Background Report Reference

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Title: Air Emissions Test Report for the Wet Scrubber, Louisiana Pacific Corporation, Dungannon, VA, February-16, 1995

ETS, Inc.

March 1995

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AIR EMISSIONS TEST REPORT
FOR THE WET SCRUBBER

PREPARED FOR

LOUISIANA PACIFIC CORPORATION
DUNGANNON, VIRGINIA

TEST DATE: FEBRUARY 16, 1995
REPORT DATE: MARCH 01, 1995

ETS, INC.

A subsidiary of ETS International, Inc.

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ROANOKE, VA 24012

703-265-0004

Pollution Control Consultants
Specializing In
Toxic Emission Measurement and Control

ETS CONTRACT NUMBER
95-403-T

REPORT CERTIFICATION

The sampling and analysis performed for this report were carried out under my direction and supervision.

DATE: 3/1/95

SIGNATURE: W. Tony Underwood

Tony Underwood
Project Manager
ETS, Inc.

I have reviewed all testing details and results in this report and hereby certify that the test report is authentic and accurate.

DATE: 2-28-95

SIGNATURE: Andy A. Hetz

Andy A. Hetz
Manager - Field Services
ETS, Inc.

TABLE OF CONTENTS

		PAGE
1.0	INTRODUCTION	1
1.1	BACKGROUND	1
1.2	OBJECTIVE	1
1.3	TEST PROGRAM	1
2.0	SUMMARY OF RESULTS	2
3.0	DISCUSSION OF RESULTS	2
4.0	SAMPLING AND ANALYTICAL PROCEDURES	2
4.1	SAMPLING PROCEDURES	5
4.1.1	SAMPLING POINT DETERMINATION - EPA METHOD 1	5
4.1.2	VOLUMETRIC MEASUREMENTS - EPA METHOD 2	5
4.1.3	MOLECULAR WEIGHT DETERMINATION EPA METHOD 3	7
4.1.4	FLUE GAS MOISTURE CONTENT - EPA METHOD 4	7
4.1.5	PARTICULATE AND MULTIPLE METALS SAMPLING	9
4.1.5.1	SAMPLING TRAIN DESCRIPTION	9
4.1.5.2	SAMPLING TRAIN OPERATION	11
4.1.5.3	SAMPLE RECOVERY AND CLEAN-UP	11
4.1.5.4	FIELD BLANKS	12
4.2	ANALYTICAL PROCEDURES	12
4.2.1	O_2 AND CO_2 - EPA METHOD 3A	12
4.2.2	MOISTURE CONTENT - EPA METHOD 4	13
4.2.3	PARTICULATE ANALYSES - EPA METHOD 5 AND 202	13
4.2.4	MULTI-METALS ANALYSES - EPA MULTI-METALS	15
5.0	DATA ANALYSIS	16
6.0	FIELD EQUIPMENT CALIBRATIONS	16

LIST OF TABLES

TABLE 1 - SUMMARY OF PARTICULATE AND METALS EMISSIONS . . 3

TABLE OF CONTENTS (Cont.)

LIST OF FIGURES

FIGURE 1 - TRAVERSE POINT LOCATIONS FOR THE SCRUBBER INLET AND OUTLET DUCTS 6

FIGURE 2 - EPA METHOD 3 SAMPLING TRAIN 8

FIGURE 3 - EPA METHOD 5/202 AND MULTIPLE METALS SAMPLING TRAIN 10

LIST OF APPENDICES

APPENDIX A - TEST LOG

APPENDIX B - DATA AND RESULTS FOR EPA METHOD 5/202 AND MULTIPLE METALS TESTING - SCRUBBER INLET

APPENDIX C - DATA AND RESULTS FOR EPA METHOD 5/202 AND MULTIPLE METALS TESTING - SCRUBBER OUTLET

APPENDIX D - CALCULATIONS

APPENDIX E - RAW FIELD DATA FOR EPA METHOD 5/202 AND MULTIPLE METALS TESTING - SCRUBBER INLET

APPENDIX F - RAW FIELD DATA FOR EPA METHOD 5/202 AND MULTIPLE METALS TESTING - SCRUBBER OUTLET

APPENDIX G - GRAVIMETRIC LABORATORY DATA

APPENDIX H - METALS LABORATORY DATA

APPENDIX I - FIELD EQUIPMENT CALIBRATION DATA

1.0 INTRODUCTION

1.1 Background: An air emissions diagnostic test program was conducted at the wet scrubber inlet and outlet of the strandboard manufacturing plant at Louisiana Pacific Corporation in Dungannon, Virginia. The test program was performed on February 16, 1995 by ETS, Incorporated (ETS) of Roanoke, Virginia. ETS personnel participating in the test program were Tony Underwood, Troy Pryor, Carl Powell, and Matt Bauman. Program coordination was provided by Susan Somers and Mickey Mullins of Louisiana Pacific.

1.2 Objective: The objective of the diagnostic test program was to evaluate the particulate, calcium, iron, manganese, phosphorus, potassium, sodium, and sulfur emissions from the wet scrubber inlet and outlet.

1.3 Test Program: One test of approximately 60 minutes was conducted at the inlet and outlet to the wet scrubber. Testing was conducted in accordance with the U.S. Environmental Protection Agency (EPA) reference test methods published in the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A. Appendix A of this report contains a complete test log detailing the date and time of each test run.

2.0 SUMMARY OF RESULTS

Table 1 gives the results of the diagnostic testing for emissions of particulate and metals. Detailed data and results for the scrubber inlet and outlet are found in Appendices B and C.

3.0 DISCUSSION OF RESULTS

Due to the lack of sufficient access to the sampling ports, all sampling performed at both the inlet and outlet was conducted at a single point in the duct. A traverse was performed both before and after sampling at each location in order to provide data on the stack velocity and temperature. The data from this traverse was used during particulate and metals testing so that sampling could be performed isokinetically.

High moisture and particulate concentrations were also encountered during the testing. Filters at both the inlet and outlet were changed every 20 to 25 minutes, until the supply of filters were exhausted. As a result, the test duration was reduced to approximately 60 minutes from 120 minutes as originally scheduled. Also, slightly higher concentrations of calcium, iron, sodium, sulfur, and total particulate were measured at the scrubber outlet. This may have been caused by the presence of the compounds in the scrubber water, inherent inaccuracies in the test methods, or the fact that the inlet and outlet tests were conducted concurrently and not simultaneously.

TABLE 1

SUMMARY OF PARTICULATE AND METALS EMISSIONS
LOUISIANA PACIFIC

SCRUBBER OUTLET AND INLET

RUN I.D.	**OUT-M5/202-R1**	**IN-M5/202-R1**
DATE	02/16/95	02/16/95
TIME STARTED	18:00	18:00
TIME ENDED	21:10	21:10
SAMPLING PARAMETERS		
Metered Volume - dcf	37.507	46.671
Corrected Volume - dscf	35.807	44.072
Total Test Time - min	55	60.6
% Isokinetics	96.3	107.1
GAS PARAMETERS		
Gas Temperature - ° F	134	200
Oxygen - %	17.5	17.7
Carbon Dioxide - %	2.4	2.3
Moisture - %	23.2	15.7
GAS FLOWRATE		
Velocity - ft/sec	86.51	90.12
Actual Volume - acfm	65229	67946
Standard Volume - dscfm	42270	43377
SUSPENDED PARTICULATE EMISSIONS		
Conc. - gr/dscf	0.169	0.200
Mass Rate - lb/hr	61.39	74.432
CONDENSIBLE PARTICULATE EMISSIONS		
Conc. - gr/dscf	0.045	0.002
Mass Rate - lb/hr	16.23	0.892
TOTAL PARTICULATE EMISSIONS		
Conc. - gr/dscf	0.214	0.203
Mass Rate - lb/hr	77.62	75.324
METALS EMISSIONS - (lb/hr)		
Calcium	3.06	1.92
Iron	0.36	0.17
Manganese	0.07	0.09
Phosphorus	0.13	0.13
Potassium	2.70	3.38
Sodium	3.28	2.66
Sulfur	0.62	0.54

NOTE: All metal components were blank corrected in accordance with draft EPA Method 29

However, a higher concentration of condensible particulate, specifically inorganic condensible particulate, was found at the scrubber outlet. This supports the conclusion that dissolved solids within the scrubber water may have contributed to higher pollutant readings at the scrubber outlet.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

All sampling and analytical procedures followed those recommended by the EPA in 40 CFR 60, Appendix A, or other methods generally accepted by the EPA and the Virginia Department of Environmental Quality (VDEQ). These procedures were modified to incorporate EPA Method 5, EPA Method 202, and draft EPA Method 29 into a single sampling train. The following specific methods were used:

- EPA Method 1 for determination of sampling and traverse points;
- EPA Method 2 for flue gas velocity and volumetric flow rate;
- EPA Method 3 for sampling for flue gas composition and molecular weight;
- EPA Method 3A for flue gas composition and molecular weight;
- EPA Method 4 for flue gas moisture content;
- Modified EPA Method 5 for determination of total particulate emissions;
- Modified EPA approved "Methodology for the Determination of Metals Emissions in Exhaust Gases from Hazardous Waste Incineration and Similar Combustion Processes" (EPA Document 530-SW-91-010) for manganese and phosphorous emissions; (Draft EPA Method 29);

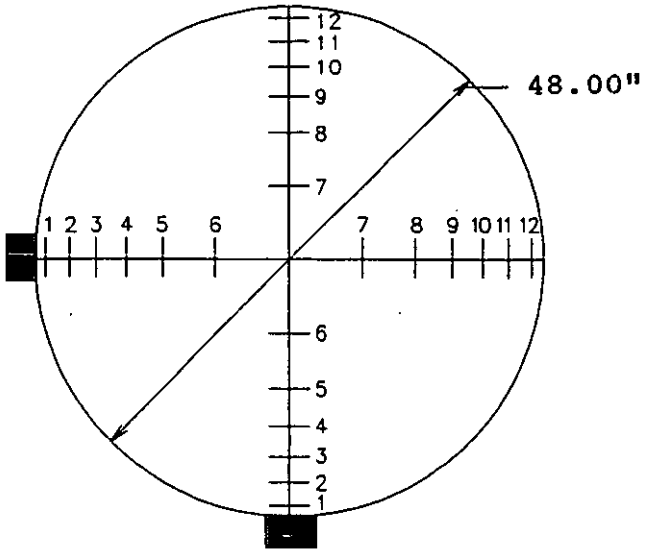
- Modified EPA Method 202 for determination of suspended and condensible particulate emissions.

Appendices E and F contain all of the field sampling data. Laboratory data for the analyses are contained in Appendices G and H.

4.1 Sampling Procedures

4.1.1 Traverse Point Determination - EPA Method 1: A total of 24 traverse points (12 for each of two ports) were utilized at the wet scrubber inlet and outlet for all gas flow rate measurements. The scrubber inlet and outlet ducts each had a diameter of 48 inches. Figure 1 shows the location of the traverse points for the wet scrubber inlet and outlet.

4.1.2 Volumetric Measurements - EPA Method 2: EPA Method 2 was used to determine the velocity and volumetric flow rates of the stack gases. Stainless steel Type-S pitot tubes were used to measure the gas velocity heads. The pitot tubes were calibrated against a NBS traceable pitot tube in accordance with Method 2. Calibrated Type-K thermocouples were used to determine gas temperatures. Velocity and temperature measurements were made at each point in the traverse as shown in Figure 1. These measurements were performed before and after the pollutant sampling described below.



POINT	% ID	DISTANCE FROM INSIDE OF PORT (inches)
1	2.1	1.02
2	6.7	3.22
3	11.8	5.67
4	17.7	8.51
5	25.0	12.00
6	35.6	17.07
7	64.4	30.93
8	75.0	36.00
9	82.3	39.49
10	88.2	42.33
11	93.3	44.78
12	97.9	46.98

INSIDE STACK DIAMETER	48.0 in	4.0 ft

Figure 1 - Traverse Points for the Wet Scrubber Inlet and Outlet

4.1.3 Molecular Weight Determination - EPA Method 3: Gas compositional measurements (O_2 and CO_2) for determining the average molecular weight of the stack gases were done in accordance with EPA Reference Method 3. Multi-point, integrated sampling was used to obtain a constant rate sample of flue gas concurrent with the pollutant testing. Sampling was of the same duration (except purges following port changes) as the pollutant runs.

A stainless steel probe was affixed to the pollutant sampling probe for this purpose. A peristaltic pump, delivering 500 to 750 mL/min of flue gas, was used to fill a Tedlar bag. Moisture was removed from the sample gas by means of an air-cooled condenser located prior to the pump. Figure 2 shows a schematic of the Method 3 sampling train.

4.1.4 Flue Gas Moisture Content - EPA Method 4: The flue gas moisture was measured in conjunction with each of the particulate tests according to the sampling and analytical procedures outlined in EPA Method 4. The flue gas moisture for each test was determined by gravimetric analyses of the water collected in the impinger condensers of the particulate sampling train. All impingers were contained in an ice bath throughout the testing in order to assure complete condensation of the moisture in the flue gas stream. Any moisture which was not condensed in the

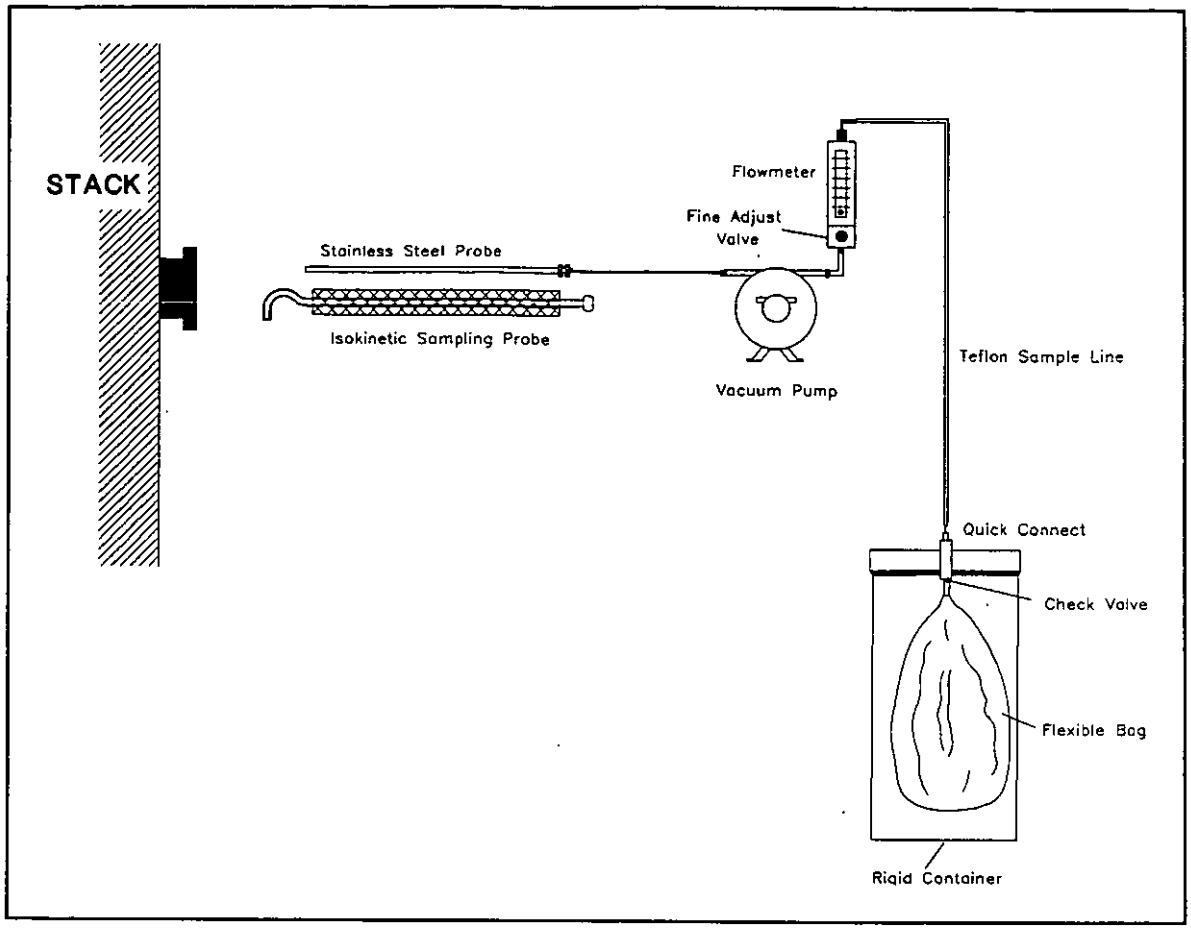


Figure 2 - EPA Method 3 Sampling Train

impingers was captured in the silica gel contained in the final impinger.

4.1.5 Particulate and Multiple Metals Sampling: Sampling for total particulate, calcium, iron, manganese, phosphorus, potassium, sodium, and sulfur was performed in accordance with EPA Method 5 of 40 CFR 60 in conjunction with EPA Method 202 of 40 CFR 51 and with Draft EPA Method 29. This methodology is commonly referred to as the Multi-Metals procedure.

4.1.5.1 Sampling Train Description: Figure 3 shows the major components of the Method 5/202 and multiple metals sampling train. A heated stainless steel probe with a teflon liner was used to withdraw the gas sample. The probe was equipped with an appropriately sized glass nozzle connected to the liner for isokinetic gas withdrawal.

From the nozzle and probe, sample gas was pulled through a heated glass filter holder which held a Pallflex ultra-pure 2500 QUAT-UP quartz filter supported on a teflon frit maintained at 248°F ± 25°F to prevent water condensation. Sample gas was subsequently passed through an impinger train consisting of five glass impingers immersed in an ice bath. The first, second, and third impingers each contained 100 milliliters of deionized distilled water. The fourth impinger was initially empty, and

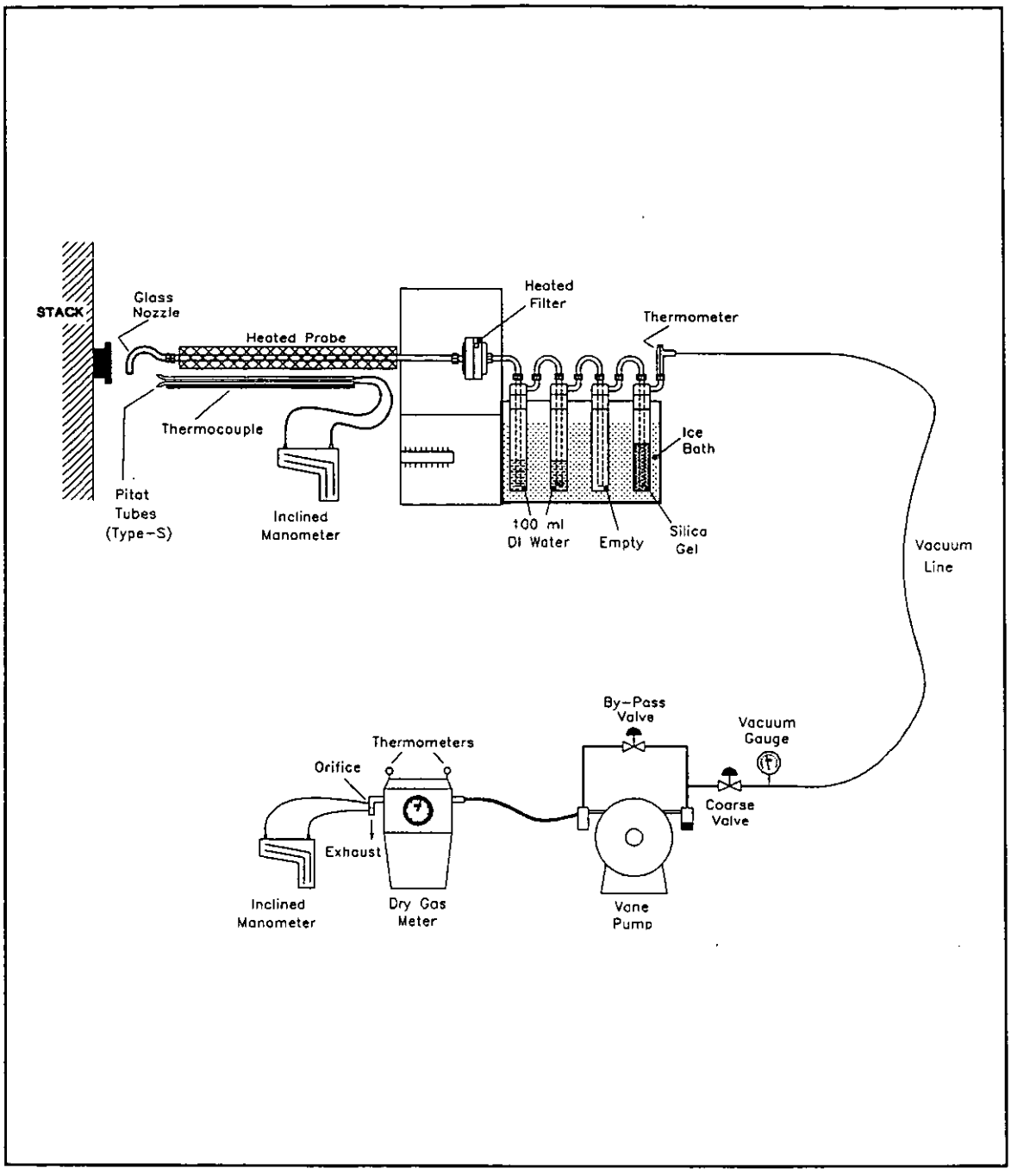


Figure 3 - EPA Method 5/202 and Multiple Metals Sampling Train

the fifth initially contained approximately 200 grams of silica gel.

4.1.5.2 Sampling Train Operation: Sampling was done in accordance with EPA Method 5 procedures and specifications, including leak checking and isokinetic sampling rate. However, stack traversing during sampling was not performed due to difficulties in accessing the sampling ports. Sampling was conducted at a single point within the duct. One test run of approximately 60 minutes was performed at both the inlet and outlet.

4.1.5.3 Sample Recovery and Clean-Up: Recovery of the front-half of the sampling train (probe plus filter and associated glassware) was performed in accordance with EPA Method 5 procedures. The probe and front-half glassware were rinsed with acetone three times each and brushed between rinses with a Teflon fiber brush. Following the acetone rinse, the probe and front-half glassware were rinsed with 0.1 Normal nitric acid. Exposed filters were placed back into their original tared containers.

The back-half of the sampling train (impingers plus connecting glassware) were recovered in accordance with EPA Method 202 procedures. The pH of the first impinger was measured immediately after the test. If the pH was less than 4.5, then the entire impinger train was purged for one hour using purified

air in accordance with Method 202 procedures. If the pH of the first impinger exceeded 4.5, then the purge was omitted.

After purging (if applicable), the contents of the first four impingers were measured and transferred to glass jars. The first four impingers and all back-half glassware were rinsed twice with water. All water rinses were collected with the impinger contents. The back-half glassware was then rinsed twice with methylene chloride. These rinses were collected into a separate glass jar.

The silica gel from the fifth impinger was transferred back to its original Nalgene container. The amount of moisture collected in the sampling train was quantified in order to determine the stack gas moisture content in accordance with EPA Method 4.

4.1.5.4 Field Blanks: Acetone, 0.1 Normal nitric acid, water, and methylene chloride field blanks were collected during the test program. Each blank was taken from the same reagent stock used for testing.

4.2 Analytical Procedures

4.2.1 Oxygen and Carbon Dioxide - EPA Method 3A: Oxygen and carbon dioxide concentrations of the Method 3 gas samples were measured instrumentally using continuous gas analyzers. A

Teledyne Model 320A Chemical Cell Portable O_2 Analyzer and a HORIBA Model PIR-2000 NDIR CO_2 Analyzer were used for the analyses. Each instrument conformed to the design specifications of EPA Method 3A. Prior to each series of analyses, each analyzer was zeroed using zero nitrogen, and spanned using a certified calibration gas with a concentration of 80 to 90 percent of the instrument span. Following calibration a mid range gas, 50 to 60 percent of the instrument span, was introduced to each monitor. The mid range response error never exceeded two percent of the instrument span.

4.2.2 Moisture Content Analysis- EPA Method 4: Moisture contents were determined gravimetrically in accordance with Method 4 by measuring either the volume or mass gains of each impinger in the pollutant sampling trains. Data for these measurements are included in the respective analytical appendices for each pollutant.

4.2.3 Particulate Analyses - EPA Method 5 and 202: Particulate matter was determined in accordance with EPA Method 5 and 202 procedures. Appendix G contains the laboratory data for the analysis.

The filter was desiccated and analyzed gravimetrically constant weight. The front-half acetone rinse was evapora analyzed gravimetrically to a constant weight. The fron

particulate catch equals the sum of the front half acetone rinse and the filter, in accordance with Method 5.

The determination of the total condensible particulate matter in the back-half of the sampling train was determined in accordance with Method 202 procedures. The total sulfate concentration of the impinger contents and aqueous rinses was determined by analyzing an aliquot of the impinger water and rinses sample using ion chromatography. The impinger contents and aqueous rinses were then combined with the methylene chloride rinses and extracted twice with methylene chloride using a separatory funnel. The sample was divided into organic (methylene chloride) and inorganic (aqueous) fractions. The organic fraction was evaporated at room temperature and pressure, and the resulting residue gravimetrically analyzed to a constant weight.

The inorganic fraction was evaporated to dryness at 105°C. If the pH of the original impinger solutions was less than 4.5, then the resulting residue was redissolved in 100 milliliters of distilled water and the pH was increased using concentrated ammonium hydroxide. The resulting solution was evaporated to dryness at 105°C once more, and the residue was determined gravimetrically. If the pH of the original solution was greater than 4.5, then the addition of ammonium hydroxide was omitted.

The back-half condensible particulate catch equals the organic residue plus the inorganic residue plus the combined water removed by the acid-base reaction based on the impinger analysis for sulfate. The total particulate catch equals the front-half probe rinse and filter plus the back-half condensibles.

4.2.4 Multi-Metals Analyses - EPA Multi-Metals: The filter of the EPA Method 5/202 sampling train were analyzed for calcium, iron, manganese, phosphorus, potassium, sodium, and sulfur. Analyses of the filters were conducted after completion of the Method 5 gravimetric analyses. SW-846 Methods (atomic absorption) were used to determine the metals concentrations. Appendix H contains the laboratory report for the metals analyses.

The digested filters of the sampling train were prepared for analysis in accordance with the procedures given in the EPA method. All digestions were performed using a 600-watt microwave digester and Teflon pressure relief vessels. After preparation, the samples were analyzed with a Perkin Elmer Plasma 2000 inductively coupled plasma (ICP) atomic absorption spectrometer for calcium, iron, manganese, phosphorous, potassium, sodium, and sulfur.

Duplicate analyses were performed on all metals samples. In addition, field blanks were analyzed. Spikes were added to the samples to determine the metals recovery efficiencies.

5.0 DATA ANALYSIS

All equations and calculations used to determine the pollutant emissions in this test program are documented in Appendix D.

6.0 FIELD EQUIPMENT CALIBRATIONS

All field equipment was calibrated in accordance with the requirements of the applicable EPA Methods and those recommended within the "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III" (EPA-600/4-77-027b, August, 1977). Equipment calibration documentation is found in Appendix I.

APPENDIX A

TEST LOG

TESTLOG

LOUISIANA PACIFIC

LOCATION	TEST PARAMETER	TEST METHOD	RUN I.D.	DATE	START TIME	END TIME
SCRUBBER INLET	TSP, METALS	METHOD 5/202, METALS	IN-M5/202-R1	02/16/95	18:00	21:10
SCRUBBER OUTLET	TSP, METALS	METHOD 5/202, METALS	OUT-M5/202-R1	02/16/95	18:00	21:10

APPENDIX B

DATA AND RESULTS FOR EPA METHOD 5/202 AND MULTIPLE METALS TESTING

- SCRUBBER INLET -

RUN NUMBER	**IN-M5/202-R1**	
Date	02/16/95	
Start Time	18:00	
End Time	21:10	
Stack Diam.	48	inches
Nozzle I.D.	0.190	inches
Meter Box Gamma	0.9995	
Meter Box dH@	1.6203	
Barometric	29.13	in.Hg
Cp	0.84	
Test Duration	60.6	minutes

METHOD 1-4 RESULTS

Metered Volume	46.671	dcf
Volume @ Std.Cond.	44.072	dscf
% Water	15.73	%
% Isokinetics	107.1	%
Velocity	90.12	ft/sec
Actual Flow	67946	acfm
Std. Flow	51472	scfm
Dry Std. Flow	43377	dscfm

METHOD 4 DATA

	INIT. (ml)	FINAL (ml)	NET (ml)
IMP.1	100.0	223.0	123.0
IMP.2	100.0	128.0	28.0
IMP.3	100.0	104.0	4.0
IMP.4	0.0	4.0	4.0
IMP.5			0.0
IMP.6			0.0
IMP.7			0.0
TOTAL	300.0	459.0	159.0
S.G.	200.0	215.7	15.7

METHOD 3 DATA

%O2	17.7	Md	29.08
%CO2	2.30	Ms	27.33
%CO	0.0	Ps	28.32
%N2	80.0	Fo	1.391
O2+CO2	20.0	%EA	518

POINT	STACK TEMP (DegF)	STATIC (in.WC)	DP (in.WC)	DH (in.WC)	METER VOLUME (dcf)	METER TEMPERATURE INLET (DegF)	METER TEMPERATURE OUTLET (DegF)
1	208	-11.00	1.6	1.70	429.670	85	83
2	206	-11.00	1.2	1.25	476.341	83	83
3	204		1.7	1.75		83	82
4	206		1.6	1.70		86	83
5	206		1.7	1.75		88	85
6	206		1.9	2.00		87	83
7	193		2.1	2.20		88	85
8	191		2.1	2.20		91	85
9	192		2.0	2.10		92	86
10	190		1.6	1.70		92	86
11	194		2.1	2.20		91	86
12	201		1.8	1.90		92	90
13			1.9				
14			1.4				
15			1.3				
16			1.3				
17			1.6				
18			1.4				
19			2.2				
20			2.4				
21			2.7				
22			2.5				
23			2.5				
24			2.3				
AVG.	200	-11.00	1.87	1.87	46.671		86

LOUISIANA PACIFIC
SCRUBBER INLET
EPA METHOD 5/202 ANALYTICAL DATA AND RESULTS

SAMPLING DATA:

Run Number:	**IN-M5/202-R1**	
Corr. Sample Volume:	44.072	dscf
Corr. Flowrate	43377	dscfm
O2 Content:	17.7	%
CO2 Content:	2.3	%

SUMMARY:

COMPONENT	NET (grams)	CORRECTED FOR BLANK (grams)
SUSPENDED PM		
Probe Wash	0.24920	0.24920
Filter	0.32260	0.32260
CONDENSIBLE PM		
Organic CPM	0.00950	0.00857
Inorganic CPM	0.00789	-0.00171
TOTAL CPM	0.01739	0.00686
TOTAL PM	0.58919	0.57866

ANALYTICAL DATA:

METHOD 5 COMPONENTS	TARE (grams)	FINAL (grams)	NET (grams)	VOLUME (ml)
Acetone Probe Wash	66.85120	67.10040	0.24920	85.0
Acetone Blank Residue	67.48430	67.48430	0.00000	125.0
Applicable Acetone Blank			0.00000	
Max. Allowable Blank			0.00067	
Filter	1.15800	1.48060	0.32260	

METHOD 202 COMPONENTS	TARE (grams)	FINAL (grams)	NET (grams)	REAGENT VOLUME (ml)
Volume of Cont.#4				430.0
Organic CPM (Uncorr.)	66.81500	66.82450	0.00950	280.0
MeCl2 Blank	64.94680	64.94780	0.00100	300.0
Inorganic CPM (Uncorr.)	67.05080	67.05860	0.00789	430.0
H2O Blank	66.88810	66.89480	0.00670	300.0

PARTICULATE EMISSIONS:

	FILTERABLE	CPM	TOTAL
Actual Grain Loading (gr/dscf)	0.2002	0.0024	0.2026
Corrected to 7% O2 (gr/dscf)	0.8696	0.0104	0.8800
Corrected to 12% CO2 (gr/dscf)	1.0445	0.0125	1.0570
Mass Rate (lb/hr)	74.43	0.89	75.32

LOUISIANA PACIFIC
SCRUBBER INLET
MULTIPLE METALS ANALYTICAL DATA AND RESULTS

SAMPLING DATA:

Run Number:	**IN-M5/202-R1**
Corr. Sample Volume:	44.071955 dscf
Corr. Flowrate	43376.994 dscfm
O2 Content:	17.7 %
CO2 Content:	2.3 %

TRACE METALS ANALYTICAL DATA AND RESULTS:

COMPONENT		LABORATORY DATA			METALS EMISSIONS			
					CONCENTRATION			MASS
		Sample (µg)	Blank (µg)	Total (µg)	ACTUAL ug/dscm	@ 12% CO2 ug/dscm	@7% O2 ug/dscm	RATE lb/hr
Calcium	Ca	15500.00	775.00	14725.00	11799.023	61560.121	51252.007	1.92E+00
Iron	Pb	1390.00	69.50	1320.50	1058.106	5520.553	4596.148	1.72E-01
Manganese	Mn	658.00	1.89	656.11	525.736	2742.968	2283.664	8.54E-02
Phosphorus	P	980.00	0.00	980.00	785.266	4097.040	3410.999	1.28E-01
Potassium	K	26000.00	0.00	26000.00	20833.589	108696.987	90495.903	3.38E+00
Sodium	Na	21500.00	1075.00	20425.00	16366.387	85389.845	71091.493	2.66E+00
Sulfur	S	4150.00	0.00	4150.00	3325.361	17349.711	14444.538	5.40E-01

NOTE: All metal components were blank corrected in accordance with draft EPA Method 29.

APPENDIX C

DATA AND RESULTS FOR EPA METHOD 5/202 AND MULTIPLE METALS TESTING

- SCRUBBER OUTLET -

RUN NUMBER	**OUT-M5/202-R1**					
Date	02/16/95					
Start Time	18:00					
End Time	21:10		**METHOD 4 DATA**			
Stack Diam.	48	inches		INIT.	FINAL	NET
Nozzle I.D.	0.192	inches		(ml)	(ml)	(ml)
Meter Box Gamma	0.9907		IMP.1	100.0	216.0	116.0
Meter Box dH@	1.7925		IMP.2	100.0	200.0	100.0
Barometric	29.13	in.Hg	IMP.3	100.0	50.0	-50.0
Cp	0.84		IMP.4	0.0	52.0	52.0
Test Duration	55	minutes	IMP.5			0.0
			IMP.6			0.0
			IMP.7			0.0
METHOD 1-4 RESULTS			TOTAL	300.0	518.0	218.0
Metered Volume	37.507	dcf	S.G.	200.0	212.0	12.0
Volume @ Std.Cond.	35.807	dscf				
% Water	23.22	%	**METHOD 3 DATA**			
% Isokinetics	96.3	%	%O2	17.5	Md	29.08
Velocity	86.51	ft/sec	%CO2	2.40	Ms	26.51
Actual Flow	65229	acfm	%CO	0.0	Ps	28.41
Std. Flow	55051	scfm	%N2	80.1	Fo	1.417
Dry Std. Flow	42270	dscfm	O2+CO2	19.9	%EA	480

	STACK TEMP	STATIC	DP	DH	METER VOLUME	METER TEMPERATURE INLET	OUTLET
POINT	(DegF)	(in.WC)	(in.WC)	(in.WC)	(dcf)	(DegF)	(DegF)
1	137	-10.00	1.10	1.450	785.138	77	75
2	134	-9.70	1.30	1.700	822.645	76	75
3	137		1.50	1.950		77	75
4	136		1.90	2.300		78	75
5	136		1.90	2.300		79	75
6	135		2.00	2.450		83	75
7	135		2.40	3.100		82	75
8	127		2.00	2.450		74	73
9	128		2.00	2.450		77	72
10	128		1.90	2.300		78	73
11	128		1.50	1.950		79	73
12	128		1.30	1.700		79	73
13	133		2.90				
14	133		2.60				
15	135		2.40				
16	137		2.40				
17	138		2.20				
18	138		2.10				
19	136		1.50				
20	136		1.60				
21	135		1.80				
22	135		1.60				
23	135		1.50				
24	135		1.40				
AVG.	134	-9.85	1.87	2.18	37.507		76

LOUISIANA PACIFIC
SCRUBBER OUTLET
EPA METHOD 5/202 ANALYTICAL DATA AND RESULTS

SAMPLING DATA:

Run Number:	**OUT-M5/202-R1**
Corr. Sample Volume:	35.807 dscf
Corr. Flowrate	42270 dscfm
O2 Content:	17.5 %
CO2 Content:	2.4 %

SUMMARY:

COMPONENT	NET (grams)	CORRECTED FOR BLANK (grams)
SUSPENDED PM		
Probe Wash	0.05020	0.05020
Filter	0.34300	0.34300
CONDENSIBLE PM		
Organic CPM	0.03830	0.03740
Inorganic CPM	0.07637	0.06654
TOTAL CPM	0.11467	0.10394
TOTAL PM	0.50787	0.49714

ANALYTICAL DATA:

METHOD 5 COMPONENTS	TARE (grams)	FINAL (grams)	NET (grams)	VOLUME (ml)
Acetone Probe Wash	67.18960	67.23980	0.05020	120.0
Acetone Blank Residue	67.48430	67.48430	0.00000	125.0
Applicable Acetone Blank			0.00000	
Max. Allowable Blank			0.00094	
Filter	1.17200	1.51500	0.34300	

METHOD 202 COMPONENTS	TARE (grams)	FINAL (grams)	NET (grams)	REAGENT VOLUME (ml)
Volume of Cont.#4				440.0
Organic CPM (Uncorr.)	65.04900	65.08730	0.03830	270.0
MeCl2 Blank	64.94680	64.94780	0.00100	300.0
Inorganic CPM (Uncorr.)	65.07040	65.14590	0.07637	440.0
H2O Blank	66.88810	66.89480	0.00670	300.0

PARTICULATE EMISSIONS:

	FILTERABLE	CPM	TOTAL
Actual Grain Loading (gr/dscf)	0.1694	0.0448	0.2142
Corrected to 7% O2 (gr/dscf)	0.6927	0.1831	0.8758
Corrected to 12% CO2 (gr/dscf)	0.8472	0.2240	1.0711
Mass Rate (lb/hr)	61.39	16.23	77.62

LOUISIANA PACIFIC
SCRUBBER OUTLET
MULTIPLE METALS ANALYTICAL DATA AND RESULTS

SAMPLING DATA:

Run Number:	**OUT-M5/202-R1**
Corr. Sample Volume:	35.807 dscf
Corr. Flowrate	42270 dscfm
O2 Content:	17.5 %
CO2 Content:	2.4 %

TRACE METALS ANALYTICAL DATA AND RESULTS:

		LABORATORY DATA			METALS EMISSIONS			
					CONCENTRATION			MASS
COMPONENT		Sample (µg)	Blank (µg)	Total (µg)	ACTUAL ug/dscm	@ 12% CO2 ug/dscm	@7% O2 ug/dscm	RATE lb/hr
Calcium	Ca	20600.00	1030.00	19570.00	19300.668	96503.341	78905.673	3.06E+00
Iron	Pb	2460.00	123.00	2337.00	2304.837	11524.185	9422.716	3.65E-01
Manganese	Mn	460.00	1.89	458.11	451.805	2259.026	1847.086	7.15E-02
Phosphorus	P	857.00	0.00	857.00	845.206	4226.028	3455.399	1.34E-01
Potassium	K	17301.00	0.00	17301.00	17062.895	85314.476	69757.131	2.70E+00
Sodium	Na	22100.00	1105.00	20995.00	20706.057	103530.283	84651.232	3.28E+00
Sulfur	S	3940.00	0.00	3940.00	3885.776	19428.879	15885.966	6.15E-01

NOTE: All metal components were blank corrected in accordance with draft EPA Method 29.

APPENDIX D - CALCULATIONS

EPA METHODS 2-4 CALCULATIONS

1. Metered Gas Sample Volume at Standard Conditions

$$V_{m(std)} = V_m \times \gamma \times \frac{528}{29.92} \times \left[\frac{P_B + \frac{\Delta H}{13.6}}{T_m + 460} \right]$$

2. Gas Volume of Water Vapor Collected in Impinger Liquid

$$V_{WC(std)} = (v_f - v_i) \times 0.04707$$

3. Gas Volume of Water Vapor Collected in Silica Gel

$$V_{wsg(std)} = (w_f - w_i) \times 0.04715$$

4. Moisture Volume Fraction in Flue Gas

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

5. Moisture Volume Percentage in Flue Gas

$$\%H_2O = B_{ws} \times 100$$

6. Absolute Pressure of Flue Gas

$$P_s = P_B + \frac{P_{static}}{13.6}$$

7. Nitrogen Content of Flue Gas

$$\%N_2 = 100 - (\%CO_2 + \%O_2 + \%CO)$$

8. Dry Molecular Weight of Flue Gas

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

9. Wet Molecular Weight of Flue Gas

$$M_s = M_d \times (1 - B_{ws}) + 18 \times B_{ws}$$

10. Fuel Factor Based on Flue Gas Composition

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

EPA METHODS 2-4 CALCULATIONS - continued

11. Excess Air of Flue Gas

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

12. Average Gas Velocity, ft/sec

$$v_s = 85.49 \times C_p \times (\Delta P)^{1/2}_{avg} \times \frac{(T_s + 460)^{1/2}}{(P_s \times M_s)^{1/2}}$$

13. Area of Round Duct or Stack

$$A_s = \frac{\pi \times D^2}{4 \times 144} \quad (round\ ducts)$$

14. Area of Rectangular Duct

$$A_s = \frac{L \times W}{144} \quad (rectangular\ ducts)$$

15. Actual Volumetric Flow Rate of Flue Gas

$$Q_a = v_s \times A_s \times 60$$

16. Flow Rate of Flue Gas at Standard Temperature and Pressure

$$Q_s = Q_a \times \left[\frac{P_s \times 528}{(T_s + 460) \times 29.92} \right]$$

17. Dry Flow Rate of Flue Gas at Std. Temperature and Pressure

$$Q_{sd} = Q_s \times (1 - B_{ws})$$

NOMENCLATURE FOR EPA METHODS 2-4

A_s	=	Stack area, ft^2
B_{ws}	=	Moisture volume fraction
C_p	=	Pitot tube coefficient (≈0.84)
D_s	=	Stack diameter, inches
ΔH	=	Average meter orifice pressure, in.W.C.
ΔP	=	Pitot tube differential pressure, in.W.C.
F_o	=	Combustion factor
γ	=	Meter calibration factor, gamma
L	=	Length of rectangular stack or duct, inches
M_D	=	Dry molecular weight, lb/lb-mole
M_s	=	Wet molecular weight, lb/lb-mole
P_B	=	Barometric pressure, in.Hg
P_s	=	Absolute stack pressure, in.Hg
P_{static}	=	Average static pressure, in.W.C.
Q_a	=	Actual gas flow rate, acfm
Q_s	=	Standard gas flow rate, scfm
Q_{sd}	=	Dry standard gas flow rate, dscfm
T_m	=	Average meter temperature, °F
T_s	=	Average stack temperature, °F
v_f	=	Final impinger volume, ml
v_i	=	Initial impinger volume, ml
V_m	=	Uncorrected metered gas volume, dcf
$V_{m(std)}$	=	Corrected gas volume, dscf
v_s	=	Average gas velocity, ft/sec
$V_{wc(std)}$	=	Gas volume of water caught in impingers, scf
$V_{wsg(std)}$	=	Gas volume of water caught in silica gel, scf
W	=	Width of rectangular stack or duct, inches
w_f	=	Final silica gel mass, grams
w_i	=	Initial silica gel mass, grams
$\%O_2$	=	Dry volumetric concentration of O_2, %dv
$\%CO_2$	=	Dry volumetric concentration of CO_2, %dv
$\%CO$	=	Dry volumetric concentration of CO, %dv
$\%N_2$	=	Dry volumetric concentration of N_2, %dv
%EA	=	Percent excess air

EPA METHOD 5 GRAVIMETRIC CALCULATIONS

1. PM Collected in Probe Wash - M_{pw}

$$M_{pw} = (W_{pw})_{final} - (W_{pw})_{tare}$$

2. Applicable Acetone Blank Correction - B_{apw}

$$B_{apw} = [(W_{ab})_{final} - (W_{ab})_{tare}] \times \frac{V_{pw}}{V_{ab}}$$

3. Maximum Allowable Acetone Blank - B_{amax}

$$B_{amax} = 0.7845 \times 0.00001 \times V_{pw}$$

4. Actual Probe Wash Blank Correction - B_{pw}

$$B_{pw} = MINIMUM\ [B_{apw},\ B_{amax}]$$

5. PM Collected on Filter - M_f

$$M_f = (W_f)_{final} - (W_f)_{tare}$$

6. Total PM Collected for Method 5 Calculations - M_5

$$M_5 = M_{pw} + M_f - B_{pw}$$

NOMENCLATURE

B_{amax}	=	Maximum allowable acetone blank correction, based on weight of acetone in probe wash, grams
B_{apw}	=	Acetone blank correction based on residue of blank, grams
B_{pw}	=	Acetone blank correction actually used, grams
M_5	=	Total mass of particulate in train corrected for acetone blank, grams
M_f	=	Mass gain of filter, grams
M_{pw}	=	Probe wash residue, grams
V_{ab}	=	Liquid volume of acetone blank, ml
V_{pw}	=	Liquid volume of probe wash, ml
$(W_{ab})_{final}$	=	Final weight of beaker containing acetone blank residue, grams
$(W_{ab})_{tare}$	=	Tare weight of beaker containing acetone blank residue, grams
$(W_f)_{final}$	=	Final weight of filter, grams
$(W_f)_{tare}$	=	Tare weight of filter, grams
$(W_{pw})_{final}$	=	Final weight of beaker containing probe wash residue, grams
$(W_{pw})_{tare}$	=	Tare weight of beaker containing probe wash residue, grams

PARTICULATE EMISSIONS CALCULATIONS

1. Particulate Concentration - C_{sd}

$$C_{sd} = \frac{\Sigma (M_i)}{V_{m(std)}} \times \frac{7000}{453.593}$$

2. Particulate Concentration Corrected to 7% O_2 - C_{sd}@7%O_2

$$C_{sd@7\%} = C_{sd} \times \frac{20.9 - 7.0}{20.9 - \%O_2}$$

3. Particulate Concentration Corrected to 12% CO_2 - C_{sd}@12%CO_2

$$C_{sd@12\%} = C_{sd} \times \frac{12}{\%CO_2}$$

4. Particulate Mass Rate - M_p

$$M_p = \frac{\Sigma (M_i)}{V_{m(std)}} \times Q_{sd} \times \frac{60}{453.593}$$

6. Isokinetic Variation - %ISO

$$\%Iso = \frac{0.09450 \times (T_s + 460) \times V_{m(std)}}{P_s \times v_s \times A_n \times time \times (1 - B_{ws})}$$

NOMENCLATURE

A_n	=	Nozzle area, ft^2
C_{sd}	=	Particulate concentration, grains/dscf
D_n	=	Nozzle diameter, inches
ΣM_i	=	Summation of PM collected in sample train, grams
M_p	=	Mass rate of particulate emissions, lb/hr
P_s	=	Absolute stack pressure, in.Hg
Q_{sd}	=	Dry standard gas flow rate, dscfm
time	=	Net sampling time, minutes
T_s	=	Average stack temperature, °F
$V_{m(std)}$	=	Corrected gas volume, dscf
v_s	=	Average gas velocity, ft/sec
$\%O_2$	=	Dry volumetric concentration of O_2, %dv
$\%CO_2$	=	Dry volumetric concentration of CO_2, %dv
%Iso	=	Percent isokinetics

METHOD 202 CALCULATIONS

1. Calculated correction factor

$$m_c = K\, C_{SO_4^{-2}}\, V_{ic}$$

where,

K = 0.0205 when correcting for NH_{4+} and H_2O
= 0.1840 when correcting for NH_{4+} only

2. Weight of total corrected inorganic CPM (mg)

$$m_i = m_r \left(\frac{V_{ic}}{V_{ic} - V_b} \right) - m_c - m_{Cl^-}$$

3. Corrected concentration of CPM (mg/dscm, mg/dscf)

$$C_{cpm} = \frac{m_o + m_i - m_b}{V_{m(std)}}$$

4. CPM emission rate (kg/hr, lb/hr)

$$ER_{cpm} = K\, C_{cpm}\, Q$$

where K = 6.0E-5 (kg min)/(mg hr) for metric units
= 1.32E-4 (lb min)/(mg hr) for English units

5. Calculation of sulfate ion concentration using NH_3 titration

$$C_{SO_4^{-2}} = \frac{48.03\, V_t\, N}{100}$$

NOMENCLATURE

C_{CPM}	=	concentration of CPM in flue gas (mg/dscm, mg/ dscf)
C_{SO4}	=	concentration of SO_4^{-2} in sample (mg/ml)
m_c	=	mass of NH_{4+} added to sample to form $(NH_4)_2SO_4$ (mg)
m_{Cl}	=	correction factor for chloride
m_b	=	weight of CPM in $MeCl_2$ and H_2O blanks (mg)
m_i	=	weight of inorganic CPM (mg)
m_o	=	weight of organic CPM (mg)
m_r	=	weight of dried inorganic fraction (mg)
N	=	normality of NH_4OH (mg/ml)
Q	=	volumetric flow rate (dscmm, dscfm)
V_b	=	volume of sample taken for IC analysis (ml)
V_{ic}	=	volume of impinger contents sample (ml)
$V_{m(std)}$	=	volume of gas sampled, corrected to standard conditions (dscm, dscf)
V_t	=	volume of NH_4OH titrant

METALS CALCULATIONS

1. Total sample weight - W_i (micrograms)*

$$W_i = m_{front} - mb_{front}$$

2. Gas Concentration - Cm_i (micrograms/dscm)

$$C_{m_i} = \frac{W_i \times 35.3145}{Vmstd}$$

3. Concentration corrected to 7% O_2, C_{i7}

$$C_{i_7} = C_i \times \frac{13.9}{20.9 - \%O_2}$$

4. Concentration corrected to 12% CO_2, C_{i12}

$$C_{i_{12}} = C_i \times \frac{12}{\%CO_2}$$

5. The mass flow rate of substance (i), G_i (lb/hr),

$$G_i = \frac{W_i \times Q_{sd} \times 60}{V_{mstd} \times 10^6 \times 453.593}$$

NOMENCLATURE FOR METALS CALCULATIONS

m_{front}	= total sample weight collected in front half of sample train (micrograms)
mb_{front}	= front half blank correction (micrograms)
Q_{sd}	= stack gas flow rate (dscfm)
Vmstd	= the volume of gas sampled at STP (dscf)
W_i	= total sample weight of (i) (micrograms)
$\%O_2$	= oxygen content in stack gas, dry %
$\%CO_2$	= carbon dioxide content in stack gas, dry %
60	= min/hr
10^6	= micrograms per gram
35.3145	= cubic feet per cubic meter
453.593	= grams/lb

***BLANK CORRECTION RULES**

FOR ALL METALS EXCEPT MERCURY:

If the measured blank value for the front half (mfhb) is in the range of 0.0 to A μg (A = 1.4 x Filter Area), then mfhb may be used to correct the front half sample (mfh). If mfhb exceeds A μg, then the greater of the following may be used: (1) A μg, or (2) the lesser of (a) mfbh, or (b) 5 percent of mfh.

APPENDIX E

RAW FIELD DATA FOR EPA METHOD 5/202 AND MULTIPLE METALS TESTING

- SCRUBBER INLET -

Revision 1

O_2 17.7
CO_2 2.3

03/16/94

ISOKINETIC SAMPLING DATA SHEET

PAGE 1 OF 1

FACILITY: Louisiana Pacific TEST LOCATION: ~~Outlet~~ Inlet DATE: 2/16/95

START TIME: 18:00 END TIME: _____ POLLUTANT: _____ RUN I.D.: ~~MT~~ IN - M2 - R1

POINT	SAMPLE TIME	TIME	STATIC	STACK TEMP.	STACK ΔP	METER ΔH	DGM VOLUME ft^3	DGM TEMP. INLET	DGM TEMP. OUTLET	IMPINGER TEMP.	FILTER TEMP.	METER VAC.
A1	0	18:00		208	1.6	1.7	429.670	85	83	72	248	6
2	5			206	1.2	1.25	433.4	83	83	53	244	4
3	10			204	1.7	1.75	436.7	83	82	57	242	7
4	15			206	1.6	1.7	440.5	86	83	61	248	7
5	20		-11	206	1.7	1.75	443.8	89	85	60	246	7
6	25	1425 1923		206	1.9	2.0	447.1	87	83	62	253	15
7	30			193	2.1	2.2	451.5	88	85	52	258	8
8	35			191	2.1	2.2	455.9	91	85	61	250	10
9	40			192	2.0	2.1	460.2	92	86	58	256	12
10	45			190	1.6	1.7	463.9	92	86	65	258	11
11	50	1948 20:53		194	2.1	2.2	466.7	91	86	66	252	17
12	55			201	1.8	1.9	471.7	92	90	61	250	9
	60						475.985					
B1	60			191	1.9	2.0	475.985	95	89	60	258	9
2	65	2010			1.4	1.5	476.341					
3	70				1.3	1.37						
4	75				1.3	1.37						
5	80				1.6	1.7						
6	85		-11		1.4	1.5						
7	90				2.1	2.3						
8	95				2.4	2.5						
9	100				2.7	2.8						
10	105				2.5	2.6						
11	110				2.5	2.6						
12	115				2.3	2.4						
	120	2026										

CHAIN OF CUSTODY:

CONTAINER	SAMPLE I.D.	DESCRIPTION
F1 A B C	100	Filter
F2	101	FH Acetone Rinse
F3	102 101A	FH NITRIC Imp. Contents
F4	103	Imp. Extra
F5	104	H_2O Rinse
F6	105	Mech. Rinse
F7	106	Silica Gel
F8	107	Todlar Bag

LEAK CHECK:

VACUUM	15				
RATE	0.012				

IMPINGER CONTENTS:

IMPINGER	INITIAL	FINAL
#1	100	223
#2	100	128
#3	100	104
#4	0	4
#5	200g	215.7
#6		

NOZZLE #	.190
PITOT #	~~[illegible]~~ NA
BOX I.D.	5
GAMMA Y	1.620 25
ΔH@	0.99951
P_{BAR}	29.13
FILTER	1/18/95-30/31/32
TECH.	Troy & Carl

APPENDIX F

RAW FIELD DATA FOR EPA METHOD 5/202 AND MULTIPLE METALS TESTING

- SCRUBBER OUTLET -

Revision 1

03/16/94

ISOKINETIC SAMPLING DATA SHEET

PAGE 1 OF 1

FACILITY: Louisiana Pacific TEST LOCATION: Scrubber Outlet DATE: 2-16-95

START TIME: 1900 END TIME: 2110 POLLUTANT: TM, Metals, CPM RUN I.D.: OUT - MS/202 R 1

POINT	SAMPLE TIME	TIME	STATIC	STACK TEMP.	STACK ΔP	METER ΔH	DGM VOLUME ft^3	DGM TEMP. INLET	DGM TEMP. OUTLET	IMPINGER TEMP.	FILTER TEMP.	METER VAC.
A 1	0			137	1.1	1.45	785.138	77	75	67	263	4
2	5			134	1.3	1.7	787.7	76	75	60	264	6
3	10		-10	137	1.5	1.95	790.7	77	75	60	265	14
4	15			136	1.9	2.3	794.4	78	75	58	263	15
5	20			136	1.9	2.3	798.3	79	75	58	263	15
6	25			135	2.0	2.45	802.5	83	75	59	262	17
7	30			135	2.4	3.1	806.5	82	75	59	263	20
8	35			127	2.0	2.45	810.6	74	73	66	263	4.5
9	40		-9.7	127	2.0	2.45	814.8	77	72	63	254	5
10	45			128	1.9	2.3	818.9	78	73	62	263	10
11	50			128	1.5	1.95	822.3	79	73	60	272	18
12	55 60			128	1.3	1.7	825.645	79	73	61	271	18
B 1				133	2.9							
2				133	2.6							
3				135	2.4							
4				137	2.4							
5				138	2.2							
6				137	2.1							
7				136	1.5							
8				136	1.6							
9				135	1.7							
10				135	1.6							
11				135	1.6							
12				135	1.4							

O_2 17.

CO_2 2.

CHAIN OF CUSTODY:

CONTAINER	SAMPLE I.D.	DESCRIPTION
	108	Filter
	109	PA Acetone
	109A	Nitric Prl
	110	Imp.
	111	Imp Empty
	112	H_2O Rinse
	113	$MeCl_2$ Rinse
	114	S.G.
	115	Bag

LEAK CHECK:

VACUUM	25				
RATE	—				

IMPINGER CONTENTS:

IMPINGER	INITIAL	FINAL
#1	100	216
#2	100	200
#3	100	50
#4	0	52
#5 SG	200	212
#6		

NOZZLE #	.192
PITOT #	
BOX I.D.	11
GAMMA Y	.9907
ΔH@	1.79253
P_{BAR}	29.13
FILTER	29/36/40
TECH.	Underwood

APPENDIX G

GRAVIMETRICS LABORATORY DATA

E T S , I N C .

F I E L D S A M P L E L O G

Contract No. 95-403
Job I.D.
Test Method 5/202

Print Date 02/18/95 Time 12:09:37

Sample No.	Container No.	Other I.D.	Run I.D.	Sample Type	Volume,ml no Rinses	Volume,ml w/ Rinses	Analyst	Date	Comments
00100	F1	See Comments	INL -202-R1	Filter			pjb	02/18/95	Q01/18/95-0030 Q01/18/95-0031 Q01/18/95-0032
00101	F2		INL -202-R1	FH Acetone Rinse			pjb	02/18/95	
00101	F2a		INL -202-R1	FH .1N HNO3 Rinse			pjb	02/18/95	
00102	F3		INL -202-R1	Impinger contents			pjb	02/18/95	
00103	F4		INL -202-R1	Imp. Contents extra			pjb	02/18/95	
00104	F5		INL -202-R1	H20 Impinger Rinse			pjb	02/18/95	
00105	F6		INL -202-R1	MECL2 Impinger Rinse			pjb	02/18/95	
00106	F7		INL -202-R1	Silica Gel			pjb	02/18/95	
00108	F1	See Comments	OUT -202-R1	Filter			pjb	02/18/95	Q01/18/95-0029 Q01/18/95-0036 Q01/18/95-0040
00109	F2		OUT -202-R1	FH Acetone Rinse			pjb	02/18/95	
00109	F2a		OUT -202-R1	FH .1N HNO3 Rinse			pjb	02/18/95	
00110	F3		OUT -202-R1	Impinger contents			pjb	02/18/95	
00111	F4		OUT -202-R1	Imp. Contents extra			pjb	02/18/95	
00112	F5		OUT -202-R1	H20 Impinger Rinse			pjb	02/18/95	
00113	F6		OUT -202-R1	MECL2 Impinger Rinse			pjb	02/18/95	
00114	F7		OUT -202-R1	Silica Gel			pjb	02/18/95	
00116	F1	Q01/18/95-0037	BLA -202-R1	Filter			pjb	02/18/95	
00117	F2		BLA -202-R1	FH Acetone Rinse			pjb	02/18/95	
00117	F2a		BLA -202-R1	FH .1N HNO3 Rinse			pjb	02/18/95	
00118	F3		BLA -202-R1	Impinger contents			pjb	02/18/95	
00119	F4		BLA -202-R1	Imp. Contents extra			pjb	02/18/95	

E T S , I N C .

F I E L D S A M P L E L O G

Contract No. 95-403
Job I.D.
Test Method 5/202

Print Date 02/18/95

Sample No.	Container No.	Other I.D.	Run I.D.	Sample Type	Volume,ml no Rinses	Volume,ml w/ Rinses	Analyst	Date	Comments
00120	F5		BLA -202-R1	H20 Impinger Rinse			pjb	02/18/95	
00121	F6		BLA -202-R1	MECL2 Impinger Rinse			pjb	02/18/95	
00122	F7		BLA -202-R1	Silica Gel			pjb	02/18/95	

ETS, Inc.
GRAVIMETRIC LABORATORY DATA
Final Beaker Weights

Job Number: 95-403
Report Prepared on: 02/23/95 Page 1

Beaker # / Filter # / Sample # / Run I.D. / Total Vol.,ml / Aliquot Vol.	Constant Tare Weight (g) Beaker / Filter	Final Weight Data Date	Time	Weight (g)	Analyst	Constant Final Weight (g)
09/23/94-040 See Comments 95-403-00100 INL -202-R1	67.07550 0.3925 0.3815 0.3840	02/18/95 02/19/95 02/20/95	13:00 13:00 08:82	68.55860 68.55590 68.55610	TGW TGW TGW	68.55610
09/23/94-041 95-403-00101 INL -202-R1 85.00000 85.00000	66.85120 0.00000	02/19/95 02/20/95	13:01 08:33	67.09990 67.10040	TGW TGW	67.10040
12/27/94-028 95-403-00102 INL -202-R1 430.00000 430.00000	67.05080 0.00000	02/22/95 02/23/95	14:16 08:15	67.05820 67.05860	TGW TGW	67.05860
12/27/94-027 95-403-00105 INL -202-R1 280.00000 280.00000	66.81500 0.00000	02/21/95 02/22/95	13:31 08:41	66.82480 66.82450	TGW TGW	66.82450
09/23/94-038 See Comments 95-403-00108 OUT -202-R1	67.25920 0.3931 0.3886 0.3903	02/18/95 02/19/95 02/20/95	12:57 12:58 08:30	68.77680 68.77450 68.77420	TGW TGW TGW	68.77420

ETS, Inc.
GRAVIMETRIC LABORATORY DATA
Final Beaker Weights

Job Number: 95-403
Report Prepared on: 02/23/95

Beaker # / Filter # / Sample # / Run I.D. / Total Vol.,ml / Aliquot Vol.	Constant Tare Weight (g) Beaker / Filter	Final Weight Data Date	Time	Weight (g)	Analyst	Constant Final Weight (g)
09/23/94-039	67.18960	02/19/95	12:59	67.23960	TGW	67.23980
	0.00000	02/20/95	08:81	67.23980	TGW	
95-403-00109						
OUT -202-R1						
120.00000						
120.00000						
12/27/94-026	65.07040	02/22/95	14:15	65.14540	TGW	65.14590
	0.00000	02/23/95	08:15	65.14590	TGW	
95-403-00110						
OUT -202-R1						
440.00000						
440.00000						
12/27/94-025	65.04900	02/21/95	13:30	65.08770	TGW	65.08730
	0.00000	02/21/95	08:40	65.08730	TGW	
95-403-00113						
OUT -202-R1						
270.00000						
270.00000						
09/23/94-042	64.85000	02/18/95	13:02	65.22990	TGW	65.23020
Q01/18/95-0037	0.38320	02/19/95	13:03	65.23020	TGW	
95-403-00116						
BLA -202-R1						
09/23/94-043	67.48430	02/19/95	13:03	67.48470	TGW	67.48430
	0.00000	02/20/95	08:34	67.48430	TGW	
95-403-00117						
BLA -202-R1						
125.00000						
125.00000						

ETS, Inc.
GRAVIMETRIC LABORATORY DATA
Final Beaker Weights

Job Number: 95-403
Report Prepared on: 02/23/95

Beaker # / Filter # / Sample # / Run I.D. / Total Vol.,ml / Aliquot Vol.	Constant Tare Weight (g) Beaker / Filter	Final Weight Data Date	Time	Weight (g)	Analyst	Constant Final Weight (g)
12/27/94-030	66.88810	02/22/95	14:17	66.89440	TGW	66.89480
	0.00000	02/23/95	08:15	66.89480	TGW	
95-403-00118						
BLA -202-R1						
300.00000						
300.00000						
12/27/94-029	64.94680	02/21/95	13:32	64.94820	TGW	64.94780
	0.00000	02/22/95	08:42	64.94780	TGW	
95-403-00121						
BLA -202-R1						
300.00000						
300.00000						

APPENDIX H

METALS LABORATORY DATA

ETS Analytical Services, Inc.

Proudly serving industry and government since 1973.

A USEPA Contract Laboratory

A subsidiary of ETS International, Inc.

ETS, Inc.
1401 Municipal Road N.W.
Roanoke, VA 24012
ATTN: Dr. Ted Handel

Re: Laboratory Analysis
ETSAS Client No. 6593
P. O. Box 5387

REPORT DATE/NUMBER: February 23, 1995 / 323

ANALYSIS FOR: Calcium, Iron, Potassium, Manganese, Sodium, Sulfur, Silicon, Phosphorous

METHOD OF ANALYSIS: SW-846 Method 6010A

SAMPLE ANALYSIS DATA

CLIENT ID: IN-M5/202-R1
MATRIX: FILTER/AQ
COLLECTION DATE: / /
OTHER ID: 95-403-T
DESCRIPTION: 1A & 1B

LAB ID: 174948
COLLECTED BY: CLIENT
DATE RECEIVED: 02/20/95
TIME COLLECTED:

METALS/ELEMENTS RESULTS:

Calcium — **15500 ug, Total**
>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
>Method: ICP, SW-846 Method 6010A; Det Limit= 60.0 ug, Total
>Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Iron — **1390 ug, Total**
>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
>Method: ICP, SW-846 Method 6010A; Det Limit= 6.00 ug, Total
>Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Manganese — **658 ug, Total**
>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
>Method: ICP, SW-846 Method 6010A; Det Limit= 0.30 ug, Total
>Comments: Initial Volume for Fraction 1A and 1B = 150 mls

REPORT CONTINUED ON NEXT PAGE

SAMPLE ANALYSIS DATA

CLIENT ID: IN-M5/202-R1 ▪ LAB ID: 174948 (continued)

Phosphorus — **980 ug, Total**
- Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
- Method: ICP, SW-846 Method 6010A; Det Limit= 300 ug, Total
- Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Potassium — **26000 ug, Total**
- Analysis Date: 02/22/95 by: KO Run ID: 022195ETS
- Method: ICP, SW-846 Method 6010A; Det Limit= 600 ug, Total
- Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Silicon — **367000 ug, Total**
- Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
- Method: ICP, SW-846 Method 6010A; Det Limit= 30.0 ug, Total
- Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Sodium — **21500 ug, Total**
- Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
- Method: ICP, SW-846 Method 6010A; Det Limit= 150 ug, Total
- Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Sulfur — **4150 ug, Total**
- Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
- Method: ICP, SW-846 Method 6010A; Det Limit= 300 ug, Total
- Comments: Initial Volume for Fraction 1A and 1B = 150 mls

CLIENT ID: OUT-M5/202-R1 **LAB ID: 174949**
MATRIX: FILTER/AQ COLLECTED BY: CLIENT
COLLECTION DATE: / / DATE RECEIVED: 02/20/95
OTHER ID: 95-403-T TIME COLLECTED:
DESCRIPTION: 1A & 1B

Calcium — **20600 ug, Total**
- Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
- Method: ICP, SW-846 Method 6010A; Det Limit= 60.0 ug, Total
- Comments: Initial Volume for Fraction 1A and 1B = 120 mls

Iron — **2460 ug, Total**
- Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
- Method: ICP, SW-846 Method 6010A; Det Limit= 6.00 ug, Total
- Comments: Initial Volume for Fraction 1A and 1B = 120 mls

Manganese — **460 ug, Total**
- Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
- Method: ICP, SW-846 Method 6010A; Det Limit= 0.30 ug, Total
- Comments: Initial Volume for Fraction 1A and 1B = 120 mls

REPORT CONTINUED ON NEXT PAGE

SAMPLE ANALYSIS DATA

CLIENT ID: OUT-M5/202-R1 ▪ LAB ID: 174949 (continued)

Phosphorus — **857 ug, Total**
↳>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
↳>Method: ICP, SW-846 Method 6010A; Det Limit= 300 ug, Total
↳>Comments: Initial Volume for Fraction 1A and 1B = 120 mls

Potassium — **17301 ug, Total**
↳>Analysis Date: 02/22/95 by: KO Run ID: 022195ETS
↳>Method: ICP, SW-846 Method 6010A; Det Limit= 600 ug, Total
↳>Comments: Initial Volume for Fraction 1A and 1B = 120 mls

Silicon — **106000 ug, Total**
↳>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
↳>Method: ICP, SW-846 Method 6010A; Det Limit= 30.0 ug, Total
↳>Comments: Initial Volume for Fraction 1A and 1B = 120 mls

Sodium — **22100 ug, Total**
↳>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
↳>Method: ICP, SW-846 Method 6010A; Det Limit= 150 ug, Total
↳>Comments: Initial Volume for Fraction 1A and 1B = 120 mls

Sulfur — **3940 ug, Total**
↳>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
↳>Method: ICP, SW-846 Method 6010A; Det Limit= 300 ug, Total
↳>Comments: Initial Volume for Fraction 1A and 1B = 120 mls

CLIENT ID: BLANK **LAB ID: 174950**
MATRIX: FILTER/AQ COLLECTED BY: CLIENT
COLLECTION DATE: / / DATE RECEIVED: 02/20/95
OTHER ID: 95-403-T TIME COLLECTED:
DESCRIPTION: 1A & 1B

Calcium — **83.1 ug, Total**
↳>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
↳>Method: ICP, SW-846 Method 6010A; Det Limit= 60.0 ug, Total
↳>Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Iron — **138 ug, Total**
↳>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
↳>Method: ICP, SW-846 Method 6010A; Det Limit= 6.00 ug, Total
↳>Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Manganese — **1.89 ug, Total**
↳>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
↳>Method: ICP, SW-846 Method 6010A; Det Limit= 0.30 ug, Total
↳>Comments: Initial Volume for Fraction 1A and 1B = 150 mls

REPORT CONTINUED ON NEXT PAGE

SAMPLE ANALYSIS DATA

CLIENT ID: BLANK ▪ LAB ID: 174950 (continued)

Phosphorus — **< 300 ug, Total**
>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
>Method: ICP, SW-846 Method 6010A; Det Limit= 300 ug, Total
>Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Potassium — **< 300 ug, Total**
>Analysis Date: 02/22/95 by: KO Run ID: 022195ETS
>Method: ICP, SW-846 Method 6010A; Det Limit= 600 ug, Total
>Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Silicon — **162000 ug, Total**
>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
>Method: ICP, SW-846 Method 6010A; Det Limit= 30.0 ug, Total
>Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Sodium — **9610 ug, Total**
>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
>Method: ICP, SW-846 Method 6010A; Det Limit= 150 ug, Total
>Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Sulfur — **< 300 ug, Total**
>Analysis Date: 02/21/95 by: KO Run ID: 022195ETS
>Method: ICP, SW-846 Method 6010A; Det Limit= 300 ug, Total
>Comments: Initial Volume for Fraction 1A and 1B = 150 mls

Quality Assurance performed on the above data is presented on the following page(s).

If we may be of further assistance, please contact us at any time.

Sincerely,
ETS ANALYTICAL SERVICES, INC.

Susanne H. Deegan, Project Manager

QUALITY ASSURANCE SUMMARY

CALIBRATION VERIFICATION

ANALYTE	UNITS	TYPE	TRUE	FOUND	% REC	QAO	RUN ID
Calcium	ug/l	CCV1	50000	49300	98.6	90-110%	022195ETS
Iron	ug/l	CCV1	10000	10700	107.0	90-110%	022195ETS
Manganese	ug/l	CCV1	2500	2640	105.6	90-110%	022195ETS
Phosphorus	ug/l	CCV1	5000	5080	101.6	90-110%	022195ETS
Potassium	ug/l	CCV1	50000	49300	98.6	90-110%	022195ETS
Sodium	ug/l	CCV1	50000	50100	100.2	90-110%	022195ETS
Sulfur	ug/l	CCV1	5000	5170	103.4	90-110%	022195ETS
Calcium	ug/l	CCV2	50000	55200	110.4	90-110%	022195ETS
Iron	ug/l	CCV2	10000	10700	107.0	90-110%	022195ETS
Manganese	ug/l	CCV2	2500	2660	106.4	90-110%	022195ETS
Phosphorus	ug/l	CCV2	5000	4660	93.2	90-110%	022195ETS
Potassium	ug/l	CCV2	50000	48400	96.8	90-110%	022195ETS
Sodium	ug/l	CCV2	50000	51700	103.4	90-110%	022195ETS
Sulfur	ug/l	CCV2	5000	4960	99.2	90-110%	022195ETS
Calcium	ug/l	CCV3	50000	53700	107.4	90-110%	022195ETS
Iron	ug/l	CCV3	10000	11000	110.0	90-110%	022195ETS
Manganese	ug/l	CCV3	2500	2720	108.8	90-110%	022195ETS
Phosphorus	ug/l	CCV3	5000	5020	100.4	90-110%	022195ETS
Sodium	ug/l	CCV3	50000	52800	105.6	90-110%	022195ETS
Sulfur	ug/l	CCV3	5000	5040	100.8	90-110%	022195ETS
Calcium	ug/l	ICSABF	525385	515000	98.0	80-120%	022195ETS
Iron	ug/l	ICSABF	187957	206000	109.6	80-120%	022195ETS
Manganese	ug/l	ICSABF	502.0	503.0	100.2	80-120%	022195ETS
Calcium	ug/l	ICSABI	525385	531000	101.1	80-120%	022195ETS
Iron	ug/l	ICSABI	187957	187000	99.5	80-120%	022195ETS
Manganese	ug/l	ICSABI	502.0	462.0	92.0	80-120%	022195ETS
Calcium	ug/l	ICV1	48810	49500	101.4	90-110%	022195ETS
Iron	ug/l	ICV1	1962	2000	101.9	90-110%	022195ETS
Manganese	ug/l	ICV1	474.0	523.0	110.3	90-110%	022195ETS

QA Report Continued on Next Page

QUALITY ASSURANCE SUMMARY
Continued

CALIBRATION VERIFICATION

ANALYTE	UNITS	TYPE	TRUE	FOUND	% REC	QAO	RUN ID
Phosphorus	ug/l	ICV1	5000	5140	102.8	90-110%	022195ETS
Potassium	ug/l	ICV1	49182	48600	98.8	90-110%	022195ETS
Sodium	ug/l	ICV1	46804	47700	101.9	90-110%	022195ETS
Sulfur	ug/l	ICV1	5000	5120	102.4	90-110%	022195ETS

BLANKS

ANALYTE	UNITS	TYPE	FOUND	QAO	RUN ID
Calcium	ug/l	CCB1	<200	<200 ug/l	022195ETS
Iron	ug/l	CCB1	<20.0	<20 ug/l	022195ETS
Manganese	ug/l	CCB1	<1.00	<1 ug/l	022195ETS
Phosphorus	ug/l	CCB1	<1000	<1000 ug/l	022195ETS
Potassium	ug/l	CCB1	<1000	<1000 ug/l	022195ETS
Sodium	ug/l	CCB1	<500	<500 ug/l	022195ETS
Sulfur	ug/l	CCB1	<1000	<1000 ug/l	022195ETS
Calcium	ug/l	CCB2	<200	<200 ug/l	022195ETS
Iron	ug/l	CCB2	<20.0	<20 ug/l	022195ETS
Manganese	ug/l	CCB2	<1.00	<1 ug/l	022195ETS
Phosphorus	ug/l	CCB2	<1000	<1000 ug/l	022195ETS
Potassium	ug/l	CCB2	<1000	<1000 ug/l	022195ETS
Sodium	ug/l	CCB2	<500	<500 ug/l	022195ETS
Sulfur	ug/l	CCB2	<1000	<1000 ug/l	022195ETS
Calcium	ug/l	CCB3	<200	<200 ug/l	022195ETS
Iron	ug/l	CCB3	<20.0	<20 ug/l	022195ETS

QA Report Continued on Next Page

QUALITY ASSURANCE SUMMARY
Continued

BLANKS

ANALYTE	UNITS	TYPE	FOUND	QAO	RUN ID
Manganese	ug/l	CCB3	<1.00	<1 ug/l	022195ETS
Phosphorus	ug/l	CCB3	<1000	<1000 ug/l	022195ETS
Sodium	ug/l	CCB3	<500	<500 ug/l	022195ETS
Sulfur	ug/l	CCB3	<1000	<1000 ug/l	022195ETS
Calcium	ug/l	ICB1	<200	<200 ug/l	022195ETS
Iron	ug/l	ICB1	<20.0	<20 ug/l	022195ETS
Manganese	ug/l	ICB1	<1.00	<1 ug/l	022195ETS
Phosphorus	ug/l	ICB1	<1000	<1000 ug/l	022195ETS
Potassium	ug/l	ICB1	<1000	<1000 ug/l	022195ETS
Sodium	ug/l	ICB1	<200	<200 ug/l	022195ETS
Sulfur	ug/l	ICB1	<1000	<1000 ug/l	022195ETS

DUPLICATES

LAB ID	ANALYTE	TYPE	SAMPLE	DUP	UNITS	RPD	QAO	RUN ID
174949	Calcium	DUP	20600	19200	ug, Total	7.0	≤20 RPD	022195ETS
174949	Iron	DUP	2460	2400	ug, Total	2.5	≤20 RPD	022195ETS
174949	Manganese	DUP	459	459	ug, Total	0.0	≤20 RPD	022195ETS
174949	Phosphorus	DUP	857	848	ug, Total	1.1	≤20 RPD	022195ETS
174949	Potassium	DUP	17300	17000	ug, Total	1.7	≤20 RPD	022195ETS
174949	Silicon	DUP	106000	103000	ug, Total	2.9	≤20 RPD	022195ETS
174949	Sodium	DUP	22100	21100	ug, Total	4.6	≤20 RPD	022195ETS
174949	Sulfur	DUP	3930	3630	ug, Total	7.9	≤20 RPD	022195ETS

QUALITY ASSURANCE SUMMARY
Continued

SPIKES

LAB ID	ANALYTE	TYPE	SAMPLE	SPK	ADDED	%REC	QAO	RUN ID
174949	Calcium	MS	20600	57500	30000	123.0	75-125%	022195ETS
174949	Iron	MS	2460	2940	600.0	80.0	75-125%	022195ETS
174949	Manganese	MS	460.0	577.0	150.0	78.0	75-125%	022195ETS
174949	Phosphorus	MS	857.0	3770	3000	97.1	75-125%	022195ETS
174949	Potassium	MS	17300	89700	60000	120.7	75-125%	022195ETS
174949	Sodium	MS	22100	58100	30000	120.1	75-125%	022195ETS
174949	Sulfur	MS	3940	9280	6000	89.0	75-125%	022195ETS

QAO: Quality Assurance Objective; REC: Recovery; RPD: Relative Percent Difference; NC: Not Calculatable.
DUP: Duplicate Analysis Result; SPK: Spiked Analysis Result; MS: Matrix SPK; MSD: Matrix SPK Duplicate.
For Duplicates <5X the Detection Limit (DL), ± DL shall apply for the QAO unless otherwise specified.

APPENDIX I

FIELD EQUIPMENT CALIBRATIONS

E T S , I N C .

METER CONSOLE CALIBRATION FORM

Contract No. 94-336
Job I.D.

Print Date 01/17/95

Meter Box No.: 5
Delta H: 1.6203
Gamma: 0.9995

Analyst: _____
Calibration Date: 01/17/95
Test Meter No. 9548
Barometric Pressure 28.86

QA/QC Check: Lynne Sexton 1/19/95
Previous Calibration Date: 08/16/94
Previous Gamma: 1.0076

Run	Orf Set	Initial Test	Final Test	Volume Test	Init Temp	Finl Temp	Test Temp	Initial Box	Final Box	Volume Box	I-I Temp	I-O Temp	F-I Temp	F-O Temp	Temp	Time	Delta H	Gamma
1	0.5	50.425	61.905	11.480	74.0	76.0	75.00	357.717	369.240	11.523	75.0	74.0	78.0	80.0	76.75	26.5	1.56055	0.99826
2	1.0	62.067	73.441	11.374	75.0	76.0	75.50	369.410	380.853	11.443	79.0	77.0	80.0	83.0	79.75	19.0	1.62843	0.99931
3	1.5	73.620	83.855	10.235	76.0	76.0	76.00	381.031	391.358	10.327	83.0	80.0	80.0	86.0	82.25	14.0	1.63329	0.99883
4	2.0	84.036	97.489	13.453	76.0	76.0	76.00	391.525	405.112	13.587	85.0	80.0	82.0	88.0	83.75	16.0	1.64182	0.99936
5	2.5	97.953	108.807	10.854	76.0	76.0	76.00	405.587	416.523	10.936	88.0	81.0	82.0	89.0	85.00	11.5	1.62500	1.00278
6	3.0	109.132	121.505	12.373	76.0	76.0	76.00	416.86[illegible]	429.375	12.515	88.0	82.0	82.0	90.0	85.50	12.0	1.63242	0.99854

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 5 REFERENCE CALIBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 1 Date 16-Dec-94

	Reference Temperature	Thermocouple Temperature	Difference %	
1	0	0	0.000	
2	34	32	0.405	
3	100	98	0.357	
4	200	199	0.152	
5	300	300	0.000	
6	401	400	0.116	
7	500	496	0.208	
8	600	600	0.000	
9	700	699	0.086	
10	801	800	0.079	
11	900	899	0.074	
			0.134	AVERAGE DIFF

Calibration Performed By ..... W.R. GRAHAM

Post Test Calibration-Contract #\- ----------

Pre-Test Calibration-Contract #- ----------

Comments:

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 5 REFERENCE CALIBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 2 Date 16-Dec-94

	Reference Temperature	Thermocouple Temperature	Difference %
1	0	0	0.000
2	32	30	0.407
3	100	97	0.535
4	200	199	0.152
5	300	300	0.000
6	400	399	0.116
7	502	500	0.208
8	599	620	-0.294
9	700	700	0.000
10	800	800	0.000
11	900	901	-0.074
			0.114 AVERAGE DIFF

Calibration Performed By ..... W.R. GRAHAM

Post Test Calibration-Contract #\- _____

Pre-Test Calibration-Contract #- _____

Comments:

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 5 REFERENCE CALIBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 3 Date 16-Dec-94

	Reference Temperature	Thermocouple Temperature	Difference %
1	0	0	0.000
2	30	29	0.204
3	100	98	0.357
4	200	199	0.152
5	302	302	0.000
6	402	400	0.232
7	502	500	0.203
8	600	600	0.000
9	701	701	0.000
10	800	800	0.000
11	900	900	0.000

0.105 AVERAGE DIFF

Calibration Performed By ..... W.R. GRAHAM

Post Test Calibration-Contract #\- _____

Pre-Test Calibration-Contract #- _____

Comments:

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 5 REFERENCE CALIBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 4 Date 16-Dec-94

	Reference Temperature	Thermocouple Temperature	Difference %
1	0	0	0.000
2	32	32	0.407
3	100	98	0.357
4	200	200	0.200
5	300	301	-0.132
6	400	400	0.000
7	500	499	0.104
8	600	601	-0.094
9	700	701	-0.086
10	800	801	-0.079
11	900	901	-0.074

0.037 AVERAGE DIFF

Calibration Performed By ..... W.R. GRAHAM

Post Test Calibration-Contract #\- _____

Pre-Test Calibration-Contract #- _____

Comments:

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 5 REFERENCE CALIBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 5 Date 16-Dec-94

	Reference Temperature	Thermocouple Temperature	Difference %	
1	0	0	0.000	
2	32	30	0.407	
3	100	98	0.337	
4	200	200	0.000	
5	300	301	-0.132	
6	400	399	0.116	
7	500	499	0.104	
8	600	601	-0.094	
9	700	701	-0.086	
10	800	801	-0.079	
11	900	901	-0.074	
			0.047	AVERAGE DIFF

Calibration Performed By ..... W.R. GRAHAM

Post Test Calibration-Contract #\- _____

Pre-Test Calibration-Contract #- _____

Comments:

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 5 REFERENCE CALIBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 6 Date 29-Dec-94

	Reference Temperature	Thermocouple Temperature	Difference %
1	0	0	0.000
2	33	33	0.000
3	100	100	0.000
4	200	202	-0.303
5	300	302	-0.263
6	400	401	-0.116
7	501	501	0.000
8	600	602	-0.189
9	701	703	-0.172
10	800	801	-0.079
11	900	902	-0.147
			-0.115 AVERAGE DIFF

Calibration Performed By ..... W.R. Graham

Post Test Calibration-Contract #\- _____

Pre-Test Calibration-Contract #- _____

Comments:

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 5 REFERENCE CALIBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 7 Date 29-Dec-94

	Reference Temperature	Thermocouple Temperature	Difference %
1	0	0	0.000
2	33	32	0.203
3	100	99	0.179
4	200	201	-0.152
5	300	301	-0.132
6	401	401	0.000
7	500	500	0.000
8	600	601	-0.094
9	701	702	-0.086
10	800	801	-0.079
11	901	902	-0.073
			-0.021 AVERAGE DIFF

Calibration Performed By ..... W.R. Graham

Post Test Calibration-Contract #\- _____

Pre-Test Calibration-Contract #- _____

Comments:

E T S , I N C .

METER CONSOLE CALIBRATION FORM

Contract No. 94-296
Job I.D.

Print Date 12/19/94

Meter Box No.: 11
Delta H: 1.7925
Gamma: 0.9907

Analyst: [signature]
Calibration Date: 12/19/94
Test Meter No. 9548
Barometric Pressure 29.19

QA/QC Check: [signature] 12/30/94
Previous Calibration Date: 08/31/94
Previous Gamma: 0.9841

Run	Orf Set	Initial Test	Final Test	Volume Test	Init Temp	Finl Temp	Test Temp	Initial Box	Final Box	Volume Box	I-I Temp	I-O Temp	F-I Temp	F-O Temp	Temp	Time	Delta H	Gamma
1	0.5	220.414	230.585	10.171	74.0	72.0	73.00	627.031	637.375	10.344	78.0	75.0	77.0	78.0	77.00	25.0	1.73551	0.98941
2	1.0	230.735	241.052	10.317	72.0	72.0	72.00	637.527	647.996	10.469	78.0	77.0	77.0	80.0	78.00	18.0	1.73902	0.99409
3	1.5	241.189	253.951	12.762	72.0	75.0	73.50	648.144	661.115	12.971	80.0	77.0	78.0	81.0	79.00	18.5	1.80760	0.99029
4	2.0	254.071	264.408	10.337	74.0	72.0	73.00	661.235	671.730	10.495	81.0	78.0	78.0	81.0	79.50	13.0	1.80891	0.99196
5	2.5	264.696	274.865	10.169	72.0	77.0	74.50	672.040	682.355	10.315	81.0	78.0	78.0	82.0	79.75	11.5	1.83784	0.98930
6	3.0	275.054	285.238	10.184	73.0	74.0	73.50	682.543	692.881	10.338	81.0	78.0	78.0	82.0	79.75	10.5	1.82627	0.98917

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 11 REFERENCE CAILBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 1 Data 17-Sep-94

	Reference Temperature	Thermocouple Temperature	Difference %	
1	0	0	0.000	
2	32	32	0.000	
3	100	101	-0.179	
4	200	200	0.000	
5	300	300	0.000	
6	400	400	0.000	
7	500	500	0.000	
8	600	600	0.000	
9	700	700	0.000	
10	800	801	-0.079	
11	901	901	0.000	
			-0.023	AVERAGE DIFF

Calibration Performed-By ..... Mick Berkhead

Post Test Calibration-Contract #\- _____

Pre-Test Calibration-Contract #- _____

Comments:

8

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 11 REFERENCE CAILBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 2 Date 17-Sep-94

	Reference Temperature	Thermocouple Temperature	Difference %	
1	0	0	0.200	
2	75	75	0.000	
3	100	100	0.000	
4	200	200	0.000	
5	300	299	0.132	
6	400	400	0.000	
7	500	499	0.104	
8	600	600	0.000	
9	700	699	0.086	
10	800	800	0.000	
11	901	900	0.073	
			0.036	AVERAGE DIFF

Calibration Performed By ..... Mick Berkhead

Post Test Calibration-Contract #\- _____

Pre-Test Calibration-Contract #- _____

Comments:

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 11 REFERENCE CAILBRATOR RH71 CAL-K
THERMOCOUPLE NUMBER 3 Date 17-Sep-94

	Reference Temperature	Thermocouple Temperature	Difference %	
1	0	0	0.000	
2	75	75	0.000	
3	100	100	0.000	
4	200	200	0.000	
5	300	300	0.000	
6	400	400	0.000	
7	500	499	0.104	
8	600	600	0.000	
9	700	699	0.086	
10	800	800	0.000	
11	901	900	0.073	
			0.024	AVERAGE DIFF

Calibration Performed By ..... Mick Berkhead

Post Test Calibration-Contract #\- _____

Pre-Test Calibration-Contract #- _____

Comments:

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 11 REFERENCE CAILBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 4 Date 17-Sep-94

	Reference Temperature	Thermocouple Temperature	Difference %	
1	0	0	0.000	
2	32	32	0.000	
3	100	100	0.000	
4	200	200	0.000	
5	300	300	0.000	
6	400	420	0.000	
7	500	500	0.200	
8	600	600	0.200	
9	700	700	0.000	
10	800	800	0.200	
11	901	901	0.000	
			0.000	AVERAGE DIFF

Calibration Performed By ..... Mick Berkhead

Post Test Calibration-Contract #\- _____

Pre-Test Calibration-Contract #- _____

Comments:

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 11 REFERENCE CAILBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 5 Date 17-Sep-94

	Reference Temperature	Thermocouple Temperature	Difference %	
1	0	0	0.000	
2	32	32	0.000	
3	100	100	0.000	
4	200	200	0.000	
5	300	300	0.000	
6	400	400	0.000	
7	500	500	0.000	
8	600	600	0.000	
9	700	700	0.000	
10	800	800	0.000	
11	901	901	0.000	
			0.000	AVERAGE DIFF

Calibration Performed By ..... Mick Berkhead

Post Test Calibration-Contract #\- ----------

Pre-Test Calibration-Contract #- ----------

Comments:

R

E.T.S. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 11 REFERENCE CAILBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 6 Date 17-Sep-94

	Reference Temperature	Thermocouple Temperature	Difference %	
1	0	0	0.000	
2	32	32	0.000	
3	100	100	0.000	
4	200	200	0.000	
5	300	300	0.000	
6	400	400	0.000	
7	500	500	0.000	
8	600	600	0.000	
9	700	700	0.000	
10	800	800	0.000	
11	901	901	0.000	
			0.000	AVERAGE DIFF

Calibration Performed By ..... Mick Berkhead

Post Test Calibration-Contract #\- ----------

Pre-Test Calibration-Contract #- ----------

Comments:

R

E.T.G. INC.
METER CONSOLE CALIBRATION FORM

Meter Box No..... 11 REFERENCE CAILBRATOR HH71 CAL-K
THERMOCOUPLE NUMBER 7 Date 17-Sep-94

	Reference Temperature	Thermocouple Temperature	Difference %
1	0	0	0.000
2	32	32	0.000
3	100	100	0.000
4	200	200	0.000
5	300	300	0.000
6	400	400	0.000
7	500	500	0.000
8	600	600	0.000
9	700	700	0.000
10	800	800	0.000
11	901	901	0.000
			0.000 AVERAGE DIFF

Calibration Performed By ..... Mick Berkhead

Post Test Calibration-Contract #\- ----------

Pre-Test Calibration-Contract #- ----------

Comments: