Number -56 Comments	Filter No. 4251 Filter Type 4" GF Filter Tare Wt. .9879 g Filter+Sample Wt. 1.3732 g Sample Wt. 0.3853 g
2	Test 13 Run 2 Log Number -78 Comments	Filter No. 4190 Filter Type 4" GF Filter Tare Wt. .9290 g Filter+Sample Wt. 1.3056 g Sample Wt. 0.3766 g
3	Test 13 Run 3 Log Number -81 Comments	Filter No. 4192 Filter Type 4" GF Filter Tare Wt. .9579 g Filter+Sample Wt. 1.2887 g Sample Wt. 0.3308 g
4	Test ____ Run ____ Log Number ____ Comments	Filter No. ____ Filter Type ____ Filter Tare Wt. ____ g Filter+Sample Wt. ____ g Sample Wt. ____ g
5	Test ____ Run ____ Log Number ____ Comments	Filter No. ____ Filter Type ____ Filter Tare Wt. ____ g Filter+Sample Wt. ____ g Sample Wt. ____ g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.3853	0.3766	0.3308		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.7858	1.9689	1.5881		

LSC-02PR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Impinger Catch/Wisconsin Protocol

Job L.P. Uranio
Team Leader DB
Date Submitted 4-13-92
Test No. 14
Date of Analysis 5-5-92

Source #3 Boiler
Test Site Stack
Date of Test 4-7-92
No. of Runs Completed 3
Technician C. Helgeson

		Solvent Phase	Aqueous Phase
0	Test 14 Run 0 Field Blank Log Number 5744-193 Comments	Dish No. 72A Dish Tare Wt. 80.0593 g Dish+Sample Wt. 80.0602 g Sample Wt. 0.0009 g	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g
1	Test 14 Run 1 Log Number -97 Comments	Dish No. 74 Dish Tare Wt. 77.3054 g Dish+Sample Wt. 77.3074 g Sample Wt. 0.0020 g	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g
2	Test 14 Run 2 Log Number -101 Comments	Dish No. 89 Dish Tare Wt. 71.7484 g Dish+Sample Wt. 71.7506 g Sample Wt. 0.0022 g	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g
3	Test 14 Run 3 Log Number -105 Comments	Dish No. 300 Dish Tare Wt. 63.9730 g Dish+Sample Wt. 63.9756 g Sample Wt. 0.0026 g	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g
4	Test Run Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g
5	Test Run Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g

Results Solvent Phase: Blank Solvent Wt. 0.0004 g

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0016	0.0018	0.0022		

Results Aqueous Phase:

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

LSC-03WYR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job L.P. Urania La. | Source #3 Boiler
Team Leader DB | Test Site Stack
Date Submitted 4- -92 | Date of Test 4-7-92
Test No. 14 | No. of Runs Completed 3
Date of Analysis 4-15-92 | Technician C. Helgeson
Transport Leakage (None) [ ] ml | Solvent Acetone

0	Test ___ Run 0 Field Blank Log Number ___ Vol. of Solvent ___ ml *Solvent Residue 3.33 ug/ml	Dish No. ___ Dish Tare Wt. ___ g Dish+Sample Wt. ___ g Sample Wt. ___ g
1	Test 14 Run 1 Vol. of Solvent 180 ml Log Number 5794-95 Comments ___	Dish No. 209 Dish Tare Wt. 43.2110 g Dish+Sample Wt. 43.2528 g Sample Wt. 0.0418 g
2	Test 14 Run 2 Vol. of Solvent 170 ml Log Number -99 Comments ___	Dish No. 410 Dish Tare Wt. 50.5570 g Dish+Sample Wt. 50.5960 g Sample Wt. 0.0390 g
3	Test 14 Run 3 Vol. of Solvent 170 ml Log Number -103 Comments ___	Dish No. 502 Dish Tare Wt. 46.9004 g Dish+Sample Wt. 46.9359 g Sample Wt. 0.0355 g
4	Test ___ Run ___ Vol. of Solvent ___ ml Log Number ___ Comments ___	Dish No. ___ Dish Tare Wt. ___ g Dish+Sample Wt. ___ g Sample Wt. ___ g
5	Test ___ Run ___ Vol. of Solvent ___ ml Log Number ___ Comments ___	Dish No. ___ Dish Tare Wt. ___ g Dish+Sample Wt. ___ g Sample Wt. ___ g

*Solvent Residue ___ ug/ml = [(Sample Wt. ___ g)(10^6)]/Vol. of Sol. ___ ml
EPA-M5 Acetone Residue Blank Spec. ≤ 7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0412	0.0384D-7	0.0349		

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job L.P. Uranium
Team Leader DB
Date Submitted 4-13-92
Test No. 14
Date of Analysis 4-15-92

Source #3 Boiler Stack
Test Site Stack
Date of Test 4-7-92
No. of Runs Completed 3
Technician C. Helgeson

0	Test ____ Run 0 Field Blank Log Number ____ Comments ____	Filter No. ____ Filter Type ____ Filter Tare Wt. ____ g Filter+Sample Wt. ____ g Sample Wt. ____ g
1	Test 14 Run 1 Log Number 5794-96 Comments ____	Filter No. 4161 Filter Type 4"GF Filter Tare Wt. .9427 g Filter+Sample Wt. 1.0505 g Sample Wt. 0.1078 g
2	Test 14 Run 2 Log Number -100 Comments ____	Filter No. 4191 Filter Type 4"GF Filter Tare Wt. .9368 g Filter+Sample Wt. 1.0290 g Sample Wt. 0.0922 g
3	Test 14 Run 3 Log Number -104 Comments ____	Filter No. 4193 Filter Type 4"GF Filter Tare Wt. .9575 g Filter+Sample Wt. 1.0867 g Sample Wt. 0.1292 g
4	Test ____ Run ____ Log Number ____ Comments ____	Filter No. ____ Filter Type ____ Filter Tare Wt. ____ g Filter+Sample Wt. ____ g Sample Wt. ____ g
5	Test ____ Run ____ Log Number ____ Comments ____	Filter No. ____ Filter Type ____ Filter Tare Wt. ____ g Filter+Sample Wt. ____ g Sample Wt. ____ g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.1078	0.0922	0.1292		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.1506	0.1324	0.1663		

LSC-02PR

Interpoll Laboratories
(612) 786-6020

EPA Method 6 Sulfur Dioxide Titration Data Sheet

Job L.P. Urania
Team Leader DB
Date Submitted 4-13-92
Test No. 13
Date of Analysis 4-10-92

Source #1 Boiler
Test Site Stack
Date of Test 4-7-92
No. of Runs Completed 3
Technician C. Helgeson

Test/Run	Sample Log Number	pH of Original Sample *	Final Vol. (V_{soln})	Dilution Factor (DF)	Aliquot Titrated (V_a)	No. of An.	Start Vol. Buret (ml)	Final Vol. Buret (ml)	Volume of Tit. (V_t) (ml)
Field Blank		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			V_b
13-1	5744-57	☑ pH<3.5 ☐ pH____	☑ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☑ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☑ 20 ml ☐ ____ ml	1	1.00	1.15	.15
						2	1.15	1.30	.15
						Avg			.15
13-2	-79	☑ pH<3.5 ☐ pH____	☑ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☑ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☑ 20 ml ☐ ____ ml	1	1.30	1.45	.15
						2	1.45	1.60	.15
						Avg			.15
13-3	-82	☑ pH<3.5 ☐ pH____	☑ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☑ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☑ 20 ml ☐ ____ ml	1	1.60	1.75	.15
						2	1.75	1.90	.15
						Avg			.15
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			

Normality of Titrant (N): 0.0100 N

Vol. Titrant for Field blank (V_b): .15 ml
Vol. Titrant for Method Blank: .15 ml

☐ Ion Exchange
☐ EPA Audit(s)
Audit No. ____
Audit No. ____

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

S-421

EPA Method 6 Sulfur Dioxide Titration Data Sheet

Job: L.P. Urania
Team Leader: MK
Date Submitted: 4-13-92
Test No.: 14
Date of Analysis: 4-30-92

Source: #3 Boiler
Test Site: Stack
Date of Test: 4-7-92
No. of Runs Completed: 3
Technician: C. Helgeson

Test/ Run	Sample Log Number	pH of Original Sample *	Final Vol. (V_{soln})	Dilution Factor (DF)	Aliquot Titrated (V_a)	No. of An.	Start Vol. Buret (ml)	Final Vol. Buret (ml)	Volume of Tit. (V_t) (ml)
Field Blank 14-0	5744-88	☑ pH<3.5 ☐ pH____	☑ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☑ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☑ 20 ml ☐ ____ ml	1	0.00	.15	.15
						2	.15	.30	.15
						Avg			.15 V_b
14-1	-97	☑ pH<3.5 ☐ pH____	☑ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☑ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☑ 20 ml ☐ ____ ml	1	.30	.45	.15
						2	.45	.60	.15
						Avg			.15
14-2	-101	☑ pH<3.5 ☐ pH____	☑ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☑ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☑ 20 ml ☐ ____ ml	1	.60	.75	.15
						2	.75	.90	.15
						Avg			.15
14-3	-106	☑ pH<3.5 ☐ pH____	☑ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☑ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☑ 20 ml ☐ ____ ml	1	.90	1.05	.15
						2	1.05	1.20	.15
						Avg			.15
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			
		☐ pH<3.5 ☐ pH____	☐ 500 ml ☐ 250 ml ☐ 100 ml ☐ ____ ml	☐ 1 DF ☐ 10 DF ☐ 25 DF ☐ 50 DF ☐ ____ DF	☐ 1 ml ☐ 5 ml ☐ 10 ml ☐ 20 ml ☐ ____ ml	1			
						2			
						Avg			

Normality of Titrant (N): 0.0100 N

Vol. Titrant for Field blank (V_b): .15 ml
Vol. Titrant for Method Blank: .15 ml

☐ Ion Exchange
☐ EPA Audit(s)
Audit No. ____
Audit No. ____

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

S-421

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(612)786-6020

EPA Method 7A Recovery and Analysis Data Sheet (1)

**********SOURCE**********	**********RECOVERY**********	**********ANALYTICAL**********
Job L.P. / Urbania	Date of Recovery 4-13-92	Date of Analysis 5-1-92
Source No. 1 Boiler Stack	Recovered by C. Helgeson	Analyst SMS
Date of Sampling 4-7-92	Recovery volume 500 ml	Eluent ASHA
Test No(s) 13	Barometric at time 29.55 IN.HG.	Chromatograph: Dionex System 4000i

Samples collected in accordance with EPA Method 7, CFR Title 40, Part 60, Appendix A. Samples analyzed in accordance with EPA Method 7A by ion chromatography. Mercury manometers used to measure flask pressures/vacuums in sampling and in recovery. Thommen Model TX 19 jewel barometer calibrated against laboratory mercury in glass barometer used to measure field barometric pressure. Three field blanks are prepared and the average used to correct measured nitrate concentrations. All samples are analyzed as a batch using a Dionex Model 4270 Chromatograph Data Intergrator. The integrator is programmed to give the actual concentration of the 500 ml recovered sample even if a subsequent dilution was made. The dilution is indicated here as well as on the chromatogram.

$$C_{RS} = DF(C_{DS}) \qquad M_{NO_3} = (C_{RS} - \bar{C}_B)V_R \qquad \bar{C}_B = (C_{B1} + C_{B2} + C_{B3})/3$$

where:

C_{RS} = concentration of nitrate in 500 ml recovered sample in ug/ml

DF = dilution factor

C_{DS} = concentration of nitrate of a 500 ml recovered sample which has been diluted by a factor of DF to bring it into the proper range for the ion chromatograph. This value is an intermediate number and is not outputted by the electronic integrator which is programmed to output the concentration of the original undiluted 500 ml recovered sample.

M_{NO_3} = total mass of nitrate in micrograms in the 500 ml recovered sample and/or in the 2L flask.

C_B = average conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

C_{B1}, C_{B2}, C_{B3} = conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

V_R = recovery volume for samples and field blanks in ml

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EPA Method 7A Recovery and Analysis Data Sheet (2)

	Sample Log ID No.	Flask No.	Test/ Run	Final Flask Conditions t_f (°F)	+	-	Δ Pg (IN.HG.)	Chrom Run No.	DF	Nitrate Concentration (ug/ml) Uncorr. for blank C_{RS}	Corr. for blank ($C_{RS} - C_B$)	Total nitrate in Sample (ug) ($M_{NO_3^-}$)
1	5794-83	1	13-1-A	72°		✓	.1			0.1092	0.1092	346
2	-84	2	13-1-B		✓		.1			0.581	0.581	291
3	-85	3	13-1-C				0			0.389	0.389	196
4	-86	4	13-1-D		✓		.2			0.701	0.701	351
5	-87	5	13-2-A			✓	1.1			0.575	0.575	288
6	-88	6	13-2-B			✓	1.7			0.530	0.530	265
7	-89	7	13-2-C		✓		.3			0.561	0.561	281
8	-90	8	13-2-D			✓	.6			0.513	0.513	257
9	-91	9	13-3-A			✓	.8			0.591	0.591	296
10	-92	10	13-3-B			✓	.7			0.1056	0.1056	528
11	-93	11	13-3-C			✓	.7			0.593	0.593	297
12	-94	12	13-3-D	↓		✓	.9			0.576	0.576	288
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
Blank 1									1	CB1		
Blank 2									1	CB2		$\bar{C}_B$ = ____
Blank 3									1	CB3		

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EPA Method 7A Recovery and Analysis Data Sheet (1)

**********SOURCE**********	**********RECOVERY**********	**********ANALYTICAL**********
Job L.P. / Urbania	Date of Recovery 4-13-92	Date of Analysis 5-1-92
Source No. 3 Boiler Stack	Recovered by C. Helgeson	Analyst SMS
Date of Sampling 4-7-92	Recovery volume 500 ml	Eluent ASHA
Test No(s) 14	Barometric at time 29.55 IN.HG.	Chromatograph: Dionex System 4000i

Samples collected in accordance with EPA Method 7, CFR Title 40, Part 60, Appendix A. Samples analyzed in accordance with EPA Method 7A by ion chromatography. Mercury manometers used to measure flask pressures/vacuums in sampling and in recovery. Thommen Model TX 19 jewel barometer calibrated against laboratory mercury in glass barometer used to measure field barometric pressure. Three field blanks are prepared and the average used to correct measured nitrate concentrations. All samples are analyzed as a batch using a Dionex Model 4270 Chromatograph Data Intergrator. The integrator is programmed to give the actual concentration of the 500 ml recovered sample even if a subsequent dilution was made. The dilution is indicated here as well as on the chromatogram.

$$C_{RS} = DF(C_{DS}) \qquad M_{NO_3} = (C_{RS} - \bar{C}_B)V_R \qquad \bar{C}_B = (C_{B1} + C_{B2} + C_{B3})/3$$

where: C_{RS} = concentration of nitrate in 500 ml recovered sample in ug/ml

DF = dilution factor

C_{DS} = concentration of nitrate of a 500 ml recovered sample which has been diluted by a factor of DF to bring it into the proper range for the ion chromatograph. This value is an intermediate number and is not outputted by the electronic integrator which is programmed to output the concentration of the original undiluted 500 ml recovered sample.

M_{NO_3} = total mass of nitrate in micrograms in the 500 ml recovered sample and/or in the 2L flask.

C_B = average conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

C_{B1}, C_{B2}, C_{B3} = conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

V_R = recovery volume for samples and field blanks in ml

Interpoll Laboratories
(612)786-6020

EPA Method 7A Recovery and Analysis Data Sheet (2)

	Sample Log ID No.	Flask No.	Test/ Run	Final Flask Conditions t_f (°F)	+	-	ΔPg (IN.HG.)	Chrom Run No.	DF	Nitrate Concentration (ug/ml) Uncorr. for blank C_{RS}	Corr. for blank (C_{RS} - C_B)	Total nitrate in Sample (ug) ($M_{NO_3^-}$)
1	5794-107	13	14-1-A	72°		✓	.4			0.436	0.436	218
2	-108	14	14-1-B	↓		✓	.1			0.463	0.463	232
3	-109	15	14-1-C			✓	.2			0.418	0.418	209
4	-110	16	14-1-D			✓	.2			0.477	0.477	239
5	-111	17	14-2-A			✓	.3			0.445	0.445	223
6	-112	18	14-2-B			✓	.5			0.464	0.464	232
7	-113	19	14-2-C			✓	.2			0.558	0.558	279
8	-114	20	14-2-D			✓	.2			0.604	0.604	302
9	-115	21	14-3-A			✓	.1			0.518	0.518	259
10	-116	22	14-3-B			✓	.2			0.454	0.454	227
11	-117	23	14-3-C			✓	.1			0.473	0.473	237
12	-118	24	14-3-D	↓		-	0			0.451	0.451	226
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
Blank 1	-119	31		72°	✓		.8		1	CB1 <0.025		
Blank 2									1	CB2		
Blank 3									1	CB3		

$\bar{C}_B$ = <12.5

S-340(2) R-9/85

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job L.P. / VRANIA, LA.
Team Leader M. KOEHLER
Date Submitted
Test No. 13

Source NO. 1 BOILER
Test Site STACK
Date of Test 4/7/92
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
3 + BLANK	Probe Wash: ■ Acetone ☐ D.I. Water	■ As per EPA M-5 ☐ Other	
3 + BLANK	Filter: ■ 4" G.F. ☐ S.S. Thimble ☐ 2.5" G.F. ☐ 47 mm G.F.	■ As per EPA M-5 ☐ As per EPA M-17 ☐ Other	
3 + BLANK	Impinger Catch: ☐ D.I. Water ■ 3% H_2O_2 ☐ 4M5 Hg Only ☐ 4M5 Metals ☐ 1.0 N NaOH ☐ Other	☐ MN Protocol ☐ WI Protocol ■ EPA M-6 or 8 ☐ Acid Gases ☐ Formaldehyde ☐ Metals ☐ Other	BACK HALF / SO_2 + PARTIC.
~~ALBANY~~	Integrated Gas sample	☐ As per EPA M-3 ☐ As per EPA M-10 ☐ Other	
12 + BLANK	Oxides of Nitrogen (NO_x)	☐ As per EPA M-7A ☐ Other	Date 4/7/92 Time (HRS)
	☐ Fuel Sample ☐ Aggregate	☐ Attached fuel Form #S-0163RRR	
	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☐ Other	
	Audit Samples ☐ Sulfur Dioxide ☐ Oxides of Nit. ☐ Other	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other	

Source Information

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

S-278RRRR

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job L.P. / Uranium, LA
Team Leader Mikeheler
Date Submitted
Test No. 14

Source No. 3 Boiler
Test Site Stack
Date of Test 4-7-92
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
3	Probe Wash: ☒ Acetone ☐ D.I. Water	☒ As per EPA M-5 ☐ Other	
3	Filter: ☒ 4" G.F. ☐ S.S. Thimble ☐ 2.5" G.F. ☐ 47 mm G.F.	☒ As per EPA M-5 ☐ As per EPA M-17 ☐ Other	
3	Impinger Catch: ☐ D.I. Water ☒ 3% H_2O_2 ☐ 4M5 Hg Only ☐ 4M5 Metals ☐ 1.0 N NaOH ☐ Other	☐ MN Protocol ☐ WI Protocol ☒ EPA M-6 or 8 ☐ Acid Gases ☐ Formaldehyde ☐ Metals ☒ Other Condensibles	SO_2 & Part.
3	Integrated Gas sample	☒ As per EPA M-3 ☐ As per EPA M-10 ☐ Other	
12+2	Oxides of Nitrogen (NO_x)	☒ As per EPA M-7A ☐ Other	Date Time (HRS)
—	☐ Fuel Sample ☐ Aggregate	☐ Attached fuel Form #S-0163RRR	
—	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☐ Other	
—	Audit Samples ☐ Sulfur Dioxide ☐ Oxides of Nit. ☐ Other	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other	

Source Information

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

S-278RRRR

APPENDIX E

BOILER INFORMATION SHEETS

INTERPOLL LABORATORIES
BOILER INFORMATION SHEET

Company: Louisiana Pacific
Location: Urania, Louisiana
Boiler No.: 1
Manufacturer: Riley
Class and Type: Water tube - Wood fired 2 Drum
Year Built: 1969
Firing Equipment: Wood fired

☐ Economizer — Gas Temp. In _____ °F Gas Temp. Out _____ °F
☑ Air Preheater — Gas Temp. In _____ °F Gas Temp. Out 500 °F

Fuel (State, County, Mine) _____ BTU/LB: _____
Steaming Capacity: 110,000 Lbs. per hour
Design Steam Pressure: 650 PSI
Design Steam Temperature: _____
Normal Steam Load: 85,000 lbs per hour

Steam Data:

☑ Saturated — Normal Steam Pressure 330 PSIG Feedwater Temp. 220 °F
☐ Superheated — Normal Steam Temp. _____ °F (if superheated)

Pollution Control Equipment:

☑ Mechanical Collector
- No. of tubes 85
- Tube Dia. 8"
- Manuf. Zurn
- Press. Drop _____
- Rated Eff. _____

☐ ESP
- No. of sections _____
- Hotside ☐ Coldside ☐
- Voltage _____ KV
- Manuf. _____
- Press. Drop _____ IN.WC

☐ Scrubber
- Type _____
- Liquid flow _____ GPM
- Manuf. _____
- Press. Drop _____ IN.WC

☐ Baghouse
- No. of Sections _____
- Cleaning mechanism _____
- _____
- No. of Bags _____
- Cloth area/bag _____ SQ.FT. _____
- Manuf. _____
- Press. Drop _____ IN.WC

Type of Stack: Metal
Stack Height: 50 feet
Stack Diameter: 60"
Units Emitting through Stack: 1
Rated Boiler Efficiency: _____

Form #S-0075RRR

INTERPOLL LABORATORIES
BOILER INFORMATION SHEET

Company: Louisiana Pacific
Location: Urania, Louisiana
Boiler No.: 3
Manufacturer: Zurn
Class and Type: Water Tube - Wood fired 2 Drum M.P. VC
Year Built: 1978
Firing Equipment: Wood fired

☐ Economizer — Gas Temp. In _____ °F Gas Temp. Out _____ °F
☑ Air Preheater — Gas Temp. In _____ °F Gas Temp. Out 430 °F

Fuel (State, County, Mine) _____ BTU/LB: _____
Steaming Capacity: 110,000 Lbs. per hour
Design Steam Pressure: 300 PSI
Design Steam Temperature: _____
Normal Steam Load: 50,000 Lbs per hour

Steam Data:
☑ Saturated — Normal Steam Pressure 260 PSIG Feedwater Temp. 220 °F
☐ Superheated — Normal Steam Temp. _____ °F (if superheated)

Pollution Control Equipment:

☑ Mechanical Collector
- No. of tubes 120
- Tube Dia. 8"
- Manuf. Zurn
- Press. Drop _____
- Rated Eff. _____

☐ ESP
- No. of sections _____
- Hotside ☐ Coldside ☐
- Voltage _____ KV
- Manuf. _____
- Press. Drop _____ IN.WC

☑ Scrubber
- Type Venturi
- Liquid flow 1000 GPM
- Manuf. Zurn
- Press. Drop _____ IN.WC

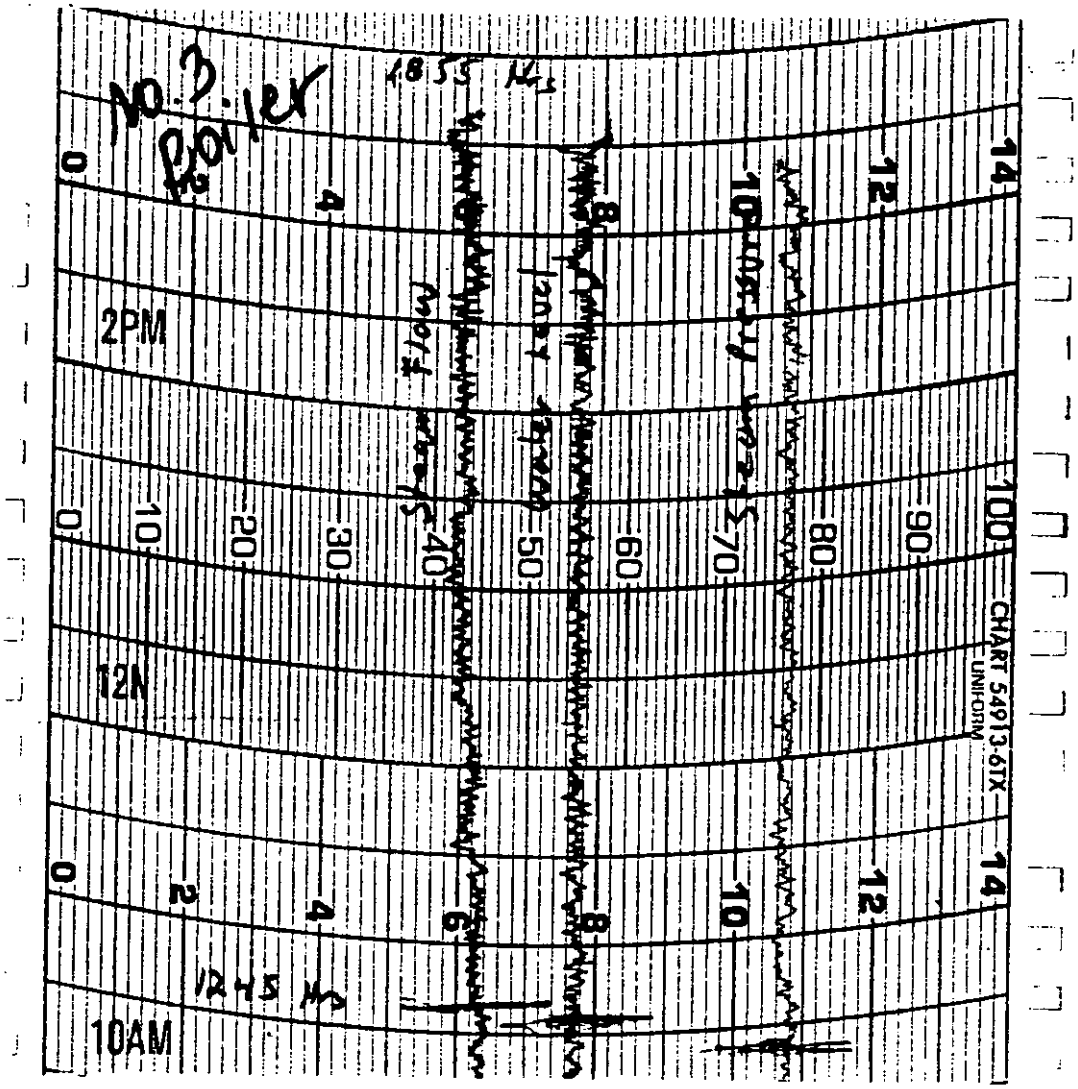
☐ Baghouse
- No. of Sections _____
- Cleaning mechanism _____
- _____
- No. of Bags _____
- Cloth area/bag _____ SQ.FT. _____
- Manuf. _____
- Press. Drop _____ IN.WC

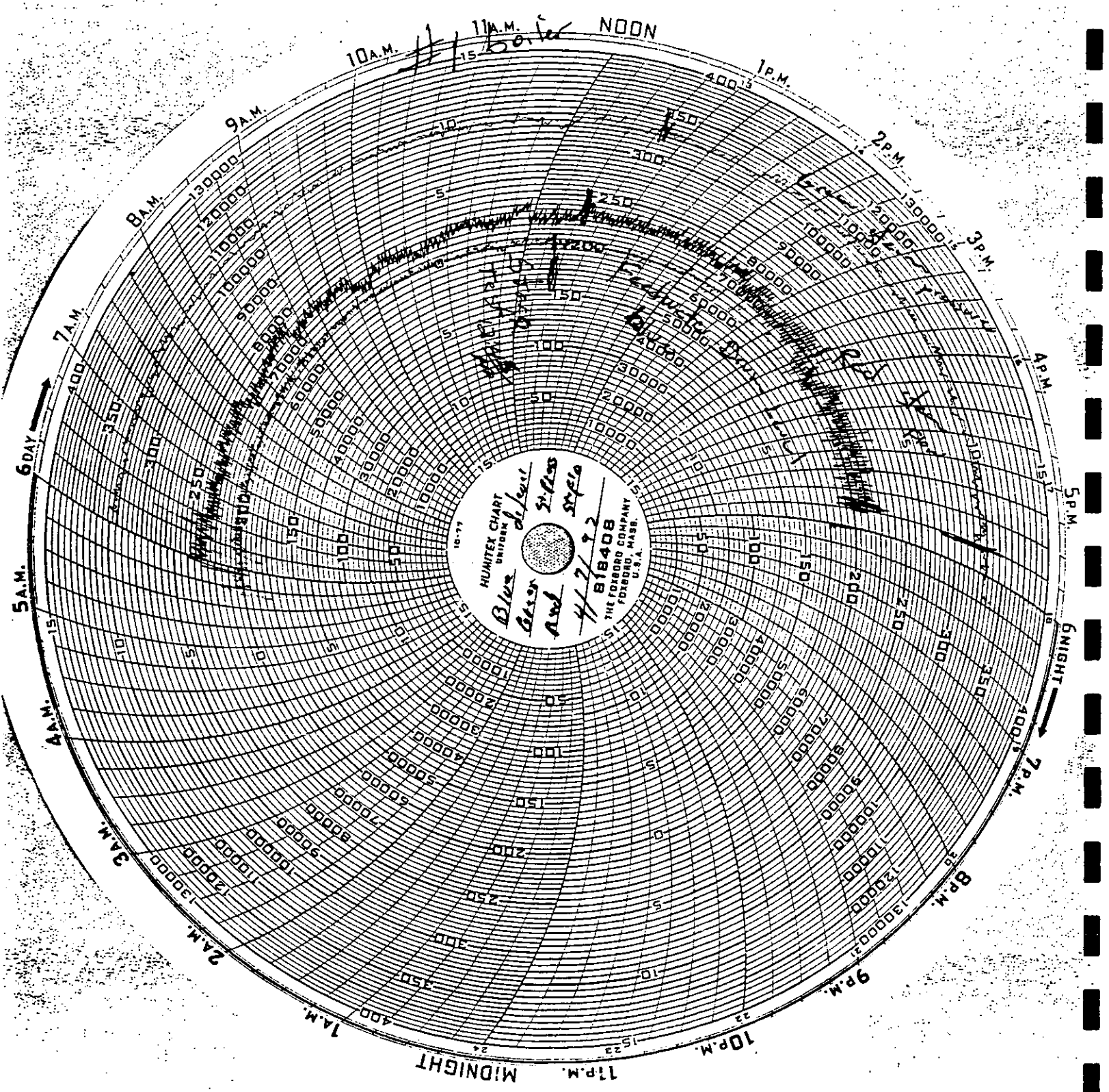
Type of Stack: Metal
Stack Height: 165 feet
Stack Diameter: 78"
Units Emitting through Stack: 1
Rated Boiler Efficiency: _____

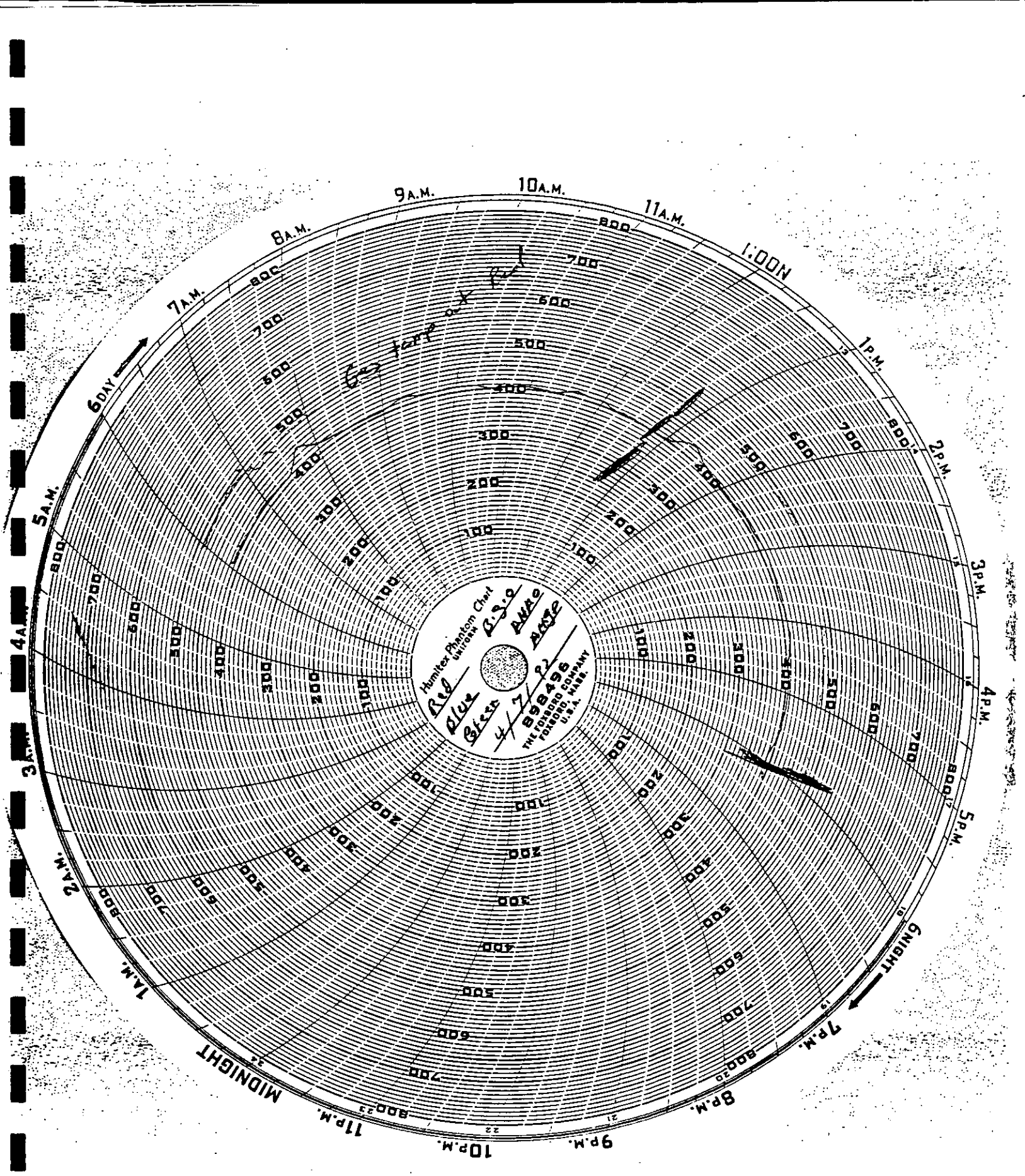
Form #S-0075RRR

APPENDIX F

BOILER OPERATIONAL DATA


2PM
12N
10AM
CHART 54913-6TX
UNIFORM


NOON
1P.M.
2P.M.
3P.M.
4P.M.
5P.M.
6P.M.
7P.M.
8P.M.
9P.M.
10P.M.
11P.M.
MIDNIGHT
1A.M.
2A.M.
3A.M.
4A.M.
5A.M.
6A.M.
7A.M.
8A.M.
9A.M.
10A.M.
11A.M.
6 DAY
NIGHT
HUMITEX CHART
818408
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.


Humiter Phantom Chart
Uniform
898496
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.
9A.M.
10A.M.
11A.M.
12 NOON
1P.M.
2P.M.
3P.M.
4P.M.
5P.M.
6 NIGHT
7P.M.
8P.M.
9P.M.
10P.M.
11P.M.
MIDNIGHT
1A.M.
2A.M.
3A.M.
4A.M.
5A.M.
6 DAY
7A.M.
8A.M.

APPENDIX G

PROCEDURES

Particulate Loadings and Emission Rates

The particulate emission rates were determined per EPA Methods 1-5, CFR title 40, Part 60, Appendix A (revised July 1, 1987). In this procedure, a preliminary velocity profile of the gases in the flue is obtained by means of a temperature and velocity traverse. On the basis of these values, sampling nozzles of appropriate diameter are selected to allow isokinetic sampling, a necessary prerequisite for obtaining a representative sample.

The sampling train consists of a heated stainless steel-lined sampling probe equipped with a Type S pitot and a thermocouple. The probe is attached to a sampling module which houses the all-glass in line filter holder in a temperature controlled oven. In addition, the sampling module also houses the impinger or condenser case and a Drierite drying column. The sampling module is connected by means of an umbilical cord to the control module which houses the dry test gasmeter, the calibrated orifice, a leakless pump, two inclined manometers, and all controls required for operating the sampling train.

Particulate samples were collected as follows: The sample gas was drawn in through the sampling probe isokinetically and passed through a 4-inch diameter Gelman Type A/E glass fiber filter. The particulates were removed at this point and collected on the filter. The gases then passed through an ice-cooled impinger train and a desiccant-packed drying column which quantitatively absorb all moisture from the sample gas stream after which the sample gas passes through the pump and the dry test gasmeter which integrates the sample gas flow throughout the course of the test. A calibrated orifice attached to the outlet of the gasmeter provides instantaneous flow rate data.

A representative particulate sample was acquired by sampling for equal periods of time at the centroid of a number of equal area regions in the duct. The sampling rate is adjusted at each site such that an isokinetic sampling condition prevails. Nomographs are used to aid in the rapid determination of the sampling rate.

After sampling is complete, the filter is removed and placed in a clean container. The nozzle and inlet side of the filter holder are quantitatively washed with acetone and the washings are stored in a second container. A brush is often used in the cleaning step to help dislodge deposits. The samples are returned to the laboratory where they are logged in and analyzed. The volume of the acetone rinse ("probe wash") is noted and then the rinse is quantitatively transferred to a tared 120 cc porcelain evaporating dish and the acetone evaporated off at 97-105 ^{o}F. This temperature is used to prevent condensation of atmospheric moisture due to the cooling effect induced by the evaporation of acetone. The acetone-free sample is then transferred to an oven and dried at 105 ^{o}C for 30 minutes, cooled in a desiccator over Drierite, and then weighed to the nearest .01 mg. The filter sample is quantitatively transferred to a 6-inch watch glass and dried in an oven at 105 ^{o}C for two hours. The filter and watch glass are then cooled in a desiccator and the filter weighed to the nearest .01 mg. All weighings are performed in a balance room where the relative humidity is hydrostatted to less than 50% relative humidity. Microscopic examination of the samples is performed if any unusual characteristics are observed. The weight of the acetone rinse is corrected for the acetone blank. The Drierite column is weighed on-site and the water collected by Drierite is added to the condensate so that the total amount of absorbed water may be ascertained.

Integrated gas samples for Orsat analysis were collected at a constant flow rate throughout each particulate run. The gas samples were analyzed using al all-glass Orsat analyzer. Standard commercially prepared solutions were used in the Orsat analyzer (sat. KOH for carbon dioxide and reduced methylene blue for oxygen). In addition to the above, the oxygen content of the flue gas was measured at each traverse during the particulate determinations using a Teledyne Model 320P-4 Portable Oxygen Analyzer to sample the effluent from the Method 5 train.

3a P2(7)

Interpoll Laboratories
(612)786-6020

Condensible Organic Compounds Analysis

(State of Minnesota - MPCA Exhibit C)

Method II-8672-MN

Equipment: Separatory funnel - 500 cc with Teflon stopcock

Powder funnel - 75 mm ID with a 17 mm stem

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

Reagents: Diethyl ether - reagent grade

Chloroform - reagent grade

Sodium sulfate - (ACS) granular anhydrous

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

Glass wool (Pyrex microfiber)

PREPARATION

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

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

SAMPLING

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

ANALYSIS

I. Organics

Caution! Work in vented hood!!!

A. Organic Blank Determination

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

B. Organic Sample Determination

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

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

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

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

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

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

II. Inorganics

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

A. Inorganic Blank Determination

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

B. Inorganic Sample Determination

Follow steps 1-5 in Section A above.

NOTES

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

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

3. Special state requirements:

   <u>Michigan</u> - Total sample evaporated in tared evaporating dish on steam bath.

   <u>Iowa</u> - Organics and inorganics separately, as required.

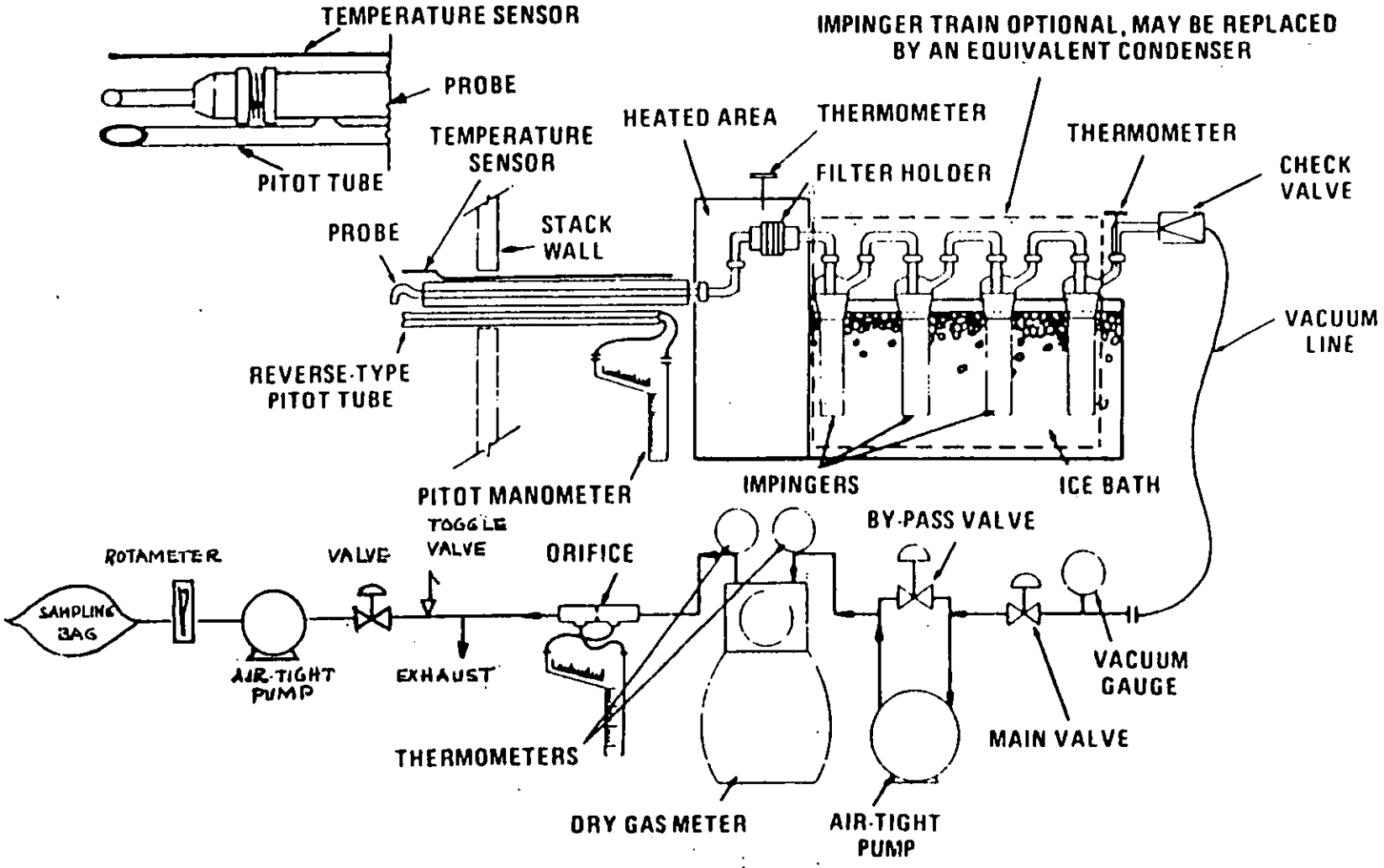
   <u>Wisconsin</u> - Use Method II-8672-WI.

   <u>Rest of states</u> - Organics only.

REFERENCES

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

Minnesota Pollution Control Agency, Exhibit C.



Particulate-sampling train.

METHOD 6C—DETERMINATION OF SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES (INSTRUMENTAL ANALYZER PROCEDURE)

1. *Applicability and Principle*

1.1 *Applicability.* This method is applicable to the determination of sulfur dioxide (SO_2) concentrations in controlled and un-

controlled emissions from stationary sources only when specified within the regulations.

1.2 Principle. A gas sample is continuously extracted from a stack, and a portion of the sample is conveyed to an instrumental analyzer for determination of SO_2 gas concentration using an ultraviolet (UV), nondispersive infrared (NDIR), or fluorescence analyzer. Performance specifications and test procedures are provided to ensure reliable data.

2. *Range and Sensitivity*

2.1 Analytical Range. The analytical range is determined by the instrumental design. For this method, a portion of the analytical range is selected by choosing the span of the monitoring system. The span of the monitoring system shall be selected such that the pollutant gas concentration equivalent to the emission standard is not less than 30 percent of the span. If at any time during a run the measured gas concentration exceeds the span, the run shall be considered invalid.

2.2 Sensitivity. The minimum detectable limit depends on the analytical range, span, and signal-to-noise ratio of the measurement system. For a well designed system, the minimum detectable limit should be less than 2 percent of the span.

3. *Definitions*

3.1 Measurement System. The total equipment required for the determination of gas concentration. The measurement system consists of the following major subsystems:

3.1.1 Sample Interface. That portion of a system used for one or more of the following: sample acquisition, sample transport, sample conditioning, or protection of the analyzers from the effects of the stack effluent.

3.1.2 Gas Analyzer. That portion of the system that senses the gas to be measured and generates an output proportional to its concentration.

3.1.3 Data Recorder. A strip chart recorder, analog computer, or digital recorder for recording measurement data from the analyzer output.

3.2 Span. The upper limit of the gas concentration measurement range displayed on the data recorder.

3.3 Calibration Gas. A known concentration of a gas in an appropriate diluent gas.

3.4 Analyzer Calibration Error. The difference between the gas concentration exhibited by the gas analyzer and the known concentration of the calibration gas when the calibration gas is introduced directly to the analyzer.

3.5 Sampling System Bias. The difference between the gas concentrations exhibited by the measurement system when a known concentration gas is introduced at the outlet of the sampling probe and when the same gas is introduced directly to the analyzer.

3.6 Zero Drift. The difference in the measurement system output reading from the initial calibration response at the zero concentration level after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.7 Calibration Drift. The difference in the measurement system output reading from the initial calibration response at a mid-range calibration value after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.8 Response Time. The amount of time required for the measurement system to display 95 percent of a step change in gas concentration on the data recorder.

3.9 Interference Check. A method for detecting analytical interferences and excessive biases through direct comparison of gas concentrations provided by the measurement system and by a modified Method 6 procedure. For this check, the modified Method 6 samples are acquired at the sample by-pass discharge vent.

3.10 Calibration Curve. A graph or other systematic method of establishing the relationship between the analyzer response and the actual gas concentration introduced to the analyzer.

4. *Measurement System Performance Specifications*

4.1 Analyzer Calibration Error. Less than ±2 percent of the span for the zero, mid-range, and high-range calibration gases.

4.2 Sampling System Bias. Less than ±5 percent of the span for the zero, and mid- or high-range calibration gases.

4.3 Zero Drift. Less than ±3 percent of the span over the period of each run.

4.4 Calibration Drift. Less than ±3 percent of the span over the period of each run.

4.5 Interference Check. Less than ±7 percent of the modified Method 6 result for each run.

5. *Apparatus and Reagents*

5.1 Measurement System. Any measurement system for SO_2 that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1. The essential components of the measurement system are described below:

5.1.1 Sample Probe. Glass, stainless steel, or equivalent, of sufficient length to traverse the sample points. The sampling probe shall be heated to prevent condensation.

5.1.2 Sample Line. Heated (sufficient to prevent condensation) stainless steel or

Teflon tubing, to transport the sample gas to the moisture removal system.

5.1.3 Sample Transport Lines. Stainless steel or Teflon tubing, to transport the sample from the moisture removal system to the sample pump, sample flow rate control, and sample gas manifold.

5.1.4 Calibration Valve Assembly. A three-way valve assembly, or equivalent, for blocking the sample gas flow and introducing calibration gases to the measurement system at the outlet of the sampling probe when in the calibration mode.

5.1.5 Moisture Removal System. A refrigerator-type condenser or similar device (e.g., permeation dryer), to remove condensate continuously from the sample gas while maintaining minimal contact between the condensate and the sample gas. The moisture removal system is not necessary for analyzers that can measure gas concentrations on a wet basis; for these analyzers, (1) heat the sample line and all interface components up to the inlet of the analyzer sufficiently to prevent condensation, and (2) determine the moisture content and correct the measured gas concentrations to a dry basis using appropriate methods, subject to the approval of the Administrator. The determination of sample moisture content is not necessary for pollutant analyzers that measure concentrations on a wet basis when (1) a wet basis CO_2 analyzer operated according to Method 3A is used to obtain simultaneous measurements, and (2) the pollutant/CO_2 measurements are used to determine emissions in units of the standard.

5.1.6 Particulate Filter. An in-stack or heated (sufficient to prevent water condensation) out-of-stack filter. The filter shall be borosilicate or quartz glass wool, or glass fiber mat. Additional filters at the inlet or outlet of the moisture removal system and inlet of the analyzer may be used to prevent accumulation of particulate material in the measurement system and extend the useful life of the components. All filters shall be fabricated of materials that are nonreactive to the gas being sampled.

5.1.7 Sample Pump. A leak-free pump, to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. The pump may be constructed of any material that is nonreactive to the gas being sampled.

5.1.8 Sample Flow Rate Control. A sample flow rate control valve and rotameter, or equivalent, to maintain a constant sampling rate within 10 percent.

(NOTE: The tester may elect to install a back-pressure regulator to maintain the sample gas manifold at a constant pressure in order to protect the analyzer(s) from overpressurization, and to minimize the need for flow rate adjustments.)

5.1.9 Sample Gas Manifold. A sample gas manifold, to divert a portion of the sample gas stream to the analyzer, and the remainder to the by-pass discharge vent. The sample gas manifold should also include provisions for introducing calibration gases directly to the analyzer. The manifold may be constructed of any material that is nonreactive to the gas being sampled.

5.1.10 Gas Analyzer. A UV or NDIR absorption or fluorescence analyzer, to determine continuously the SO_2 concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

(NOTE: Housing the analyzer(s) in a clean, thermally-stable, vibration-free environment will minimize drift in the analyzer calibration.)

5.1.11 Data Recorder. A strip chart recorder, analog computer, or digital recorder, for recording measurement data. The data recorder resolution (i.e., readability) shall be 0.5 percent of span. Alternatively, a digital or analog meter having a resolution of 0.5 percent of span may be used to obtain the analyzer responses and the readings may be recorded manually. If this alternative is used, the readings shall be obtained at equally spaced intervals over the duration of the sampling run. For sampling run durations of less than 1 hour, measurements at 1-minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be obtained. For sampling run durations greater than 1 hour, measurements at 2-minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be obtained.

5.2 Method 6 Apparatus and Reagents. The apparatus and reagents described in Method 6, and shown by the schematic of the sampling train in Figure 6C-2, to conduct the interference check.

5.3 SO_2 Calibration Gases. The calibration gases for the gas analyzer shall be SO_2 in N_2 or SO_2 in air. Alternatively, SO_2/CO_2, SO_2/O_2, or $SO_2/CO_2/O_2$ gas mixtures in N_2 may be used. For fluorescence-based analyzers, the O_2 and CO_2 concentrations of the calibration gases as introduced to the analyzer shall be within 1 percent (absolute) O_2 and 1 percent (absolute) CO_2 of the O_2 and CO_2 concentrations of the effluent samples as introduced to the analyzer. Alternatively, for fluorescence-based analyzers, use calibration blends of SO_2 in air and the nomographs provided by the vendor to determine the quenching correction factor (the effluent O_2 and CO_2 concentrations must be

known). Use three calibration gases as specified below:

5.3.1 High-Range Gas. Concentration equivalent to 80 to 90 percent of the span.

5.3.2 Mid-Range Gas. Concentration equivalent to 50 to 60 percent of the span.

5.3.3 Zero Gas. Concentration of less than 0.25 percent of the span. Purified ambient air may be used for the zero gas by passing air through a charcoal filter, or through one or more impingers containing a solution of 3 percent H_2O_2.

6. *Measurement System Performance Test Procedures*

Perform the following procedures before measurement of emissions (Section 7).

6.1 Calibration Gas Concentration Verification. There are two alternatives for establishing the concentrations of calibration gases. Alternative Number 1 is preferred.

6.1.1 Alternative Number 1—Use of calibration gases that are analyzed following the Environmental Protection Agency Traceability Protocol Number 1 (see Citation 1 in the Bibliography). Obtain a certification from the gas manufacturer that Protocol Number 1 was followed.

6.1.2 Alternative Number 2—Use of calibration gases not prepared according to Protocol Number 1. If this alternative is chosen, obtain gas mixtures with a manufacturer's tolerance not to exceed ±2 percent of the tag value. Within 6 months before the emission test, analyze each of the calibration gases in triplicate using Method 6. Citation 2 in the Bibliography describes procedures and techniques that may be used for this analysis. Record the results on a data sheet (example is shown in Figure 6C-3). Each of the individual SO_2 analytical results for each calibration gas shall be within 5 percent (or 5 ppm, whichever is greater) of the triplicate set average; otherwise, discard the entire set, and repeat the triplicate analyses. If the average of the triplicate analyses is within 5 percent of the calibration gas manufacturer's cylinder tag value, use the tag value; otherwise, conduct at least three additional analyses until the results of six consecutive runs agree with 5 percent (or 5 ppm, whichever is greater) of their average. Then use this average for the cylinder value.

6.2 Measurement System Preparation. Assemble the measurement system by following the manufacturer's written instructions for preparing and preconditioning the gas analyzer and, as applicable, the other system components. Introduce the calibration gases in any sequence, and make all necessary adjustments to calibrate the analyzer and the data recorder. Adjust system components to achieve correct sampling rates.

6.3 Analyzer Calibration Error. Conduct the analyzer calibration error check by introducing calibration gases to the measurement system at any point upstream of the gas analyzer as follows:

6.3.1 After the measurement system has been prepared for use, introduce the zero, mid-range, and high-range gases to the analyzer. During this check, make no adjustments to the system except those necessary to achieve the correct calibration gas flow rate at the analyzer. Record the analyzer responses to each calibration gas on a form similar to Figure 6C-4.

NOTE: A calibration curve established prior to the analyzer calibration error check may be used to convert the analyzer response to the equivalent gas concentration introduced to the analyzer. However, the same correction procedure shall be used for all effluent and calibration measurements obtained during the test.

6.3.2 The analyzer calibration error check shall be considered invalid if the gas concentration displayed by the analyzer exceeds ±2 percent of the span for any of the calibration gases. If an invalid calibration is exhibited, take corrective action, and repeat the analyzer calibration error check until acceptable performance is achieved.

6.4 Sampling System Bias Check. Perform the sampling system bias check by introducing calibration gases at the calibration valve installed at the outlet of the sampling probe. A zero gas and either the mid-range or high-range gas, whichever most closely approximates the effluent concentrations, shall be used for this check as follows:

6.4.1 Introduce the upscale calibration gas, and record the gas concentration displayed by the analyzer on a form similar to Figure 6C-6. Then introduce zero gas, and record the gas concentration displayed by the analyzer. During the sampling system bias check, operate the system at the normal sampling rate, and make no adjustments to the measurement system other than those necessary to achieve proper calibration gas flow rates at the analyzer. Alternately introduce the zero and upscale gases until a stable response is achieved. The tester shall determine the measurement system response time by observing the times required to achieve a stable response for both the zero and upscale gases. Note the longer of the two times as the response time.

6.4.2 The sampling system bias check shall be considered invalid if the difference between the gas concentrations displayed by the measurement system for the analyzer calibration error check and for the sampling system bias check exceeds ±5 percent of the span for either the zero or upscale calibration gas. If an invalid calibration is exhibited, take corrective action, and repeat the

sampling system bias check until acceptable performance is achieved. If adjustment to the analyzer is required, first repeat the analyzer calibration error check, then repeat the sampling system bias check.

7. *Emission Test Procedure*

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to Method 6.

7.2 Interference Check Preparation. For each individual analyzer, conduct an interference check for at least three runs during the initial field test on a particular source category. Retain the results, and report them with each test performed on that source category.

If an interference check is being performed, assemble the modified Method 6 train (flow control valve, two midget impingers containing 3 percent H_2O_2, and dry gas meter) as shown in Figure 6C-2. Install the sampling train to obtain a sample at the measurement system sample by-pass discharge vent. Record the initial dry gas meter reading.

7.3 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the sampling system bias check. Maintain constant rate sampling (i.e., ±10 percent) during the entire run. The sampling time per run shall be the same as for Method 6 plus twice the system response time. For each run, use only those measurements obtained after twice response time of the measurement system has elapsed, to determine the average effluent concentration. If an interference check is being performed, open the flow control valve on the modified Method 6 train concurrent with the initiation of the sampling period, and adjust the flow to 1 liter per minute (±10 percent).

(NOTE: If a pump is not used in the modified Method 6 train, caution should be exercised in adjusting the flow rate since overpressurization of the impingers may cause leakage in the impinger train, resulting in positively biased results).

7.4 Zero and Calibration Drift Tests. Immediately preceding and following each run, or if adjustments are necessary for the measurement system during the run, repeat the sampling system bias check procedure described in Section 6.4 (Make no adjustments to the measurement system until after the drift checks are completed.) Record and analyzer's responses on a form similar to Figure 6C-5.

7.4.1 If either the zero or upscale calibration value exceeds the sampling system bias specification, then the run is considered invalid. Repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before repeating the run.

7.4.2 If both the zero and upscale calibration values are within the sampling system bias specification, then use the average of the initial and final bias check values to calculate the gas concentration for the run. If the zero or upscale calibration drift value exceeds the drift limits, based on the difference between the sampling system bias check responses immediately before and after the run, repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before conducting additional runs.

7.5 Interference Check (if performed). After completing the run, record the final dry gas meter reading, meter temperature, and barometric pressure. Recover and analyze the contents of the midget impingers, and determine the SO_2 gas concentration using the procedures of Method 6. (It is not necessary to analyze EPA performance audit samples for Method 6.) Determine the average gas concentration exhibited by the analyzer for the run. If the gas concentrations provided by the analyzer and the modified Method 6 differ by more than 7 percent of the modified Method 6 result, the run is invalidated.

8. *Emission Calculation*

The average gas effluent concentration is determined from the average gas concentration displayed by the gas analyzer, and is adjusted for the zero and upscale sampling system bias checks, as determined in accordance with Section 7.4. The average gas concentration displayed by the analyzer may be determined by integration of the area under the curve for chart recorders, or by averaging all of the effluent measurements. Alternatively, the average may be calculated from measurements recorded at equally spaced intervals over the entire duration of the run. For sampling run durations of less than 1 hour, measurements at 1-minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be used. For sampling run durations greater than 1 hour, measurements at 2-minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be used. Calculate the effluent gas concentration using Equation 6C-1.

$$C_{gas} = (\bar{C} - C_o)\ \frac{C_{ma}}{C_m - C_o}$$

Eq. 6C-1

Where:

C_{gas} = Effluent gas concentration, dry basis, ppm.

$\bar{C}$ = Average gas concentration indicated by gas analyzer, dry basis, ppm.

C_o = Average of initial and final system calibration bias check responses for the zero gas, ppm.

C_m = Average of initial and final system calibration bias check responses for the upscale calibration gas, ppm.

C_{ma} = Actual concentration of the upscale calibration gas, ppm.

9. *Bibliography*

1. Traceability Protocol for Establishing True Concentrations of Gases Used for Calibrations and Audits of Continuous Source Emission Monitors: Protocol Number 1. U.S. Environmental Protection Agency, Quality Assurance Division. Research Triangle Park, NC. June 1978.

2. Westlin, Peter R. and J. W. Brown. Methods for Collecting and Analyzing Gas Cylinder Samples. Source Evaluation Society Newsletter. *3*(3):5–15. September 1978.

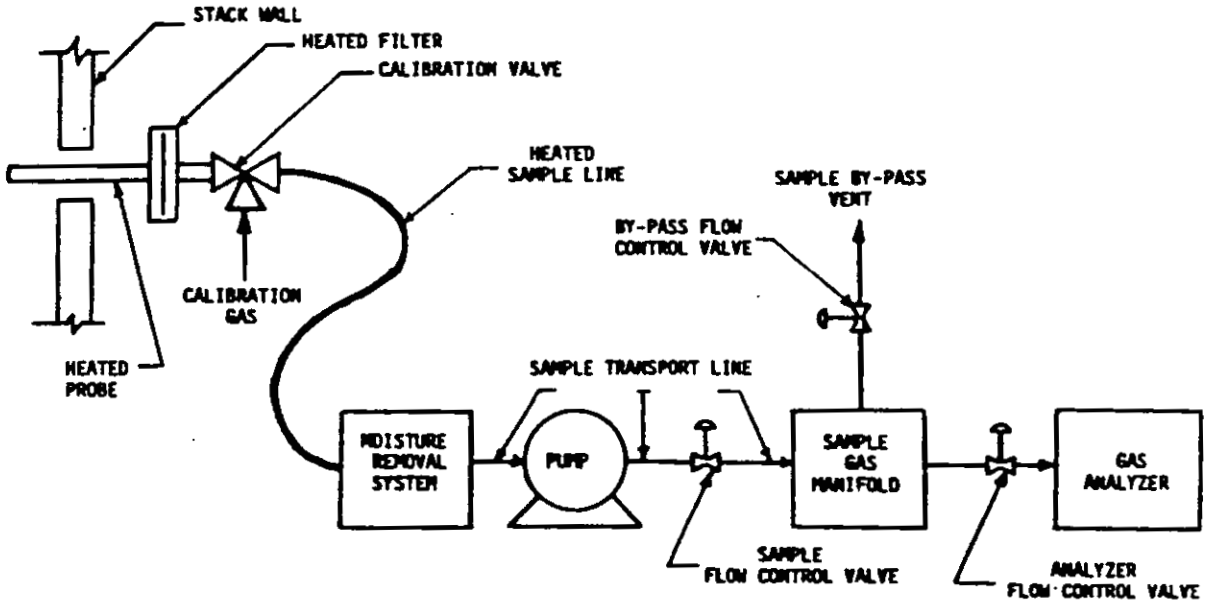


Figure 6C-1. Measurement system schematic.

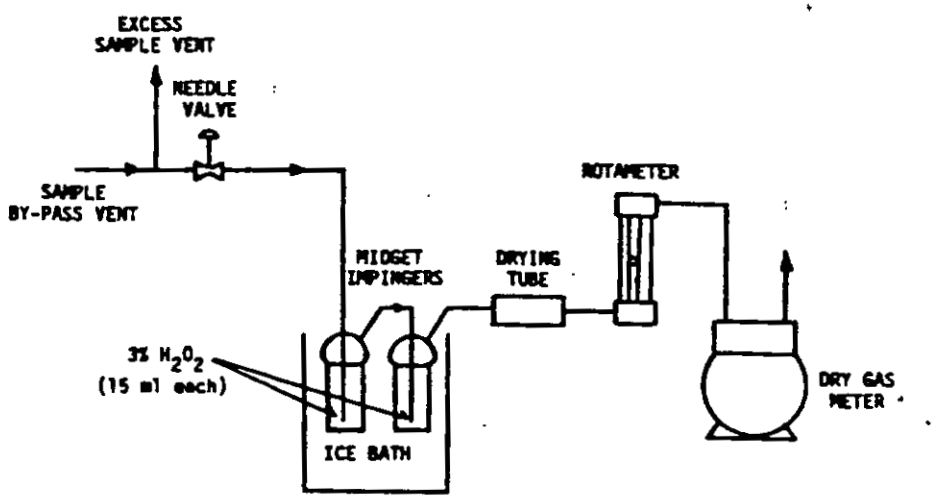


Figure 6C-2. Interference check sampling train.

FIGURE 6C-3—ANALYSIS OF CALIBRATION GASES

Analytic method used _____

Date _____

METHOD 7E—DETERMINATION OF NITROGEN OXIDES EMISSIONS FROM STATIONARY SOURCES (INSTRUMENTAL ANALYZER PROCEDURE)

1. *Applicability and Principle*

1.1 Applicability. This method is applicable to the determination of nitrogen oxides (NO_x) concentrations in emissions from stationary sources only when specified within the regulations.

1.2 Principle. A gas simple is continuously extracted from a stack, and a portion of the sample is conveyed to an instrumental chemiluminescent analyzer for determination of NO_x concentration. Performance specifications and test procedures are provided to ensure reliable data.

2. *Range and Sensitivity*

Same as Method 6C, Sections 2.1 and 2.2.

3. *Definitions*

3.1 Measurement System. The total equipment required for the determination of NO_x concentration. The measurement system consists of the following major subsystems:

3.1.1 Sample Interface, Gas Analyzer, and Data Recorder. Same as Method 6C, Sections 3.1.1, 3.1.2, and 3.1.3.

3.1.2 NO_2 to NO Converter. A device that converts the nitrogen dioxide (NO_2) in the sample gas to nitrogen oxide (NO).

3.2 Span, Calibration Gas, Analyzer Calibration Error, Sampling System Bias, Zero Drift, Calibration Drift, and Response Time. Same as Method 6C, Sections 3.2 through 3.8.

3.3 Interference Response. The output response of the measurement system to a

component in the sample gas, other than the gas component being measured.

4. *Measurement System Performance Specifications*

Same as Method 6C, Sections 4.1 through 4.4.

5. *Apparatus and Reagents*

5.1 Measurement System. Any measurement system for NO_x that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1 of Method 6C. The essential components of the measurement system are described below:

5.1.1 Sample Probe, Sample Line, Calibration Valve Assembly, Moisture Removal System, Particulate Filter, Sample Pump, Sample Flow Rate Control, Sample Gas Manifold, and Data Recorder. Same as Method 6C, Sections 5.1.1 through 5.1.9, and 5.1.11.

5.1.2 NO_2 to NO Converter. That portion of the system that converts the nitrogen dioxide (NO_2) in the sample gas to nitrogen oxide (NO). An NO_2 to NO converter is not necessary if data are presented to demonstrate that the NO_2 portion of the exhaust gas is less than 5 percent of the total NO_x concentration.

5.1.3 NO_x Analyzer. An analyzer based on the principles of chemiluminescence, to determine continuously the NO_x concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

5.2 NO_x Calibration Gases. The calibration gases for the NO_x analyzer shall be NO in N_2. Three calibration gases, as specified in Sections 5.3.1 through 5.3.3. of Method 6C, shall be used. Ambient air may be used for the zero gas.

6. *Measurement System Performance Test Procedures*

Perform the following procedures before measurement of emissions (Section 7).

6.1 Calibration Gas Concentration Verification. Follow Section 6.1 of Method 6C, except if calibration gas analysis is required, use Method 7, and change all 5 percent performance values to 10 percent (or 10 ppm, whichever is greater).

6.2 Interference Response. Conduct an interference response test of the analyzer prior to its initial use in the field. Thereafter, recheck the measurement system if changes are made in the instrumentation that could alter the interference response (e.g., changes in the gas detector). Conduct the interference response in accordance with Section 5.4 of Method 20.

6.3 Measurement System Preparation, Analyzer Calibration Error, and Sample System Bias Check. Follow Sections 6.2 through 6.4 of Method 6C.

6.4 NO_2 to NO Conversion Efficiency. Unless data are presented to demonstrate that the NO_2 concentration within the sample stream is not greater than 5 percent of the NO_x concentration, conduct an NO_2 to NO conversion efficiency test in accordance with Section 5.6 of Method 20.

7. *Emission Test Procedure*

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to tests performed using Method 7.

7.2 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the system calibration drift test. Maintain constant rate sampling (i.e., ±10 percent) during the entire run. The sampling time per run shall be the same as the total time required to perform a run using Method 7, plus twice the system response time. For each run, use only those measurements obtained after twice the response time of the measurement system has elapsed, to determine the average effluent concentration.

7.3 Zero and Calibration Drift Test. Follow Section 7.4 of Method 6C.

8. *Emission Calculation*

Follow Section 8 of Method 6C.

9. *Bibliography*

Same as bibliography of Method 6C.

(CO) content using a Luft-type nondispersive infrared analyzer (NDIR) or equivalent.

1.2 Applicability. This method is applicable for the determination of carbon monoxide emissions from stationary sources only when specified by the test procedures for determining compliance with new source performance standards. The test procedure will indicate whether a continuous or an integrated sample is to be used.

2. *Range and Sensitivity*

2.1 Range. 0 to 1,000 ppm.

2.2 Sensitivity. Minimum detectable concentration is 20 ppm for a 0 to 1,000 ppm span.

3. *Interferences*

Any substance having a strong absorption of infrared energy will interfere to some extent. For example, discrimination ratios for water (H_2O) and carbon dioxide (CO_2) are 3.5 percent H_2O per 7 ppm CO and 10 percent CO_2 per 10 ppm CO, respectively, for devices measuring in the 1,500 to 3,000 ppm range. For devices measuring in the 0 to 100 ppm range, interference ratios can be as high as 3.5 percent H_2O per 25 ppm CO and 10 percent CO_2 per 50 ppm CO. The use of silica gel and ascarite traps will alleviate the major interference problems. The measured gas volume must be corrected if these traps are used.

4. *Precision and Accuracy*

4.1 Precision. The precision of most NDIR analyzers is approximately ±2 percent of span.

4.2 Accuracy. The accuracy of most NDIR analyzers is approximately ±5 percent of span after calibration.

5. *Apparatus*

5.1 Continuous Sample (Figure 10-1).

5.1.1 Probe. Stainless steel or sheathed Pyrex[1] glass, equipped with a filter to remove particulate matter.

5.1.2 Air-Cooled Condenser or Equivalent. To remove any excess moisture.

5.2 Integrated Sample (Figure 10-2).

5.2.1 Probe. Stainless steel or sheathed Pyrex glass, equipped with a filter to remove particulate matter.

5.2.2 Air-Cooled Condenser or Equivalent. To remove any excess moisture.

5.2.3 Valve. Needle valve, or equivalent, to to adjust flow rate.

5.2.4 Pump. Leak-free diaphragm type, or equivalent, to transport gas.

5.2.5 Rate Meter. Rotameter, or equivalent, to measure a flow range from 0 to 1.0 liter per min (0.035 cfm).

Method 10—Determination of Carbon Monoxide Emissions From Stationary Sources

1. *Principle and Applicability*

1.1 Principle. An integrated or continuous gas sample is extracted from a sampling point and analyzed for carbon monoxide

[1] Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

5.2.6 Flexible Bag. Tedlar, or equivalent, with a capacity of 60 to 90 liters (2 to 3 ft^3). Leak-test the bag in the laboratory before using by evacuating bag with a pump followed by a dry gas meter. When evacuation is complete, there should be no flow through the meter.

5.2.7 Pitot Tube. Type S, or equivalent, attached to the probe so that the sampling rate can be regulated proportional to the stack gas velocity when velocity is varying with the time or a sample traverse is conducted.

5.3 Analysis (Figure 10–3).

5.3.1 Carbon Monoxide Analyzer. Nondispersive infrared spectrometer, or equivalent. This instrument should be demonstrated, preferably by the manufacturer, to meet or exceed manufacturer's specifications and those described in this method.

5.3.2 Drying Tube. To contain approximately 200 g of silica gel.

5.3.3 Calibration Gas. Refer to section 6.1.

5.3.4 Filter. As recommended by NDIR manufacturer.

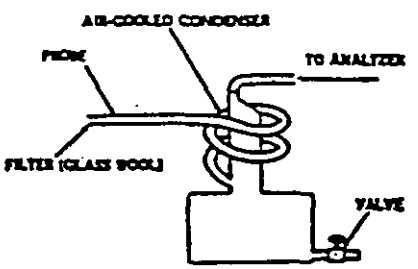


Figure 10-1. Continuous sampling train.

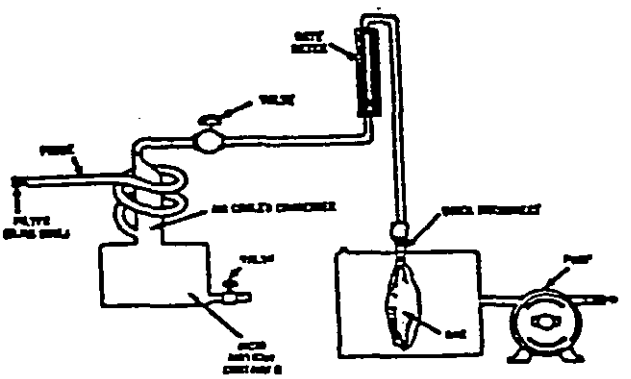


Figure 10-2. Integrated gas-sampling train.

5.3.5 CO_2 Removal Tube. To contain approximately 500 g of ascarite.

5.3.6 Ice Water Bath. For ascarite and silica gel tubes.

5.3.7 Valve. Needle valve, or equivalent, to adjust flow rate

5.3.8 Rate Meter. Rotameter or equivalent to measure gas flow rate of 0 to 1.0 liter per min (0.035 cfm) through NDIR.

5.3.9 Recorder (*optional*). To provide permanent record of NDIR readings.

6. *Reagents*

6.1 Calibration Gases. Known concentration of CO in nitrogen (N_2) for instrument span, prepurified grade of N_2 for zero, and two additional concentrations corresponding approximately to 60 percent and 30 percent span. The span concentration shall not exceed 1.5 times the applicable source performance standard. The calibration gases shall be certified by the manufacturer to be within ±2 percent of the specified concentration.

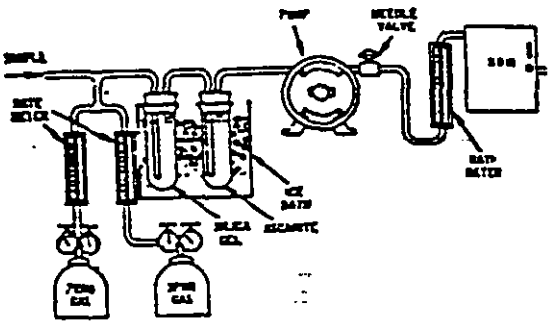


Figure 10-3. Analytical equipment.

6.2 Silica Gel. Indicating type, 6 to 16 mesh, dried at 175° C (347° F) for 2 hours.

6.3 Ascarite. Commercially available.

7. *Procedure*

7.1 Sampling.

7.1.1 Continuous Sampling. Set up the equipment as shown in Figure 10–1 making sure all connections are leak free. Place the probe in the stack at a sampling point and purge the sampling line. Connect the analyzer and begin drawing sample into the analyzer. Allow 5 minutes for the system to stabilize, then record the analyzer reading as required by the test procedure. (See section 7.2 and 8). CO_2 content of the gas may be determined by using the Method 3 integrated sample procedure, or by weighing the ascarite CO_2 removal tube and computing CO_2 concentration from the gas volume sampled and the weight gain of the tube.

7.1.2 Integrated Sampling. Evacuate the flexible bag. Set up the equipment as shown in Figure 10–2 with the bag disconnected. Place the probe in the stack and purge the sampling line. Connect the bag, making sure that all connections are leak free. Sample at a rate proportional to the stack velocity. CO_2 content of the gas may be determined by using the Method 3 integrated sample procedures, or by weighing the ascarite CO_2 removal tube and computing CO_2 concentra-

tion from the gas volume sampled and the weight gain of the tube.

7.2 CO Analysis. Assemble the apparatus as shown in Figure 10-3, calibrate the instrument, and perform other required operations as described in section 8. Purge analyzer with N_2 prior to introduction of each sample. Direct the sample stream through the instrument for the test period, recording the readings. Check the zero and span again after the test to assure that any drift or malfunction is detected. Record the sample data on Table 10-1.

8. *Calibration*

Assemble the apparatus according to Figure 10-3. Generally an instrument requires a warm-up period before stability is obtained. Follow the manufacturer's instructions for specific procedure. Allow a minimum time of 1 hour for warm-up. During this time check the sample conditioning apparatus, i.e., filter, condenser, drying tube, and CO_2 removal tube, to ensure that each component is in good operating condition. Zero and calibrate the instrument according to the manufacturer's procedures using, respectively, nitrogen and the calibration gases.

TABLE 10-1—FIELD DATA

Comments

Location_____
Test_____
Date_____
Operator_____

Clock time	Rotameter setting, liters per minute (cubic feet per minute)

9. *Calculation*

Concentration of carbon monoxide. Calculate the concentration of carbon monoxide in the stack using Equation 10-1.

$$C_{CO\ stack} = C_{CO\ NDIR}(1 - F_{CO_2})$$

Eq. 10-1

Where:

$C_{CO\ stack}$ = Concentration of CO in stack, ppm by volume (dry basis).

$C_{CO\ NDIR}$ = Concentration of CO measured by NDIR analyzer, ppm by volume (dry basis).

F_{CO_2} = Volume fraction of CO_2 in sample, i.e., percent CO_2 from Orsat analysis divided by 100.

10. Alternative Procedures

10.1 Interference Trap. The sample conditioning system described in Method 10A, sections 2.1.2 and 4.2, may be used as an alternative to the silica gel and ascarite traps.

11. *Bibliography*

11.1 McElroy, Frank. The Intertech NDIR-CO Analyzer, Presented at 11th Methods Conference on Air Pollution, University of California, Berkeley, CA. April 1, 1970.

11.2 Jacobs, M. B., et al., Continuous Determination of Carbon Monoxide and Hydrocarbons in Air by a Modified Infrared Analyzer, J. Air Pollution Control Association, 9(2): 110-114. August 1959.

11.3 MSA LIRA Infrared Gas and Liquid Analyzer Instruction Book, Mine Safety Appliances Co., Technical Products Division, Pittsburgh, PA.

11.4 Models 215A, 315A, and 415A Infrared Analyzers, Beckman Instruments, Inc., Beckman Instructions 1635-B, Fullerton, CA. October 1967.

11.5 Continuous CO Monitoring System, Model A5611, Intertech Corp., Princeton, NJ.

11.6 UNOR Infrared Gas Analyzers, Bendix Corp., Ronceverte, WV

ADDENDA

A. PERFORMANCE SPECIFICATIONS FOR NDIR CARBON MONOXIDE ANALYZERS

Range (minimum)	0-1000 ppm.
Output (minimum)	0-10mV.
Minimum detectable sensitivity.	20 ppm.
Rise time, 90 percent (maximum).	30 seconds.
Fall time, 90 percent (maximum).	30 seconds.
Zero drift (maximum)	10% in 8 hours.
Span drift (maximum)	10% in 8 hours.
Precision (minimum)	±2% of full scale.
Noise (maximum)	±1% of full scale.
Linearity (maximum deviation)	2% of full scale.
Interference rejection ratio	CO_2—1000 to 1, H_2O—500 to 1.

B. *Definitions of Performance Specifications.*

Range—The minimum and maximum measurement limits.

Output—Electrical signal which is proportional to the measurement; intended for connection to readout or data processing devices. Usually expressed as millivolts or milliamps full scale at a given impedance.

Full scale—The maximum measuring limit for a given range.

Minimum detectable sensitivity—The smallest amount of input concentration that can be detected as the concentration approaches zero.

Accuracy—The degree of agreement between a measured value and the true value; usually expressed as ± percent of full scale.

Time to 90 percent response—The time interval from a step change in the input concentration at the instrument inlet to a reading of 90 percent of the ultimate recorded concentration.

Rise Time (90 percent)—The interval between initial response time and time to 90 percent response after a step increase in the inlet concentration.

Fall Time (90 percent)—The interval between initial response time and time to 90 percent response after a step decrease in the inlet concentration.

Zero Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is zero; usually expressed as percent full scale.

Span Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is a stated upscale value; usually expressed as percent full scale.

Precision—The degree of agreement between repeated measurements of the same concentration, expressed as the average deviation of the single results from the mean.

Noise—Spontaneous deviations from a mean output not caused by input concentration changes.

Linearity—The maximum deviation between an actual instrument reading and the reading predicted by a straight line drawn between upper and lower calibration points.

Method 10A—Determination of Carbon Monoxide Emissions in Certifying Continuous Emission Monitoring Systems at Petroleum Refineries

1. Applicability and Principle

1.1 Applicability. This method applies to the measurement of carbon monoxide (CO) at petroleum refineries. This method serves as the reference method in the relative accuracy test for nondispersive infrared (NDIR) CO continuous emission monitoring systems (CEMS's) that are required to be installed in petroleum refineries on fluid catalytic cracking unit catalyst regenerators [40 CFR Part 60.105(a)(2)].

1.2 Principle. An integrated gas sample is extracted from the stack, passed through an alkaline permanganate solution to remove sulfur and nitrogen oxides, and collected in a Tedlar bag. The CO concentration in the sample is measured spectrophotometrically using the reaction of CO with p-sulfaminobenzoic acid.

1.3. Range and Sensitivity.

1.3.1 Range. Approximately 3 to 1800 ppm CO. Samples having concentrations below 400 ppm are analyzed at 425 nm, and samples having concentrations above 400 ppm are analyzed at 600 nm.

1.3.2 Sensitivity. The detection limit is 3 ppm based on three times the standard deviation of the mean reagent blank values.

1.4 Interferences. Sulfur oxides, nitric oxide, and other acid gases interfere with the colorimetric reaction. They are removed by passing the sampled gas through an alkaline potassium permanganate scrubbing solution. Carbon dioxide (CO_2) does not interfere, but, because it is removed by the scrubbing solution, its concentration must be measured independently and an appropriate volume correction made to the sampled gas.

1.5 Precision, Accuracy, and Stability.

1.5.1 Precision. The estimated intralaboratory standard deviation of the method is 3 percent of the mean for gas samples analyzed in duplicate in the concentration range of 39 to 412 ppm. The interlaboratory precision has not been established.

1.5.2 Accuracy. The method contains no significant biases when compared to an NDIR analyzer calibrated with National Bureau of Standards (NBS) standards.

1.5.3 Stability. The individual components of the colorimetric reagent are stable for at least 1 month. The colorimetric reagent must be used within 2 days after preparation to avoid excessive blank correction. The samples in the Tedlar [1] bag should be stable for at least 1 month if the bags are leak-free.

2. Apparatus

2.1 Sampling. The sampling train is shown in Figure 10A-1, and component parts are discussed below:

[1] Mention of trade names or commercial products in this publication does not constitute the endorsement or recommendation for use by the Environmental Protection Agency.

APPENDIX H

CALCULATION EQUATIONS

CALCULATION EQUATIONS

METHOD 2

$$\bar{V}_s = 85.48\ C_p\ (\sqrt{\Delta p})_{avg}\ \sqrt{\frac{T_{s(avg)}}{P_s\ M_s}}$$

$$Q_{s,d} = 60(1 - B_{ws})\ \bar{V}_s\ A\ \left(\frac{528}{T_{s(avg)}}\right)\ \left(\frac{P_s}{29.92}\right)$$

$$Q_a = 60\ \bar{V}_s\ A$$

$$\dot{m}_g = \frac{4.995\ Q_{s,d}\ G_d}{1 - B_{ws}}$$

$$RH^* = 100\ (vp_{twb}\ 0.0003641\ P_s\ (T_{db} - T_{wb}))/vp_{tdb}$$

$$B^*_{ws} = RH(vp_{tdb})/P_s$$

$$= \frac{4.585 \times 10^{-2}\ P_s M_s}{T_s\ (avg)}$$

*Alternate equations for calculating moisture content from wet bulb and dry buld data.

SYMBOLS

A	=	Cross sectional area of stack, SQ. FT.
A_n	=	Cross sectional area of nozzle, SQ. FT.
B_{ws}	=	Water vapor in gas stream, proportion by volume
C_p	=	Pitot tube coefficient, dimensionless
C_a	=	Concentration of particulate matter in stack gas, wet basis, GR/ACF
C_s	=	Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, GR/DSCF
EA	=	Excess air, percent by volume
γ	=	Dry test meter correction factor, dimensionless
G_d	=	Specific gravity (relative to air), dimensionless
I	=	Isokinetic variation, percent by volume
M_d	=	Molecular weight of stack gas, dry basis, g/g - mole.
$\dot{m}_g$	=	Mass flow of wet flue gas, LB/HR
$\dot{m}_p$	=	Particulate mass flow, LB/HR
M_s	=	Molecular weight of stack gas, wet basis, g/g, mole.
M_p	=	Total amount of particulate matter collected, g
P_{bar}	=	Atmospheric pressure, IN. HG. (uncompensated)
P_g	=	Stack static gas pressure, IN. WC.

P_s = Absolute pressure of stack gas, IN.HG.

P_{std} = Standard absolute pressure, 29.92 IN. HG.

A_a = Actual volumetric stack gas flow rate, ACFM

$Q_{s,d}$ = Dry volumetric stack gas flow rate corrected to standard conditions, DSCFM

RH = Relative humidity, %

T_{db} = Dry bulb temperature of stack gas, ^{o}F

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

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

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

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

θ = Total sampling time, min.

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml

V_m = Volume of gas sample as measured by dry gas meter, CF

$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter corrected to standard conditions, DSCF

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

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

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

VP_{twb} = Vapor pressure at T_{wb}, IN. HG

$\overline{\Delta H}$ = Average pressure differential across the orifice meter, IN. WC.

ΔP = Velocity pressure of stack gas, IN. WC.

γ = Dry test meter correction coefficient, dimensionless

ρ = Actual gas density, LB/ACF

CALCULATION EQUATIONS

METHOD 3

$$\%EA = \frac{100(\%O_2 -).5\%\ CO)}{0.264\%\ N_2 - \%O_2 + 0.5\%\ CO}$$

$$M_d = 0.44(\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$M_s = M_d\ (I - B_{ws}) + 0.18\ B_{ws}$$

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

CALCULATION EQUATIONS

METHOD 5

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

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

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

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

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

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

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

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

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

SYMBOLS

A = Cross sectional area of stack, SQ. FT.

A_n = Cross sectional area of nozzle, SQ. FT.

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

C_p = Pitot tube coefficient, dimensionless

C_a = Concentration of particulate matter in stack gas, wet basis, GR/ACF

C_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, GR/DSCF

EA = Excess air, percent by volume

γ = Dry test meter correction factor, dimensionless

G_d = Specific gravity (relative to air), dimensionless

I = Isokinetic variation, percent by volume

M_d = Molecular weight of stack gas, dry basis, g/g - mole.

$\dot{m}_g$ = Mass flow of wet flue gas, LB/HR

$\dot{m}_p$ = Particulate mass flow, LB/HR

M_s = Molecular weight of stack gas, wet basis, g/g, mole.

M_p = Total amount of particulate matter collected, g

P_{bar} = Atmospheric pressure, IN. HG. (uncompensated)

P_g = Stack static gas pressure, IN. WC.

P_s = Absolute pressure of stack gas, IN.HG.

P_{std} = Standard absolute pressure, 29.92 IN. HG.

A_a = Actual volumetric stack gas flow rate, ACFM

$Q_{s,d}$ = Dry volumetric stack gas flow rate corrected to standard conditions, DSCFM

RH = Relative humidity, %

T_{db} = Dry bulb temperature of stack gas, ^{o}F

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

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

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

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

θ = Total sampling time, min.

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml

V_m = Volume of gas sample as measured by dry gas meter, CF

$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter corrected to standard conditions, DSCF

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

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

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

vp_{twb} = Vapor pressure at T_{wb}, IN. HG

$\overline{\Delta H}$ = Average pressure differential across the orifice meter, IN. WC.

ΔP = Velocity pressure of stack gas, IN. WC.

γ = Dry test meter correction coefficient, dimensionless

ρ = Actual gas density, LB/ACF

CALCULATION EQUATIONS

METHOD 6

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

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

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

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

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

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

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

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

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

SYMBOLS

$\overline{B}'_{O_2}$	=	Average oxygen content in flue gas, % v/v, dry
$\overline{B}'_{CO_2}$	=	Average carbon dioxide content in flue gas, % v/v, dry
C_s	=	Concentration of sulfur dioxide in flue gas, dry basis, corrected to standard conditions, LB/DSCF
C_s (GR/DSCF)	=	Concentration of sulfur dioxide in flue gas, dry basis, corrected to standard conditions, GR/DSCF
C_s (MG/DSCM)	=	Concentration of sulfur dioxide in flue gas, dry basis, corrected to standard conditions, MG/DSCM
DF	=	Dilution Factor
E	=	Emission factor, LB of $SO_2/10^6$BTU
F_d	=	Dry oxygen F-Factor for given fuel type, DSCF/10^6BTU
F_c	=	Carbon dioxide F-Factor for given fuel type, DSCF/10^6BTU
ΔH	=	Average pressure drop across calibrated orifice, IN. W.C.
γ	=	Dry test meter correction factor, dimensionless
MC	=	Moisture content of flue gas, % v/v
MEQ	=	Total milliequivalents of SO_2 in gas sample
N	=	Normality of barium perchlorate titrant
P_b	=	Barometric pressure at the dry gas meter, IN. HG.

C_s (ppm-dry) = Concentration of sulfur dioxide in flue gas, dry basis, (v/v), ppm

C_s (ppm-wet) = Concentration of sulfur dioxide in flue gas, wet basis, (v/v), ppm

T_m = Absolute average dry gas meter temperature, ^{o}R

V_a = Volume of sample aliquot titrated, cc

V_m = Dry gas volume as measured by the dry gas meter, DCF

V_{std} = Dry gas volume as measured by the dry gas meter, corrected to standard conditions (at 68 ^{o}F and 1 atmosphere), DSCF

V_{soln} = Total volume of the solution in which the sulfur dioxide sample is contained, cc

V_t = Volume of barium perchlorate titrant used for the sample, cc (average of replicate titrations)

V_{tb} = Volume of barium perchlorate titrant used for the blank, cc

CALCULATION EQUATIONS

METHOD 7

$$V_{m(std)} = 17.64\ (V_f - 25)\ \left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right]$$

$$C_s = 6.243 \times 10^{-5}\ \frac{M}{V_{m(std)}}$$

$$E = \frac{2090\ C_s F}{20.9 - \bar{B}'_{O_2}}$$

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

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

$$C_s\ (ppm\text{-}dry) = 8.37552 \times 10^{6}\ C_s$$

$$C_s\ (ppm\text{-}3\%\ O_2) = 8.37552 \times 10^{6}\ C_s \left\{1 + \left[\frac{\bar{B}'_{O_2} - 3}{20.9 - B'_{O_2}}\right]\right\}$$

$$C_s\ (ppm\text{-}wet) = 8.37552 \times 10^{6}\ C_s\ \left(1 - \frac{MC}{100}\right)$$

CE6-1

SYMBOLS

$\bar{B}'_{O_2}$	=	Average oxygen content in flue gas, % v/v
C_s	=	Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, LB/DSCF
C_s (GR/DSCF)	=	Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, GR/DSCF
C_s (MG/DSCM)	=	Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, MG/DSCM
E	=	Emission factor, LB/10^6BTU
F	=	F-Factor for given fuel type, DSCF/10^4BTU
M	=	Mass of nitrogen oxides as nitrogen dioxide in gas sample, µg
MC	=	Moisture content of flue gas, %
P_f	=	Final absolute pressure in flask, IN. HG
P_i	=	Initial absolute pressure in flask, IN. HG
C_s (ppm-dry)	=	Concentration of nitrogen oxides in flue gas, dry basis, (v/v), ppm
C_s (ppm-3% O_2)	=	Concentration of nitrogen oxides in flue gas, dry basis, corrected to 3% O_2 , (v/v) ppm
C_s (ppm-wet)	=	Concentration of nitrogen oxides in flue gas, wet basis, (v/v), ppm

T_f = Final absolute temperature in flask, ^{o}R

T_i = Initial absolute temperature in flask, ^{o}R

V_f = Volume of flask and valve, cc

$V_{m(std)}$ = Sample volume at standard conditions, dry basis, cc

CALCULATION EQUATIONS

METHOD 10

$$CO\text{-}PPM\text{-}DRY = CO_{CO_2\text{-}free,dry,avg}\ (1 - CO_{2,d}/100)$$

$$CO\text{-}PPM\text{-}WET = CO\text{-}PPM\text{-}DRY\ (1 - MC/100)$$

$$GR/DSCF = 5.0885 \times 10^{-4}\ (CO\text{-}PPM\text{-}DRY)$$

$$mg/dscm = 1.165\ (CO\text{-}PPM\text{-}DRY)$$

$$\dot{m} = 8.5714 \times 10^{-3}\ (GR/DSCF)(Q_{s,d})$$

$$E = \frac{2.9857 \times 10^{-3}\ F_d\ (GR/DSCF)}{20.9 - O_{2,d}}$$

Where

$CO_{CO_2\text{-}free,dry,avg}$ = average of two determinations of carbon monoxide on a dry, CO_2-free integrated flue gas sample reported in ppm by volume

$CO_{2,d}$ = carbon dioxide concentration of flue gas on a dry percent by volume basis

$O_{2,d}$ = oxygen concentration of flue gas on a dry percent by volume basis

MC	= moisture content of flue gas on a percent by volume basis
CO·PPM·DRY	= carbon monoxide concentration in ppm by volume on a dry basis
CO·PPM·WET	= carbon monoxide concentration in ppm by volume on a wet or actual basis
GR/DSCF	= concentration of carbon monoxide in flue gas on a grains per dry standard cubic foot basis (68 ^{o}F, 29.92 IN.HG.)
mg/dscm	= concentration of carbon monoxide in flue gas on a milligrams per dry standard cubic meter basis (60 ^{o}F, 29.92 IN.HG.)
$\dot{m}$	= emission or mass rate of carbon monoxide on a LB/HR basis
$Q_{s,d}$	= volumetric flow rate of flue gas in dry standard cubic feet per minute
E	= emission factor of carbon monoxide in pounds of carbon monoxide emitted per million BTU heat input (LB/MMBTU)
F_d	= F-Factor of respective fuel in dry standard cubic feet of exhaust gas at 0% oxygen per million BTU of heat input (DSCF/MMBTU)

APPENDIX I

SAMPLING TRAIN CALIBRATION DATA

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job L.P. / VIRGINIA, LA. Date 4/3/92

Operator D. BRENNAN Module No. 3

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

Bar press 29.78 in. Hg. γ = .9991 ^H@ 1.90 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(138.00)	[redacted]	
2.5	139.90	86	78
5.0	141.79	87	79
7.5	143.68	88	80
10	145.574	88	80
[redacted]	V_m = 7.574	Avg(t_m) = 83.75	°F

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(.9991)(7.574)}\left[\frac{(83.75) + 460}{(29.78)}\right]^{0.5}$$

$$Y_{cn} = 1.0085$$

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

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

S-432R

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job L.P. / URANIA, LA. Date 4/6/92

Operator D. BRENNAN Module No. 3

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

Bar press 29.81 in. Hg. γ = .9991 ^H@ 1.90 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(405.00)	[redacted]	
2.5	406.88	77	66
5.0	408.77	78	67
7.5	410.66	81	69
10	412.538	82	69
[redacted]	V_m= 7.538	Avg(t_m)=	°F

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(.9991)(7.538)}\left[\frac{533.625}{(73.625) + 460 \over (29.81)}\right]^{0.5}$$

$$Y_{cn} = 1.0033$$

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

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

S-432R

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job L.P. / VRANIA, LA. Date 4/7/92

Operator BOB ASCHENBACH Module No. 3

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

Bar press 29.95 in. Hg. γ = .9991 ^H@ 1.90 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(678.00)	[redacted]	
2.5	679.87	65	63
5.0	681.74	66	63
7.5	683.61	68	64
10	685.473	69	64
[redacted]	V_m = 7.473	Avg(t_m) = 65.25°F	

Calculate Y_{en} as follows:

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

$$Y_{en} = \frac{1.786}{(.9991)(7.473)}\left[\frac{(65.25) + 460}{(29.25)}\right]^{0.5}$$

$$Y_{en} = 1.0017$$

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

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

S-432R

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job L.P. / Urania, LA Date 4-9-92

Operator M. Koehler Module No. 4

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

Bar press 29.90 in. Hg. γ = 1.0010 ^H@ 1.75 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(802.50)	[redacted]	
2.5	804.41	63	63
5.0	806.30	64	63
7.5	808.21	65	64
10	810.10	67	64
[redacted]	V_m=7.600	Avg(t_m)=64.125	°F

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(1.0010)(7.600)}\left[\frac{(64.125 + 460}{(29.90)}\right]^{0.5}$$

$$Y_{cn} = .9830$$

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

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

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Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job L.P. / URANIA, LA. Date 4/8/92

Operator D BRENNAN Module No. 3

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

Bar press 29.97 in. Hg. γ = .9991 ^H@ 1.90 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(851.50)	[redacted]	
2.5	853.37	64	56
5.0	855.22	68	57
7.5	857.05	70	58
10	858.855	71	59
[redacted]	V_m = 7.355	Avg(t_m) = 62.875 °F	

METER CAL 4/8/92 PW

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(.9991)(7.355)}\left[\frac{522.875}{(62.875) + 460}{(29.97)}\right]^{0.5}$$

$$Y_{cn} = 1.015$$

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

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

S-432R

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job L.P. URANIA, LA. Date 4/9/92

Operator D. BRENNAN Module No. 3

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

Bar press 29.90 in. Hg. Y = .9991 ^H@ 1.90 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(979.00)	[redacted]	
2.5	980.89	83	73
5.0		85	74
7.5	984.66	86	74
10	986.532	87	75
[redacted]	V_m = 7.532	Avg(t_m) = 79.625	°F

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(.9991)(7.532)}\left[\frac{539.625}{(29.625) + 460}{(29.90)}\right]^{0.5}$$

$$Y_{cn} = 1.0083$$

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

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

S-432R

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job LP/URANIA Date 4-3-92

Operator C Mossen Module No. 4

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

Bar press 29.78 in. Hg. γ = 1.0098 ^H@ 1.75 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(581.80)	[redacted]	
2.5	583.69	66	66
5.0	585.59	68	66
7.5	587.48	70	67
10	589.38	71	68
[redacted]	V_m = 7.58	Avg(t_m) = 67.75	°F

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(1.0098)(7.58)}\left[\frac{(67.75) + 460}{(29.78)}\right]^{0.5}$$

$$Y_{cn} = .982$$

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

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

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Page II

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job L.P. / Ironton, LA — Date 4-6-92

Operator M. Koehler — Module No. 4

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

Bar press 29.81 in. Hg. γ = 1.0010 ^H@ 1.75 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(139.20)	[redacted]	
2.5	141.06	61	60
5.0	142.04	63	61
7.5	144.82	65	62
10	146.70	67	62
[redacted]	V_m = 7.50	Avg(t_m) = 62.63	°F

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(1.0010)(7.50)}\left[\frac{(62.63) + 460}{(29.81)}\right]^{0.5}$$

$$Y_{cn} = 0.996$$

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

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

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Page 11

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job L.P. / Urania, LA Date 4-7-92

Operator M. Koehler Module No. 4

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

Bar press 29.93 in. Hg. γ = 1.0010 ^H@ 1.75 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(415.30)	[redacted]	
2.5	417.16	60	59
5.0	419.02	61	60
7.5	420.90	63	60
10	422.77	64	61
[redacted]	V_m=	Avg(t_m)=	°F

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(\quad)(\quad)}\left[\frac{(\quad) + 460}{(\quad)}\right]^{0.5}$$

Y_{cn} = _____

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

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

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Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job U.P. / Uranium, LA Date 4-8-92

Operator M. Kaehler Module No. 4

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

Bar press 29.97 in. Hg. γ = 1.0010 ^H@ 1.75 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(537.40)	[redacted]	
2.5	539.21	51	50
5.0	541.02	53	51
7.5	542.90	55	52
10	544.73	57	53
[redacted]	V_m= 7.33	Avg(t_m)= 52.75	°F

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(1.0010)(7.33)}\left[\frac{(52.75) + 460}{(29.97)}\right]^{0.5}$$

$$Y_{cn} = 1.007$$

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

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

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Page II

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: April 17, 1992

Meter Box No. : 3 (Rockwell Dry Test Meter Serial No. 712852)

Date of Last Calibration: March 18, 1992
Calibration Technician: D. Brennan
Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
March 24, 1992	2-3532	984.00	2043.42	1059.42	1059.42
March 20, 1992	2-3533	2050.00	3112.29	1062.29	2121.71
April 4, 1992	2-3534	3138.00	4206.23	1068.23	3189.94

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: April 17, 1992

Meter Box No. : 4 (Rockwell Dry Test Meter Serial No. 964553)

Date of Last Calibration: March 17, 1992
Calibration Technician: D. Brennan
Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
March 24, 1992	2-3532	709.80	1877.54	1167.74	1167.74
March 30, 1992	2-3533	1878.10	2880.97	1002.87	2170.61
April 4, 1992	2-3534	2881.80	3975.79	1093.99	3264.60

* Total volume through meter since last calibration.

Date 3/18/92

Bar. Press. 29.21 in. Hg

INTERPOLL LABORATORIES, INC.
METER CALIBRATION SHEET
EPA METHOD 5

Control Module No. 3
Serial No. DTM 712852
Wet Test Meter No. AL-20
Technician D. REENNAN

ΔH (in. WC)		Gas Volume Wet Test Meter (ft^3)	* Cal. Index ♦ (%)	* Diff. Wet Test Meter ΔP_w (in.WC)	Gas Volume Dry test meter (ft^3)		Gas temperatures			Time θ (min/sec)	Meter Coeff. Y	Orifice Const. ΔH@	C_f
							Wet Test	Dry Test					
nominal	actual				V_{di}	V_{df}	t_w (°F)	t_{di} (°F)	t_{do} (°F)				
0.5	.50	2	99.85	0.01	972.500	974.551	62.5	80	72	5.11	.9975	1.86	
1.2	1.2	3	99.91	0.025	975.000	978.068	62.5	82	73	5:04	1.0019	1.89	
2.0	2.0	3	99.93	0.055	957.000	960.058	62.0	80	70	3:55	.9996	1.89	
3.3	3.3	5	100.00	0.09	961.000	966.109	62.5	82	72	5:08	.9982	1.92	
4.7	4.7	5	100.02	0.12	967.000	972.111	62.0	85	73	4:20	.9982	1.94	
2	3	4	5	6	7		8	9	10	11/13 Avg.	.9991	1.90	

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

Approved by Daniel R. Deye Date 3/18/92

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

S0102RR 11/91

Date 3/17/92

Bar. Press. 29.21 in. Hg

INTERPOLL LABORATORIES, INC.
METER CALIBRATION SHEET
EPA METHOD 5

Control Module No. 4
Serial No. DTM 964 553
Wet Test Meter No. AL-20
Technician D. BRENNAN

ΔH (in. WC)		Gas Volume Wet Test Meter (ft^3)	* Cal. Index ♦ (%)	* Diff. Wet Test Meter ΔP_w (in.WC)	Gas Volume Dry test meter (ft^3)		Gas temperatures			Time θ (min/sec)	Meter Coeff. Y	Orifice Const. ΔH@	C_f
							Wet Test	Dry Test					
nominal	actual				V_{d1}	V_{df}	t_w (°F)	t_{d1} (°F)	t_{do} (°F)				
0.5	.50	2	99.85	0.01	703.500	705.550	63.5	82	75	4.57	1.0008	1.70	
1.2	1.2	3	99.91	0.025	706.000	709.077	63.5	82	75	4.51	.9989	1.74	
2.0	2.0	3	99.93	0.055	688.000	691.068	63.5	82	75	3.46	1.0000	1.74	
3.3	3.3	5	100.00	0.09	692.000	697.110	63.5	85	76	4.56	1.0017	1.77	
4.7	4.7	5	100.02	0.12	698.000	703.098	63.5	87	77	4.10	1.0035	1.79	
		8	8	8	8	6	7	8	8	10	11/13 ave	1.00098	1.75	

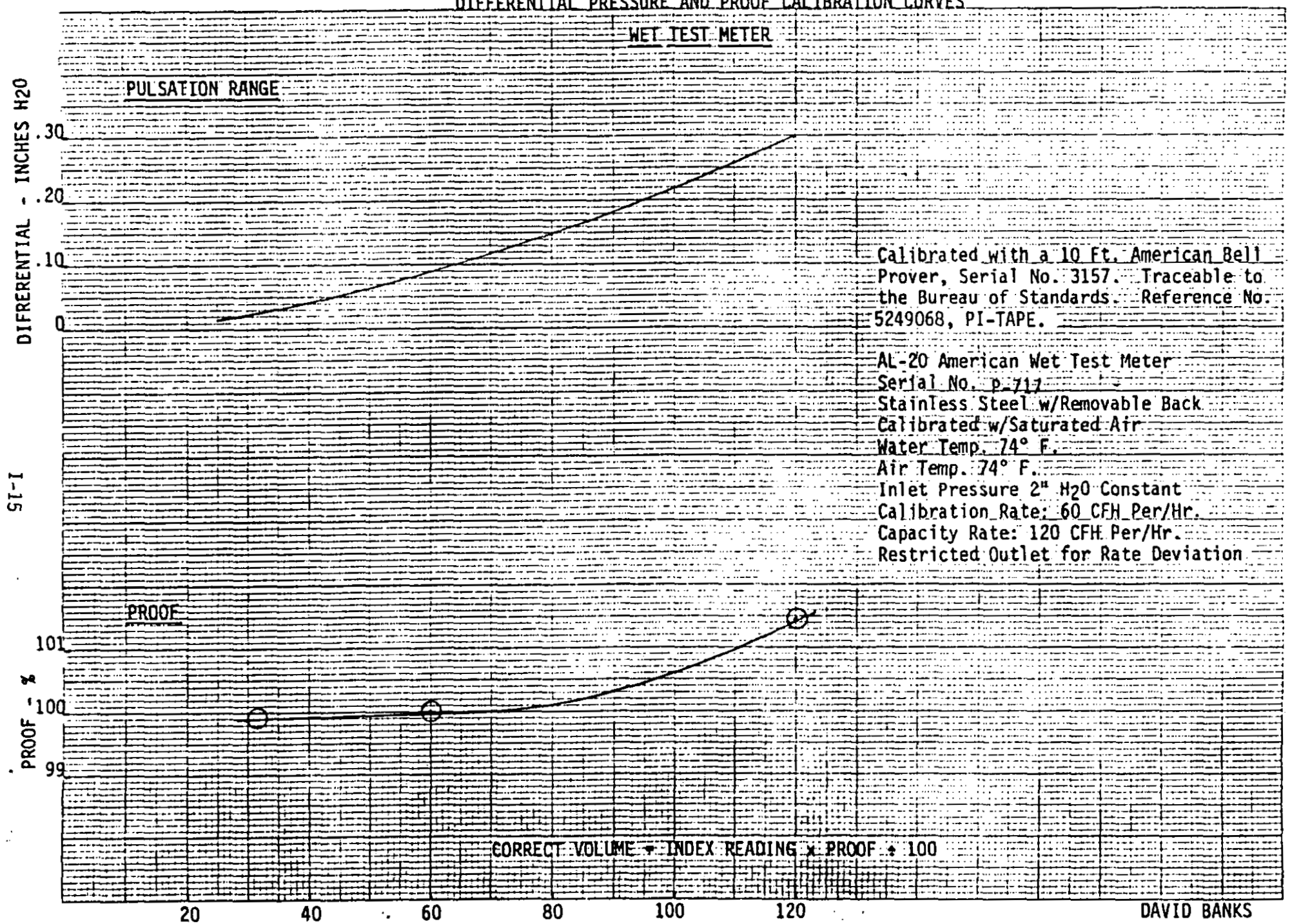
Positive leak check performed by D. BRENNAN
Meter was in tolerance ■
Meter was not in tolerance ☐; readjusted linkage
Meter was not in tolerance ☐; changed dry test meters

Approved by Daniel R. Deye Date 3/17/92

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

DIFFERENTIAL PRESSURE AND PROOF CALIBRATION CURVES

WET TEST METER



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

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

DAVID BANKS

November, 1991

I-15

12 262

20 Squares to the Inch

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 04-08-92 Nozzle : Glass

Technician: M. Kaehler

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

Position	Diameter (inches)
1	.189
2	.188
3	.188
Average:	.188

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 04-04-92 Nozzle : Glass
Technician: M. Kaehler

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

Position	Diameter (inches)
1	.238
2	.239
3	.240
Average:	.239

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 04-07-92 Nozzle Number 3-5
Technician: M. Kaehler

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

Position	Diameter (inches)
1	.308
2	.307
3	.304
Average:	.306

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 04-08-92 Nozzle Number 8-3
Technician: M. Kaehler

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

Position	Diameter (inches)
1	.183
2	.183
3	.183
Average:	.183

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 04-04-92 Nozzle Number B-4
Technician: D. Brennan

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

Position	Diameter (inches)
1	.241
2	.241
3	.241
Average:	.241

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 04-07-92 Nozzle Number 8-5

Technician: D. Brennan

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

Position	Diameter (inches)
1	.302
2	.300
3	.298
Average:	.300

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 04-08-92 Nozzle : PM1-1
Technician: D. Brennan

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

Position	Diameter (inches)
1	.133
2	.133
3	.133
Average:	.133

Interpoll Laboratories, Inc.

Temperature Measurement Device Calibration Sheet

Unit under test:

Vendor Atkins

Model Model # 39658-K Serial Number PDT #3

Range -- 1999 °F Thermocouple Type K

Date of Calibration 3/19/91 Technician D. Van Hoever

Method of Calibration:

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

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

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation Δt (°F)	Deviation (%)
0	0	-4	4	.87
100	100	93.5	6.5	1.16
200	200	195.8	4.2	.64
300	300	294	6	.74
400	400	390	10	1.16
500	500	484	11	1.14
600	600	591	9	.85
700	700	690	10	.86
800	800	794	6	.48
900	900	895	5	.37
1000	1000	999	1	.07
1100	1100	1100	—	—
1200	1200	1205	5	.30
1300	1300	1304	4	.23
1400	1400	1407	7	.38
1500	1500	1502	2	.10
1600	1600	1602	2	.10
1700	1700	1695	5	.23
1800	1800	1791	9	.40
1900	1900	1881	19	.80
2000	2000	1974	26	1.06
2100				
		Averages:		.57

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

% dev = 100 Δt / (460 + t)

☒ Unit in tolerance

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

S-433

PDT-16

Interpoll Laboratories, Inc.

Temperature Measurement Device
Calibration Sheet

Unit under test:
Vendor Fluke
Model Fluke 51 Serial Number 5220020
Range 0-2100 °F Thermocouple Type K/J
Date of Calibration 7/29/91 Technician DKH

Method of Calibration:

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

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

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation Δt (°F)	Deviation (%)
0	0	1	1	.22
100	100	98	2	.36
200	200	201	1	.15
300	300	300	0	0
400	400	398	2	.23
500	500	499	1	.10
600	600	601	1	.09
700	700	699	1	.09
800	800	801	1	.08
900	900	899	1	.07
1000	1000	1000	0	0
1100	1100	1100	0	0
1200	1200	1202	2	.12
1300	1300	1300	0	0
1400	1400	1402	2	.11
1500	1500	1500	0	0
1600	1600	1601	1	.05
1700	1700	1700	0	0
1800	1800	1801	1	.04
1900	1900	1899	1	.04
2000	2000	2001	1	.04
2100	2100	2098	2	.08
		Averages:		

OF = off scale response by unit under test (°F)
% dev = 100 Δt / (460 + t)

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

S-433

(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 24-5

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .460 IN.
3. Base to Side B opening plane (P_B) .461 IN.

Alignment:

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

6. $B_1 < 5^0$ .02
7. $B_2 < 5^0$ .01

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

Distance from Pitot to Probe Components:

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

☒ Meets all EPA design criteria thus C_p = 0.84

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

Date of Inspection: 3-2-92

Inspected by: E Trowbridge

CFR Title 40 Part 60 Appendix A Method 2

(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 4-29

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .463 IN.
3. Base to Side B opening plane (P_B) .462 IN.

Alignment:

4. α_1 <10° 0
5. α_2 <10° 0

6. B_1 <5° 2
7. B_2 < 5° 1

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

Distance from Pitot to Probe Components:

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

☒ Meets all EPA design criteria thus C_p = 0.84

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

Date of Inspection: 2-29-92

Inspected by: E Trowbridge

CFR Title 40 Part 60 Appendix A Method 2

(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 6-29

Pitot tube dimensions:

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

Alignment:

4. α_1 <10° 0
5. α_2 <10° 0

6. B_1 <5° 1
7. B_2 < 5° 1

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

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .762 IN.
11. Pitot to probe sheath 3.00 IN.
12. Pitot to thermocouple (parallel to probe) 3.00 IN.
13. Pitot to thermocouple (perpendicular to probe) .763 IN.

☒ Meets all EPA design criteria thus C_p = 0.84

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

Date of Inspection: 2-29-92

Inspected by: G Tomchek

CFR Title 40 Part 60 Appendix A Method 2

(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. S-29

Pitot tube dimensions:

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

Alignment:

4. α_1 <10° 0
5. α_2 <10° 1

6. B_1 <5° 2
7. B_2 < 5° 3

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

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .760 IN.
11. Pitot to probe sheath 3.00 IN.
12. Pitot to thermocouple (parallel to probe) 3.00 IN.
13. Pitot to thermocouple (perpendicular to probe) .262 IN.

☒ Meets all EPA design criteria thus C_p = 0.84

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

Date of Inspection: 2-29-92

Inspected by: G Trawicki

CFR Title 40 Part 60 Appendix A Method 2

INTERPOLL LABORATORIES
(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 11/4/91

Technician DAVE BRENNAN

Mercury Column Barometer No. LAB

Aneroid Barometer No. 90222001 (Duke's)

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjsted Mercury Barometer Read	Initial Aneriod Barometer Read	Difference (P_{ba}-P_{bm})
29.47	69°	.108	29.361	29.37	-.009

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

Has problem been alleviated? Yes/No. How? _____

*Note

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

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INTERPOLL LABORATORIES
(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 3-20-92
Technician Mark Kaehler
Mercury Column Barometer No. Lab 1
Aneroid Barometer No. 560815

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjsted Mercury Barometer Read	Initial Aneriod Barometer Read	Difference (P_{ba}-P_{bm})
29.260	76	.126	29.134	29.150	.016

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

Has problem been alleviated? Yes/No. How? _____

*Note

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

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