Background Report Reference

AP-42 Section Number: 10.6.1

Background Report Section: 4

Reference Number: 20

Title: Source Test Report Weyerhaeuser Company Elkin Structurwood Facility Dryer/IWS System 1 Particulate Emissions and Visual Opacity, June 1, 1987, Weyerhaeuser Company,Elkin,NC

Environmental Source Samplers, Inc

June 1987

ENVIRONMENTAL SOURCE SAMPLERS, INC. — AIR QUALITY CONSULTANTS

SOURCE TEST REPORT
WEYERHAEUSER COMPANY
ELKIN STRUCTURWOOD FACILITY
DRYER/IWS SYSTEM 1

PARTICULATE EMISSIONS & VISUAL OPACITY
JUNE 1, 1987

Prepared for:

WEYERHAEUSER COMPANY
Elkin, North Carolina

Prepared by:

ENVIRONMENTAL SOURCE SAMPLERS, INC.
Charlotte, North Carolina

1409 EAST BOULEVARD • CHARLOTTE, N.C. 28203 • Phone 704/334-3380

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1.0 INTRODUCTION

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1.0 INTRODUCTION

On June 1, 1987, Environmental Source Samplers, Inc. (ESS) conducted particulate emission and visual opacity testing for the Weyerhaeuser Company. Testing was conducted at the Structurwood Plant located in Elkin, North Carolina. Testing was performed on the Unit 1 Wood Dryer/Ionizing Wet Scrubber (IWS) system.

Three (3) particulate emission test runs were performed in the stack serving the Unit 1 system. Particulate emission testing was conducted in accordance with procedures outlined in U.S. Environmental Protection Agency (EPA) Method 5. EPA Methods 1 through 4 were used in support of EPA Method 5. In addition, particulate matter collected in the 'back half' or condenser were included in the emission calculation. Visual opacity was observed in accordance with EPA Method 9 procedures.

The purpose of the particulate emission and visual opacity test series was to determine compliance with appropriate regulations of the North Carolina Department of Natural Resources and Community Development.

Personnel present during the testing included:

Mr. Bob Brummel, Weyerhaeuser
Mr. Ken Cox, Weyerhaeuser
Mr. Brian Preston, Weyerhaeuser
Mr. Rob Seidler, Weyerhaeuser
Mr. Chuck Ritzrow, Ceilcote
Mr. Hugh Jernigan, Jr., N.C. Dept. of Natural Resources
Mr. Robert Hamlin, Jr., Environmental Source Samplers
Mr. Dayne Loy, Environmental Source Samplers
Mr. John Salkill, Environmental Source Samplers

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2.0 SUMMARY AND DISCUSSION OF RESULTS

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2.0 SUMMARY AND DISCUSSION OF RESULTS

The test results are summarized on the following page. Field data sheets are included in Appendix A; calculations in Appendix B; operational data in Appendix C; laboratory data in Appendix D; and calibration data in Appendix E.

Particulate emissions were measured at 17.2, 16.1, and 13.4 pounds per hour resulting in an average emission rate of 15.6 pounds per hour. These results include the particulate contribution of the impinger train. Particulate emissions measured in the 'front half' only were 16.5, 15.4, and 12.9 pounds per hour, for an average emission rate of 14.9 pounds per hour. These emission rates compare with the limit of 15 pounds per hour established for the Unit 1 Dryer/IWS system by the North Carolina Department of Natural Resources and Community Development.

Visual opacity was observed at 11.8, 13.0 and 11.3 percent, for an average of 12.0 percent visual opacity. Each observation consisted of 240 readings over a one hour period concurrent with the particulate testing. These observations are compare with the limit of 20 percent established by the North Carolina Department of Natural Resources and Community Development.

The dryer operated at a bottom belt speed rate of 45 percent during the test period. This equates to aproximately 19,800 pounds per hour of oven dried wood product, or 90 percent of the 22,000 pounds per hour design capacity.

The dryer/IWS system had been down for eight (8) hours prior to the test period due to a plugged cyclone. Due to the downward trend of the particulate emission rate during the test period, it is probable that the dryer had not reached a stable operating condition prior to the start of the test period.

19,800 lb/hr = 9.9 ODTH

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WEYERHAEUSER COMPANY
UNIT 1 DRYER/IWS
PARTICULATE EMISSIONS TEST SUMMARY

RUN #	1	2	3	AVG
DATE	6/01/87	6/01/87	6/01/87	
TIME START (EDT)	14:05	15:55	17:32	
TIME STOP (EDT)	15:19	17:00	18:35	
DRYER RATE (%)	45	45	45	45
DRYER INLET TEMP (°F)	1075	1075	1100	1083
DRYER OUTLET TEMP (°F)	245	245	245	245
WET CELL TO DRYER RATE (%)	80	80	80	80
FLUE GAS TEMP (°F)	146.4	147.3	147.3	147.0
FLUE GAS VELOCITY (FPS)	31.30	31.16	30.85	31.10
FLUE GAS FLOWRATE (M ACFM)	40.66	40.48	40.07	40.40
FLUE GAS FLOWRATE (M DSCFM)	27.09	26.54	26.42	26.68
MOISTURE (%)	22.4	23.5	23.1	23.0
ISOKINETIC SAMPLE RATE (%)	101.2	101.3	101.0	101.2
BAROMETRIC PRESSURE (IN HG)	29.51	29.51	29.51	29.51
STACK PRESSURE (IN HG)	29.50	29.50	29.50	29.50
OXYGEN (%)	17.1	17.4	16.9	17.1
CARBON DIOXIDE (%)	3.5	3.2	3.8	3.5
CARBON MONOXIDE (%)	0.0	0.0	0.0	0.0
NITROGEN (%)	79.4	79.4	79.3	79.4
MOLECULAR WEIGHT OF GAS (MOLES)	26.85	26.76	26.80	26.80
SAMPLE VOLUME (DCF)	30.79	30.63	30.22	30.55
PARTICULATE FRONT HALF (GR/DSCF)	0.0710	0.0677	0.0573	0.0653
PARTICULATE TOTAL (GR/DSCF)	0.0740	0.0708	0.0594	0.0681
FILT. PARTICULATE FRONT HALF (LBS/HR)	16.5	15.4	12.9	14.9
PARTICULATE TOTAL (LBS/HR)	17.2	16.1	13.4	15.6
OPACITY (%)	11.8	13.0	11.3	12.0

TOTAL - FRONT = CPM
15.6 - 14.9 = 0.7 lb/hr CPM
= 0.071 lb/ODT

DO NOT USE

(1.51) LB/ODT

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3.0 PROCESS DESCRIPTION AND OPERATION

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3.0 PROCESS DESCRIPTION AND OPERATION

The Elkin Structurwood facility consists of two (2) dryers with separate primary cyclone collectors and secondary Ceilcote ionizing wet scrubber systems. Each dryer may be heated with oil, the McConnell dust burner, or with heat from the wet cell furnace. The dryers may operate with a combination of these heat sources.

Each dryer has a maximum design capacity of 22,000 lbs/hr of oven dried wood product. The dryer rate reported in this report is based on the belt speed supplying the dryer. Depending on wood quality and moisture content, maximum belt speed is 35 - 50%, as controlled by the dryer outlet temperature.

The Ceilcote IWS consists of a venturri scrubber operating with a 3 inch water gauge pressure drop followed by a particle charging section. Ionizer elements are controlled by two (2) independent transformer-rectifiers, and are continuously flushed to prevent solids build up. Tellerette packing is used as the collecting material, and is washed at four (4) hour intervals for a five (5) minute period.

A block diagram of the process/collection system appears on the following page. A schematic of the IWS appears on the next page. Operational data was collected during each test run, and appears in Appendix C.

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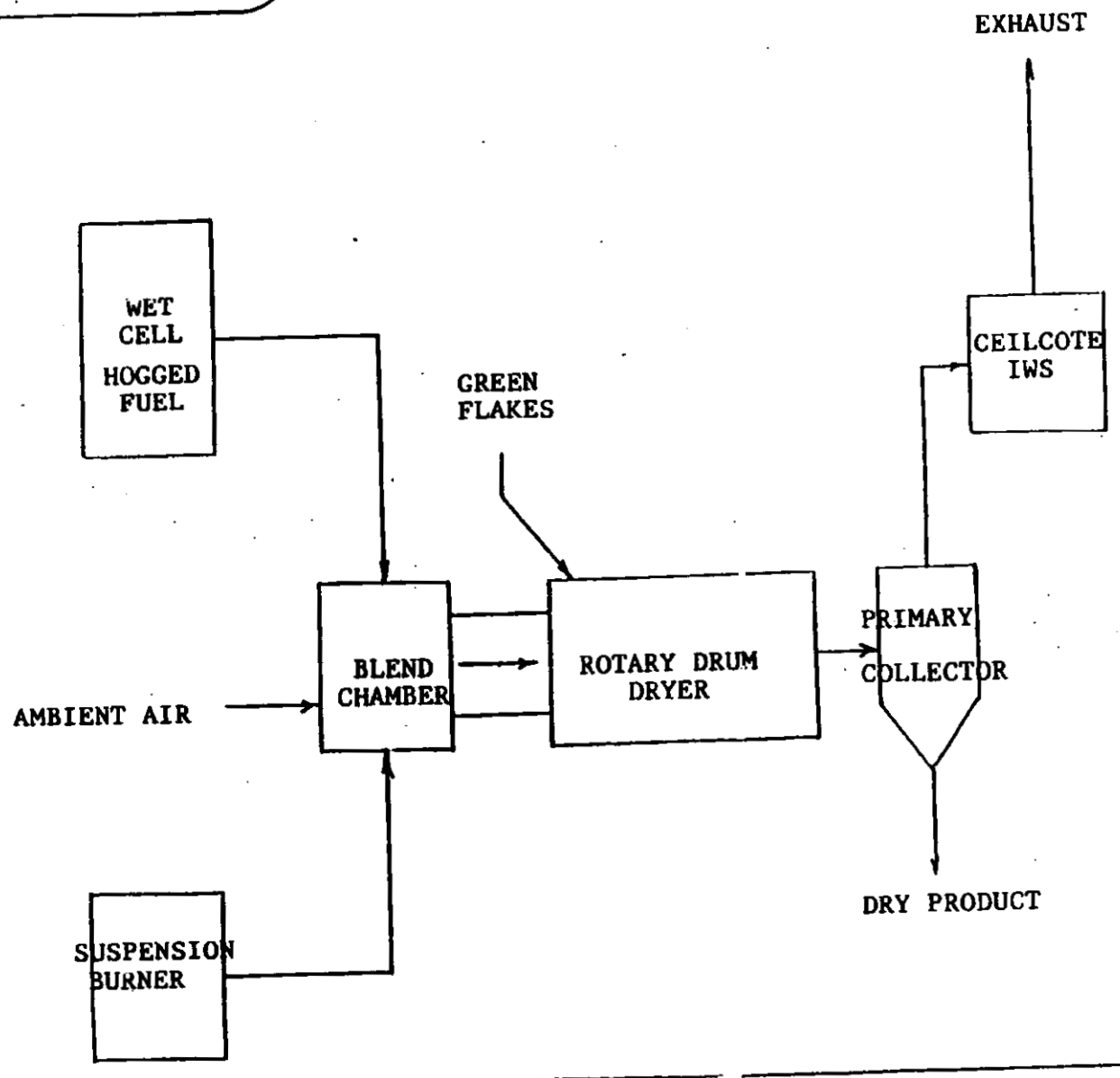
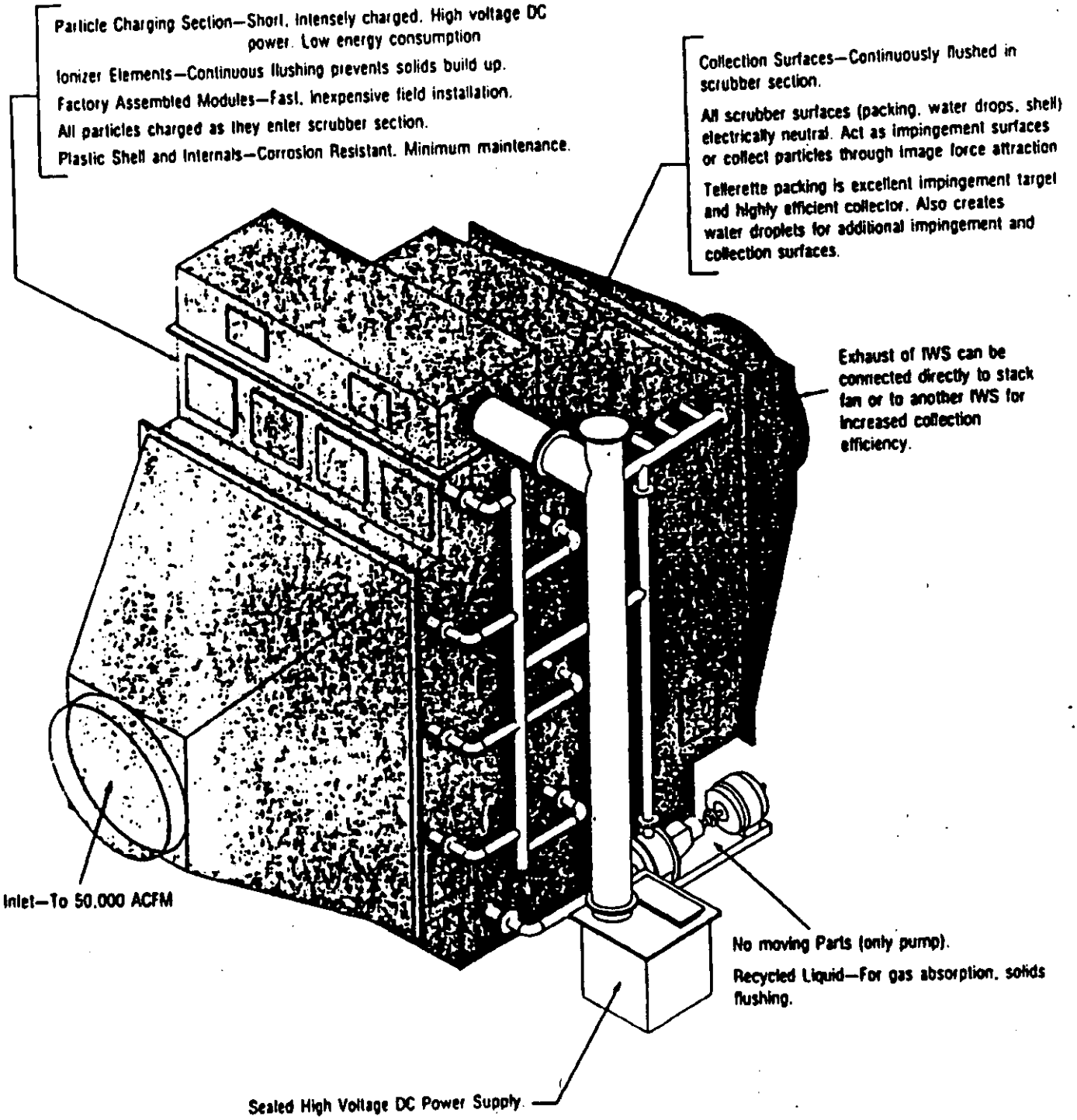
WEYERHAEUSER - ELKIN, N.C.
DRYER/COLLECTOR SYSTEM



WEYERHAEUSER - ELKIN, N.C.

CEILCOTE IONIZING WET SCRUBBER



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4.0 SAMPLING POINT LOCATION

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4.0 SAMPLING POINT LOCATION

The MTV/IWS outlet test ports were located in the stack serving the system. The test ports were located in a steel stack having an inside diameter of 5'-3". Two (2) test ports were located 55 feet or 10.5 stack diameters downstream of the IWS exit, and 25 feet or 4.8 stack diameters upstream of the stack exit.

According to the procedures of EPA Methods 1 and 2, six (6) test points were selected at each of the two (2) test ports. Each point was sampled for five (5) minutes, resulting in 60 minute test runs.

The test site is diagrammed on the following page.

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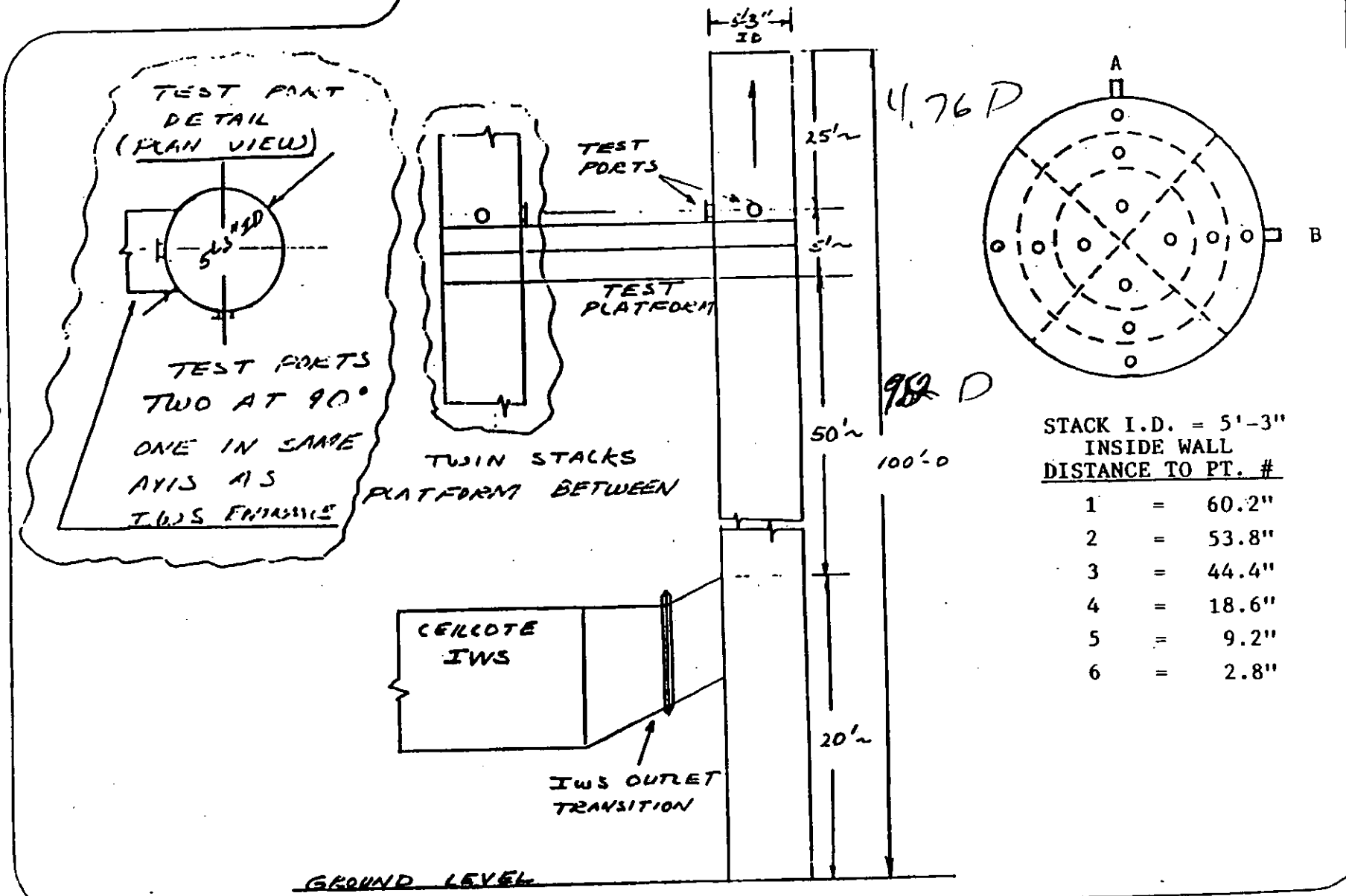
WEYERHAEUSER - ELKIN, N.C.
IONIZING WET SCRUBBERS 1 & 2
OUTLET PARTICULATE SAMPLING LOCATION



STACK I.D. = 5'-3"
INSIDE WALL
DISTANCE TO PT. #

1	=	60.2"
2	=	53.8"
3	=	44.4"
4	=	18.6"
5	=	9.2"
6	=	2.8"

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ENVIRONMENTAL
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PARTICULATE FIELD DATA

Plant Weyerhaeuser Elkin
Run Number 1
Location MTV Outlet #1
Date 6/1/87
Operator Lox SalKill
Sample case number S-4
Monitor Unit number B-21
Time start: 14:05
Time complete: 15:19

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ENVIRONMENTAL SOURCE SAMPLERS

bag no - 3

Ambient temperature, °F 78
Barometric pressure, in. Hg 29.51
Assumed moisture, % 15
Heater box setting, °F 250
Nozzle tip diameter, in. .265
Pitobe length, ft. 6
Pitobe heater setting 250

Point	Clock Time	Dry Gas Meter ft³	Pitot, in. H_2O ΔP	Orifice ΔH, in. H_2O Desired	Orifice ΔH, in. H_2O Actual	Dry gas temperature, °F		Pump Vacuum in. Hg Gauge	Sample Case Temperature, °F	Impinger Temperature, °F	Stack pressure, in. H_2O	Stack Temperature, °F
A 1	0	983.050	0.25	0.90	0.90		70	2	265	62	-0.20	148
2	5	985.610	0.23	0.40	0.40		76	2	260	62		147
3	10	988.160	0.30	1.08	1.08		88	2	260	62		143
4	15	991.065	0.25	0.40	0.40		92	6	262	60		146
5	20	993.615	0.25	0.40	0.40		94	10	264	60		145
6	25	996.250	0.25	0.40	0.40		95	10	262	62		145
B 1	30	998.755	0.20	0.72	0.72		96	5	250	64		147
2	35	001.010	0.30	0.72	0.72		98	3	264	64		147
3	40	003.250	0.25	1.90	0.90		98	3	265	64	-0.20	148
4	45	005.805	0.25	0.90	0.90		99	3	262	62		147
5	50	008.340	0.30	1.08	1.08		100	6	264	62		147
6	55	011.215	0.25	0.90	0.90		100	5	265	60		147
	60	013.720										
	TOTAL	30.670										
		AVG	0.249		0.90		92.2				-0.20	146.4

Leak rate: Start 0.000 cfm; Finish 0.000 cfm.
@ 15 lbs. @ 12 lbs

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ENVIRONMENTAL
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ORSAT GAS ANALYSIS

PLANT Weyerhaeuser IWS1 DATE 6-1-87 TEST # 1

	TIME	% CO_2	% O_2	% CO	% N_2
RUN 1		3.4	206 17.2	206 0.0	79.4
RUN 2		3.6	20.6 17.0	206 0.0	79.4
RUN 3		?	?	?	?
AVG.		3.5	17.1	0.0	79.4

GAS DENSITY CORRECTION FACTOR

COMPONENT	VOLUME PERCENT/100	MOISTURE CORRECTION	MOL. WT.	WEIGHT PER MOLE = WET BASIS
WATER	0.224	1.0	18.0	4,032
CARBON DIOXIDE	0.035 DRY BASIS	0.796	44.0	1.195
CARBON MONOXIDE	— DRY BASIS		28.0	
OXYGEN	0.171 DRY BASIS	0.776	32.0	4.286
NITROGEN & INERTS	0.794 DRY BASIS	0.776	28.2	17.375
			AVERAGE MOLECULAR WEIGHT	26.85

Plant Weyerhaeuser - Elkin
Run Number 2
Location MTV Outlet #1
Date 6/1/87
Operator Loy, Salkill
Sample case number S-4
Monitor Unit number E-4
Time start: 15:55
Time complete: 17:00

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ENVIRONMENTAL SOURCE SAMPLERS

Ambient temperature, °F 82
Barometric pressure, in. Hg 29.51
Assumed moisture, % 15
Heater box setting, °F 250
Nozzle tip diameter, in. 0.265
Pitobe length, ft. 6
Pitobe heater setting [illegible]

Point		Clock Time	Dry Gas Meter ft^3	Pitot, in. H_2O ΔP	Orifice ΔH, in. H_2O		Dry gas temperature, °F		Pump Vacuum in. Hg Gauge	Sample Case Temperature, °F	Impinger Temperature, °F	Stack Pressure, in. H_2O	Stack Temperature, °F
					Desired	Actual							
A	1	0	013.910	0.25	0.90	0.90	96		2	250	64	-0.20	144
	2	5	016.470	0.25	0.90	0.90	96		2	258	62		145
	3	10	019.020	0.25	0.90	0.90	98		2	260	62		148
	4	15	021.390	0.25	0.90	0.90	100		5	262	62		148
	5	20	023.815	0.20	0.72	0.72	100		6	265	64		148
	6	25	026.170	0.25	0.90	0.90	100		2	264	63		148
B	1	30	028.620	0.20	0.72	0.72	98		2	253	64	-0.20	147
	2	35	031.215	0.25	0.90	0.90	100		2	264	62		148
	3	40	033.530	0.25	0.90	0.90	102		3	266	64		149
	4	45	036.100	0.30	1.08	1.08	104		4	264	64		148
	5	50	039.025	0.25	0.90	0.90	104		3	262	64		147
	6	55	041.880	0.25	0.90	0.90	104		5	262	64		148
		60	044.415										
		Total	30.505										
			AVG	0.245		0.885	100.0					-0.20	147.3

Leak rate: Start 0.000 cfm; Finish 0.000 cfm.
@15 Hg. @12 Hg.

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ENVIRONMENTAL
SOURCE SAMPLERS

ORSAT GAS ANALYSIS

PLANT Weyerhaeuser IWS 1 DATE 6-1-87 TEST # 2

	TIME	% CO_2	% O_2	% CO	% N_2
RUN 1		3.2	20.6 17.4	20.6 0.0	79.4
RUN 2		3.2	20.6 17.4	20.6 0.0	79.4
RUN 3		1	1	1	1
AVG.		3.2	17.4	0.0	79.4

GAS DENSITY CORRECTION FACTOR

COMPONENT	VOLUME PERCENT/100	MOISTURE CORRECTION	MOL. WT.	WEIGHT PER MOLE = WET BASIS
WATER	0.235	1.0	18.0	4.230
CARBON DIOXIDE	0.082 DRY BASIS	0.765	44.0	1.077
CARBON MONOXIDE	~ DRY BASIS		28.0	
OXYGEN	0.174 DRY BASIS	0.765	32.0	4.260
NITROGEN & INERTS	0.794 DRY BASIS	0.765	28.2	17.129
			AVERAGE MOLECULAR WEIGHT	26.70

Plant Weyerhaeuser Elk'n
Run Number 3
Location MTV Outlet #1
Date 6/1/87
Operator LGY - SALK.
Sample case number 5-4
Monitor Unit number B-4
Time start: 17:32
Time complete: 18:35

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ENVIRONMENTAL SOURCE SAMPLERS

Ambient temperature, °F 82
Barometric pressure, in. Hg 29.51
Assumed moisture, % 15
Heater box setting, °F 250
Nozzle tip diameter, in. 0.265
Pitobe length, ft. 6
Pitobe heater setting 256

Point	Clock Time	Dry Gas Meter ft³	Pitot, in. H_2O ΔP	Orifice ΔH, in. H_2O Desired	Orifice ΔH, in. H_2O Actual	Dry gas temperature, °F		Pump Vacuum in. Hg Gauge	Sample Case Temperature, °F	Impinger Temperature, °F	Stack Pressure, in. H_2O	Stack Temperature, °F
A 1	0	045.440	0.25	0.40	0.40	96		2	238	64	-0.20	148
2	5	047.680	0.25	0.40	0.40	96		2	240	64		149
3	10	050.530	0.25	0.40	0.40	96		2	255	63		145
4	15	053.090	0.25	0.90	0.90	96		2	260	62		149
5	20	055.620	0.30	0.72	0.72	98		2	262	62		148
6	25	057.650	0.20	0.72	0.72	98		3	262	63		147
B 1	30	060.120	0.20	0.72	0.72	96		3	264	62	-0.20	148
2	35	062.515	0.25	0.90	0.90	98		4	265	63		148
3	40	065.110	0.25	0.90	0.90	98		4	265	62		147
4	45	067.650	0.30	1.08	1.08	98		5	264	61		147
5	50	070.365	0.25	0.90	0.90	98		5	263	61		146
6	55	073.060	0.25	0.90	0.90	98		5	262	60		145
	60	075.540										
	TOTAL	30.100										
		AVG.	0.241		0.870	97.7					-0.20	147.3

Leak rate: Start 0.000 cfm; Finish 0.000 cfm.

P: 5 1/2: @ 1 1/2

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ORSAT GAS ANALYSIS

PLANT Weyerhaeuser Iaslo DATE 6-1-87 TEST # 3

	TIME	% CO_2	% O_2	% CO	% N_2
RUN 1		3.8	20.8 17.0	20.8 0.0	79.2
RUN 2		3.8	20.6 16.8	20.6 0.0	79.4
RUN 3		〃	〃	〃	〃
AVG.		3.8	16.9	0.0	79.3

GAS DENSITY CORRECTION FACTOR

COMPONENT	VOLUME PERCENT/100	MOISTURE CORRECTION	MOL. WT.	WEIGHT PER MOLE = WET BASIS
WATER	0.231	1.0	18.0	4.158
CARBON DIOXIDE	0.038 DRY BASIS	0.769	44.0	1.286
CARBON MONOXIDE	— DRY BASIS		28.0	
OXYGEN	0.169 DRY BASIS	0.769	32.0	4.159
NITROGEN & INERTS	0.793 DRY BASIS	0.769	28.2	17.200
			AVERAGE MOLECULAR WEIGHT	26.80

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ENVIRONMENTAL
SOURCE SAMPLERS

VISUAL OPACITY FIELD DATA

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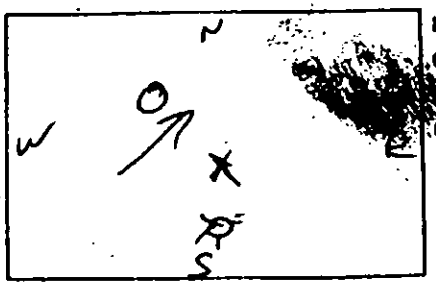
ENVIRONMENTAL SOURCE SAMPLERS

EPA METHOD 9 VISUAL OPACITY

COMPANY Weyerhaeuser
LOCATION Elkin NC
TEST NUMBER
DATE 8/6/87
TYPE FACILITY Wood Waste
CONTROL DEVICE MW / 2WS



HOURS OF OBSERVATION 1410 - 1510
OBSERVER R. Hamlin
OBSERVER CERTIFICATION DATE 3/4/82
OBSERVER AFFILIATION ESS
POINT OF EMISSIONS STACK
HEIGHT OF DISCHARGE POINT 125'

	Initial			Final
CLOCK TIME	1410			1510
OBSERVER LOCATION Distance to Discharge	125'			125'
Direction from Discharge	SE			SE
Height of Observation Point	50'			50'
BACKGROUND DESCRIPTION	HAZY SKY + Trees			BLUE SKY + Trees
WEATHER CONDITIONS Wind Direction	SW			SW
Wind Speed	5			5-10
Ambient Temperature	80			84
SKY CONDITIONS (clear, overcast, % clouds, etc.)	CLOUDS			clear
PLUME DESCRIPTION Color	white			white
Distance Visible	300'			300
OTHER INFORMATION	STEAM	1+2 PLUMES		MIXED

SUMMARY OF AVERAGE OPACITY

Set Number	Time Start--End	Opacity Sum	Opacity Average
1	1410 - 1416	265	11.0
2	1416-1422	250	10.4
3	1422 - 1428	310	12.9
4	1428 - 1434	290	12.1
5	1434 - 1440	300	12.5
6	1440 - 1446	285	11.9
7	1446 - 1452	235	9.8
8	1452 - 1458	275	11.5
9	1458 - 1504	295	12.3
10	1504 - 1510	315	13.1

Readings ranged from 5 to 20 % opacity

The source was/was not in compliance with ___ at the time evaluation was made.

240 reading Avg = 11.8% opacity

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ENVIRONMENTAL
SOURCE SAMPLERS

EPA METHOD 9 VISUAL OPACITY

Company: Weyerhaeuser
Location: Elkin NC
Test Number:
Date: 6/1/87

Observer: R. Hamlin
Type facility: WOOD FIRED / Ind
Point of emissions: STACK

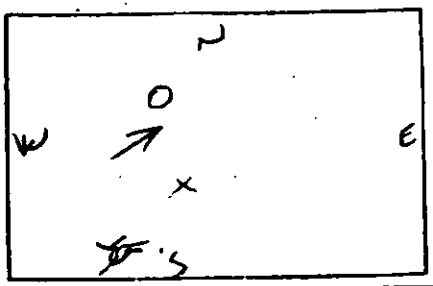
Hr	Min	Seconds 0	15	30	45	Steam plume (check if applicable) Attached	Detached	Comments
	0	10	10	10	10	✓		SMOKE OBSCURED
	1	10	15	15	15	✓		AFTER STEAM
	2	10	10	10	10	✓		DISSIPATION
	3	5	10	10	10	✓		
	4	10	10	15	15	✓		
	5	15	10	10	10	✓		
	6	10	15	10	10	✓		
	7	5	5	5	10	✓		
	8	10	10	10	15	✓		
	9	10	10	15	15	✓		
	10	10	10	10	15	✓		
	11	15	15	10	10	✓		
	12	10	10	15	15	✓		
	13	15	10	10	10	✓		
	14	10	10	10	10	✓		
	15	10	10	10	15	✓		
	16	15	15	15	15	✓		
	17	20	20	15	15	✓		
	18	15	15	15	15	✓		
	19	15	15	15	15	✓		
	20	10	10	10	10	✓		
	21	10	10	10	10	✓		
	22	10	10	10	10	✓		
	23	10	15	15	10	✓		
	24	10	10	10	10	✓		
	25	10	10	15	15	✓		
	26	15	15	10	10	✓		
	27	10	10	10	10	✓		
	28	10	10	15	15	✓		
	29	15	15	20	20	✓		

Hr	Min	Seconds 0	15	30	45	Steam plume (check if applicable) Attached	Detached	Comments
	30	10	10	10	15	✓		
	31	15	15	10	10	✓		
	32	10	10	15	15	✓		
	33	15	15	10	10	✓		
	34	10	10	10	10	✓		
	35	10	10	15	15	✓		
	36	15	15	10	10	✓		
	37	10	10	10	10	✓		
	38	10	5	5	5	✓		
	39	5	10	10	10	✓		
	40	10	10	10	10	✓		
	41	10	10	10	15	✓		
	42	15	15	15	15	✓		
	43	10	10	10	10	✓		
	44	10	10	10	10	✓		
	45	10	10	15	15	✓		
	46	15	10	10	10	✓		
	47	10	10	10	10	✓		
	48	10	10	15	15	✓		
	49	15	10	10	10	✓		
	50	10	10	15	15	✓		
	51	15	10	10	10	✓		
	52	10	15	15	15	✓		
	53	15	15	10	10	✓		
	54	10	10	15	15	✓		
	55	10	10	10	10	✓		
	56	10	15	15	15	✓		
	57	15	15	10	10	✓		
	58	10	15	15	15	✓		
	59	20	20	15	10			

ESS
ENVIRONMENTAL
SOURCE SAMPLERS

EPA METHOD 9 VISUAL OPACITY

COMPANY Weyerhaeuser
LOCATION Elkin NC
TEST NUMBER 2
DATE 6/1/87
TYPE FACILITY WOOD DRYER
CONTROL DEVICE MTV/EMS



HOURS OF OBSERVATION 1600 - 1700
OBSERVER R. Nantz
OBSERVER CERTIFICATION DATE 3/4/87
OBSERVER AFFILIATION ESS
POINT OF EMISSIONS STACK
HEIGHT OF DISCHARGE POINT 100'

	Initial			Final
CLOCK TIME	1600			1700
OBSERVER LOCATION Distance to Discharge	150			150
Direction from Discharge	S			S
Height of Observation Point	50'			50'
BACKGROUND DESCRIPTION	BLUE SKY			BLUE SKY
WEATHER CONDITIONS Wind Direction	SW			SW
Wind Speed	5			5
Ambient Temperature	85			82
SKY CONDITIONS (clear, overcast, % clouds, etc.)	clear			10-15% clouds
PLUME DESCRIPTION Color	white			white
Distance Visible	300'			300'
OTHER INFORMATION	UNIT	1+2	PLUMES	MIXED

SUMMARY OF AVERAGE OPACITY

Set Number	Time Start--End	Opacity Sum	Opacity Average
1	1600 - 1606	330	13.8
2	1606 - 1612	360	15.0
3	1612 - 1618	375	15.6
4	1618 - 1624	355	14.8
5	1624 - 1630	330	13.8
6	1630 - 1636	265	11.0
7	1636 - 1642	315	13.1
8	1642 - 1648	295	12.3
9	1648 - 1654	265	11.0
10	1654 - 1700	235	9.8

Readings ranged from 5 to 20 % opacity.

The source was/was not in compliance with ___ at the time evaluation was made.

240 ÷ 18 = 13.0%

ESS

ENVIRONMENTAL
SOURCE SAMPLERS

EPA METHOD 9 VISUAL OPACITY

Company Weyerhaeuser
Location Elkton, MD
Test Number 2
Date 6/11/03

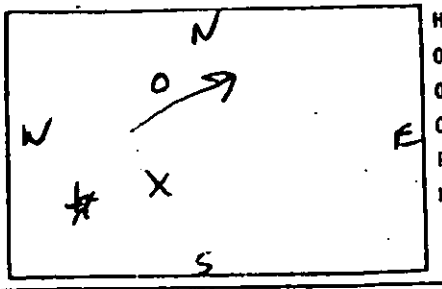
Observer R. Hamlin
Type facility Wood Waste - Boiler
Point of emissions STACK

Hr	Min	Seconds 0	15	30	45	Steam plume (check if applicable) Attached	Detached	Comments
	0	15	15	15	15	✓		SMOKE OBSERVED AFTER STEAM DISSIPATED
	1	20	15	15	15	✓		
	2	15	15	15	15	✓		
	3	10	15	10	10	✓		
	4	15	15	15	15	✓		
	5	10	10	15	15	✓		
	6	15	10	15	15	✓		
	7	20	15	15	15	✓		
	8	15	15	15	20	✓		
	9	20	15	15	15	✓		
	10	15	15	15	15	✓		
	11	10	10	15	15	✓		
	12	15	15	15	15	✓		
	13	20	20	20	20	✓		
	14	15	15	15	10	✓		
	15	10	15	15	10	✓		
	16	15	15	20	20	✓		
	17	15	15	15	15	✓		
	18	15	20	15	15	✓		
	19	20	15	15	15	✓		
	20	10	15	15	10	✓		
	21	15	10	10	15	✓		
	22	15	15	15	20	✓		
	23	15	15	15	15	✓		
	24	15	15	15	20	✓		
	25	20	15	15	20	✓		
	26	15	10	10	10	✓		
	27	15	15	15	10	✓		
	28	10	15	15	10	✓		
	29	15	10	10	10	✓		
	30	10	10	10	10	✓		
	31	10	10	10	10	✓		
	32	15	15	10	15	✓		
	33	10	15	15	10	✓		
	34	10	10	10	10	✓		
	35	10	10	10	10	✓		
	36	10	15	15	10	✓		
	37	10	15	15	15	✓		
	38	15	10	10	15	✓		
	39	15	10	10	10	✓		
	40	15	15	15	15	✓		
	41	10	15	15	15	✓		
	42	10	10	10	10	✓		
	43	15	15	15	10	✓		
	44	10	10	15	15	✓		
	45	15	15	10	10	✓		
	46	10	15	15	10	✓		
	47	10	10	15	15	✓		
	48	20	20	15	15	✓		
	49	15	15	10	10	✓		
	50	10	10	10	10	✓		
	51	10	10	10	10	✓		
	52	10	10	5	5	✓		
	53	10	10	10	5	✓		
	54	15	10	10	10	✓		
	55	10	10	10	10	✓		
	56	10	10	5	10	✓		
	57	10	10	10	5	✓		
	58	10	10	10	10	✓		
	59	15	10	10	10	✓		

ESS
ENVIRONMENTAL
SOURCE SAMPLERS

EPA METHOD 9 VISUAL OPACITY

COMPANY Weyerhaeuser
LOCATION Elkin NC
TEST NUMBER 3
DATE 6/1/87
TYPE FACILITY WOOD DRYER
CONTROL DEVICE MTU/IWS



HOURS OF OBSERVATION 1740-1840
OBSERVER R Hamlin
OBSERVER CERTIFICATION DATE 3/4/87
OBSERVER AFFILIATION ESS
POINT OF EMISSIONS STACK
HEIGHT OF DISCHARGE POINT 100'

	Initial			Final
CLOCK TIME	1740			1840
OBSERVER LOCATION Distance to Discharge	150'			150'
Direction from Discharge	S			S
Height of Observation Point	50'			50'
BACKGROUND DESCRIPTION	DARKNESS SKY			OVERCAST SKY
WEATHER CONDITIONS Wind Direction	SW			SW
Wind Speed	5			5
Ambient Temperature	80			78
SKY CONDITIONS (clear, overcast, % clouds, etc.)	OVERCAST			OVERCAST
PLUME DESCRIPTION Color	white			white
Distance Visible	200'			160'
OTHER INFORMATION	UNIT	1+2	PLUMES	MIXED

SUMMARY OF AVERAGE OPACITY

Set Number	Time Start--End	Opacity Sum	Opacity Average
1	1740-1746	240	10.0
2	1746-1752	290	12.1
3	1752-1758	205	8.5
4	1758-1804	225	11.5
5	1804-1810	225	9.4
6	1810-1816	390	16.3
7	1816-1822	320	13.3
8	1822-1828	280	11.7
9	1828-1834	275	11.5
10	1834-1840	215	9.0

Readings ranged from 5 to 20 % opacity

The source (was) was not in compliance with ___ at the time evaluation was made.

240 Reading Avg = 11.3%

ESS

ENVIRONMENTAL
SOURCE SAMPLERS

EPA METHOD 9 VISUAL OPACITY

Company Weyerhaeuser
Location Elkin NC
Test Number 3
Date 6/11/87

Observer B. Hamlin
Type facility Wood Dryer - Inc
Point of emissions STACK

Hr	Min	Seconds 0	15	30	45	Steam plume (check if applicable) Attached	Detached	Comments
	0	10	10	10	10	✓		SMOKE ABSENT AFTER STEAM DISSIPATION
	1	10	10	10	10	✓		
	2	10	10	10	10	✓		
	3	10	5	5	5	✓		
	4	10	10	10	10	✓		
	5	10	15	15	15	✓		
	6	15	15	15	15	✓		
	7	15	15	15	20	✓		
	8	15	15	10	10	✓		
	9	10	10	10	10	✓		
	10	10	10	10	10	✓		
	11	10	5	5	5	✓		
	12	10	10	10	10	✓		
	13	10	5	5	5	✓		
	14	5	5	10	10	✓		
	15	10	10	10	10	✓		
	16	10	10	10	5	✓		
	17	5	10	10	10	✓		
	18	15	15	20	15	✓		
	19	15	15	15	10	✓		
	20	10	10	10	10	✓		
	21	10	5	10	10	✓		
	22	10	10	10	10	✓		
	23	10	10	10	10	✓		
	24	10	10	5	5	✓		
	25	10	10	10	10	✓		
	26	10	10	10	10	✓		
	27	5	10	10	10	✓		
	28	10	10	10	10	✓		
	29	10	10	10	10	✓		
	30	15	15	15	15	✓		
	31	20	20	15	15	✓		
	32	15	15	15	15	✓		
	33	15	15	15	20	✓		
	34	20	15	15	20	✓		
	35	15	15	15	15	✓		
	36	20	20	15	15	✓		
	37	15	15	20	20	✓		
	38	10	10	15	15	✓		
	39	15	15	10	10	✓		
	40	10	10	10	15	✓		
	41	10	10	10	10	✓		
	42	10	10	10	10	✓		
	43	10	15	10	15	✓		
	44	10	10	10	15	✓		
	45	15	15	15	15	✓		
	46	10	10	15	10	✓		
	47	10	10	10	15	✓		
	48	15	15	15	15	✓		
	49	10	15	15	10	✓		
	50	10	10	10	10	✓		
	51	10	15	15	15	✓		
	52	10	15	10	10	✓		
	53	15	15	15	15	✓		
	54	5	5	10	5	✓		
	55	10	10	10	10	✓		
	56	10	10	10	10	✓		
	57	10	10	10	5	✓		
	58	10	10	10	10	✓		
	59	10	10	10	10	✓		

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ENVIRONMENTAL
SOURCE SAMPLERS

APPENDIX B - CALCULATIONS

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ENVIRONMENTAL
SOURCE SAMPLERS

TEST CALCULATIONS

ACCOUNT: Weyerhaeuser DATE: 6-17-87
STATION: Elkin UNIT NO.: 1 TEST NO.: 1

① Sample Volume (ft^3)	30.670 x 1.009 = 30.793	⑨ M_s	26.85
② Barr. Pressure (in. Hg.)	29.51	⑩ Nozzle Dia. (in.)	0.265
③ Avg. ΔH(in.W.C.)	0.90	⑪ Stack Pressure (in.Hg.)	29.50
④ Avg. T_m (°F)	92.2	⑫ Sampling Time (min.)	60
⑤ Condensed H_2O (ml)	178.5	⑬ Total Weight (g)	0.1397
⑥ Avg. ΔP (in.W.C.)	0.249	⑭ Stack Area (ft^3)	21.65
⑦ Pitot Factor (C_p)	0.84	⑮ % O_2	12.1
⑧ Avg. T_s (°F)	146.4		

DRY GAS VOLUME

$$V_{M\,STD} = \frac{17.65\,(⑰\,30.793)\left[(②\,29.51) + \left(\frac{③\,0.90}{13.6}\right)\right]}{(④\,92.2 + 460)} = (A)\ 29.110\ ft^3$$

VOLUME OF WATER VAPOR

$$V_{W\,STD} = 0.0471\,(⑤\,178.5) = (B)\ 8.407\ ft^3$$

MOISTURE CONTENT

$$B_{WO} = \frac{((B)\ 8.407)}{((B)\ 8.407) + ((A)\ 29.110)} = (C)\ 0.224$$

VELOCITY

$$V(fps) = (2.9)\,(⑦\,0.84)\sqrt{(⑥\,0.249)(⑧\,146.4+460)\left(\frac{28.95}{⑰\,26.85}\right)\left(\frac{29.92}{⑪\,29.50}\right)} = (D)\ 31.30\ fps$$

% ISOKINETIC

$$\%I = \frac{17.313\,((A)\ 29.110)(⑧\,146.4 + 460)}{(⑩\,0.265)^2\,(⑪\,29.50)\,(1-((C)\ 0.224))\,((D)\ 31.30)\,(⑫\,60)} = (E)\ 101.2\ \%$$

EMISSIONS

$$\text{TOTAL GR/SCF} = \frac{(⑬\,0.1397)\,(15.43)}{((A)\ 29.110)} = (F)\ 0.0740\ GR/SCFD$$

$$\text{TOTAL LBS/HR} = \frac{9.08\,((F)\ 0.0740)(⑭\,21.65)((D)\ 31.30)(⑪\,29.50)(1-((C)\ 0.224))}{(⑧\,146.4 + 460)} = (G)\ 17.2$$

$$\text{LBS/MMBTU} = \frac{29.32\,((F\quad)}{(20.9-(⑮\quad))} = NA\ LBS/MMBTU$$

ACFM = 31.30 fps x 60 s/m x 21.65 ft^2 = 40,659 ACFM
= 27,086 DSCFM

DSCFM =

FRONT Half only: $\frac{(0.1339)(15.43)}{(29.110)}$, 0.0710 GR/SCFD

$\left(\frac{0.0710}{0.0740}\right)(17.2\ lbs/hr.) = 16.5\ lbs/hr.$

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ENVIRONMENTAL
SOURCE SAMPLERS

TEST CALCULATIONS

ACCOUNT: Weyerhaeuser DATE: 6-1-87
STATION: Elk UNIT NO.: 1 TEST NO.: 2

① Sample Volume (ft^3)	30.505 x 1.004 = 30.627	⑨ M_s	26.70
② Barr. Pressure (in. Hg.)	29.51	⑩ Nozzle Dia. (in.)	0.265
③ Avg. ΔH(in.W.C.)	0.885	⑪ Stack Pressure (in.Hg.)	29.50
④ Avg. T_m (°F)	100.0	⑫ Sampling Time (min.)	60
⑤ Condensed H_2O (ml)	186.0	⑬ Total Weight (g)	0.1310
⑥ Avg. ΔP (in.W.C.)	0.245	⑭ Stack Area (ft^3)	21.65
⑦ Pitot Factor (C_p)	0.84	⑮ % O_2	17.4
⑧ Avg. T_s (°F)	147.3		

DRY GAS VOLUME

$$V_M \text{ STD} = \frac{17.65\ (①\ 30.627)\left[(②\ 29.51) + \left(\frac{③\ 0.885}{13.6}\right)\right]}{(④\ 100.0 + 460)} = (A)\ 28.549\ ft^3$$

VOLUME OF WATER VAPOR

$$V_W \text{ STD} = 0.0471\ (⑤\ 186.0) = (B)\ 8.761\ ft^3$$

MOISTURE CONTENT

$$B_{WO} = \frac{((B)\ 8.761)}{((B)\ 8.761) + ((A)\ 28.549)} = (C)\ 0.235$$

VELOCITY

$$V(fps) = (2.9)(⑦\ 0.84)\sqrt{(⑥\ 0.245)(⑧\ 147.3 + 460)\left(\frac{28.95}{⑨\ 26.70}\right)\left(\frac{29.92}{⑪\ 29.50}\right)} = (D)\ 31.16\ fps$$

% ISOKINETIC

$$\%I = \frac{17.313\ ((A)\ 28.549)(⑧\ 147.3 + 460)}{(⑩\ 0.265)^2\ (⑪\ 29.50)\ (1-((C)\ 0.235))\ ((D)\ 31.16)\ (⑫\ 60)} = (E)\ 101.3\ \%$$

EMISSIONS

TOTAL GR/SCF = $\frac{(⑬\ 0.1310)\ (15.43)}{((A)\ 28.549)}$ = (F) 0.0708 GR/SCF

TOTAL LBS/HR = $\frac{9.08\ ((F)\ 0.0708)(⑭\ 21.65)((D)\ 31.16)(⑪\ 29.50)(1-((C)\ 0.235))}{(⑧\ 147.3 + 460)}$ = (G) 16.1

LBS/MMBTU = $\frac{29.32\ ((F\ \ \ )}{(20.9-(⑮\ \ \ ))}$ = NA LBS/MMBTU

ACFM = 31.16 fps x 60 s/m x 21.65 FT^2 = 40,477 ACFM
= 26,544 DSCFM

DSCFM = FRONT HALF ONLY $\frac{(0.1253)(15.43)}{(28.549)}$ → 0.0677 GR/SCFD

$\left(\frac{0.0677}{0.0708}\right)(16.1\ lbs/hr) = 15.4\ lbs/hr.$

ESS
ENVIRONMENTAL
SOURCE SAMPLERS

TEST CALCULATIONS

ACCOUNT: Weyerhaeuser DATE: 6-1-87
STATION: Elkin UNIT NO.: 1 Fuel TEST NO.: 3

① Sample Volume (ft^3)	30,100 x 1.004 = 30.220	⑨ H_a	2.680
② Barr. Pressure (in. Hg.)	29.51	⑩ Nozzle Dia. (in.)	0.265
③ Avg. ΔH(in.W.C.)	0.870	⑪ Stack Pressure (in.Hg.)	29.50
④ Avg. T_m (°F)	97.2	⑫ Sampling Time (min.)	60
⑤ Condensed H_2O (ml)	180.5	⑬ Total Weight (g)	0.1089
⑥ Avg. ΔP (in.W.C.)	0.241	⑭ Stack Area (ft^3)	21.65
⑦ Pitot Factor (C_p)	0.84	⑮ % O_2	16.9
⑧ Avg. T_s (°F)	147.3		

DRY GAS VOLUME

$$V_M \text{ STD} = \frac{17.65\ (⑰\ 30.220)\left[(②\ 29.51) + \left(\frac{③\ 0.870}{13.6}\right)\right]}{(④\ 97.2 + 460)} = \text{(A) } 28.31\ ft^3$$

VOLUME OF WATER VAPOR

$$V_W \text{ STD} = 0.0471\ (⑤\ 180.5) = \text{(B) } 8.502\ ft^3$$

MOISTURE CONTENT

$$B_{WO} = \frac{((B)\ 8.502)}{((B)\ 8.502 + ((A)\ 28.31)} = \text{(C) } 0.231$$

VELOCITY

$$V(fps) = (2.9)(⑦\ 0.84)\sqrt{(⑥\ 0.241)(⑧\ 147.3 + 460)\left(\frac{28.95}{⑨\ 26.80}\right)\left(\frac{29.92}{⑪\ 29.50}\right)} = \text{(D) } 30.85\ fps$$

% ISOKINETIC

$$\%I = \frac{17.313\ ((A)\ 28.31)(⑧\ 147.3 + 460)}{(⑩\ 0.265)^2\ (⑪\ 29.50)\ (1-((C)\ 0.231))\ ((D)\ 30.85)\ (⑫\ 60)} = \text{(E) } 101.0\ \%$$

EMISSIONS

$$\text{TOTAL GR/SCF} = \frac{(⑬\ 0.1089)\ (15.43)}{((A)\ 28.31)} = \text{(F) } 0.0594\ \text{GR/SCF}$$

$$\text{TOTAL LBS/HR} = \frac{9.08\ ((F)\ 0.0594)(⑭\ 21.65)((D)\ 30.85)(⑪\ 29.50)(1-((C)\ 0.231))}{(⑧\ 147.3 + 460)} = \text{(G) } 13.4$$

$$\text{LBS/MMBTU} = \frac{29.32\ ((F\ \ \ \ )}{(20.9-(⑮\ \ \ ))} = NA\ \text{LBS/MMBTU}$$

ACFM = 30.85 fps x 60s/m x 21.65 ft^2 = 40,074 ACFM
= 26,419 DSCFM

DSCFM = FRONT HALF GR: $\frac{(0.1052)(15.43)}{(28.31)} = 0.0573$ GR/SCFD

$\left(\frac{0.0573}{0.0594}\right)(13.4\ lbs/hr) = 12.9\ lbs/hr$

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ENVIRONMENTAL
SOURCE SAMPLERS

APPENDIX C - OPERATIONAL DATA

ESS
ENVIRONMENTAL
SOURCE SAMPLERS

WEYERHAEUSER - ELKIN, NORTH CAROLINA
OPERATIONAL DATA - DRYER/IONIZED WET SCRUBBER

UNIT #	1	1	1				
RUN #	1	2	3				
DATE	6-1-87	6-1-87	6-1-87				
TIME	1405	1555	1735				
DRYER RATE (%) (50% = MAX = 22,000 lb ODA/hr)	45	45	45				
DRYER INLET TEMP (°F)	1075	1075	1100				
DRYER OUTLET TEMP (°F)	245	245	245				
WET CELL (WET CELL to OMEC) %	80 (80)	80 (80)	85 (80)				
OIL BURNER	0	0	0				
SUSPENSION BURNER DAMPER (%) (WC/DB)	90	90	85				
VENTURRI PRESSURE DROP (IN. H2O)	2.6	2.6	2.6				
IWS PRESSURE DROP (IN. H2O)	0.0	0.0	0.0				
PRIMARY VOLTS, AMPS (A)	280, 17	300, 20	320, 23				
(B)	340, 24	330, 23	330, 22				
SECONDARY KV, MA (A)	25, 110	25, 115	26, 125				
(B)	25, 250	25, 250	26, 240				
	11.	15.	16.5				

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ENVIRONMENTAL
SOURCE SAMPLERS

APPENDIX D - LABORATORY DATA

ESS
ENVIRONMENTAL
SOURCE SAMPLERS

ANALYTICAL DATA

Plant Weyerhaeuser — FIR.K MTV Outlet 1
Date 6/1/87
Run No. 1
Filter No. 741 742
Amount liquid lost during transport 0
Acetone blank volume, ml 200
Acetone wash volume, ml 360
Acetone blank concentration, mg/mg (equation 5-4) 0.001
Acetone wash blank, mg (equation 5-5) 0.4

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED, g		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
1 741	0.4196	0.3461	0.0735
742	0.3943	0.3795	0.0148
2 IMP	71.5291	71.5233	0.0058
WASH	69.5118	69.5007	0.0111
TOTAL			0.1401
		Less acetone blank	0.0004
		Weight of particulate matter	0.1397

	VOLUME OF LIQUID WATER COLLECTED		
	IMPINGER VOLUME, ml.	SILICA GEL WEIGHT, g	
FINAL	360	276.5	
INITIAL	200	258.0	
LIQUID COLLECTED	160	18.5	
TOTAL VOLUME COLLECTED	178.5	g*	ml

* CONVERT WEIGHT OF WATER TO VOLUME BY DIVIDING TOTAL WEIGHT INCREASE BY DENSITY OF WATER (1g/ml):

$$\frac{\text{INCREASE, g}}{\text{1 g/ml}} = \text{VOLUME WATER, ml}$$

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ENVIRONMENTAL
SOURCE SAMPLERS

ANALYTICAL DATA

Plant Weyerhaeuser-Elkin MTV #1
Date 6/1/87
Run No. 2
Filter No. 743 & 744
Amount liquid lost during transport 0
Acetone blank volume, ml 200
Acetone wash volume, ml 410
Acetone blank concentration, mg/g (equation 5-4) 0.001
Acetone wash blank, mg (equation 5-5) 0.4

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED, g		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
1 743	0.3318	0.3470	0.0848
744	0.3705	0.3445	0.3260
2 IMP	71.3283	71.3226	0.0057
Filter	70.8283	70.8134	0.0149
TOTAL			0.1314
Less acetone blank			0.0004
Weight of particulate matter			0.1310

	VOLUME OF LIQUID WATER COLLECTED		
	IMPINGER VOLUME, ml.	SILICA GEL WEIGHT, g	
FINAL	366	271.0	
INITIAL	200	251.0	
LIQUID COLLECTED	166	20.0	
TOTAL VOLUME COLLECTED	186.0	g*	ml

* CONVERT WEIGHT OF WATER TO VOLUME BY DIVIDING TOTAL WEIGHT INCREASE BY DENSITY OF WATER (1g/ml).

$$\frac{\text{INCREASE, g}}{\text{1 g/ml}} = \text{VOLUME WATER, ml}$$

ESS
ENVIRONMENTAL
SOURCE SAMPLERS

ANALYTICAL DATA

Plant Weyerhaeuser Elk. R MTV Outlet F
Date 6/1/87
Run No. 3
Filter No. 745
Amount liquid lost during transport 0
Acetone blank volume, ml 200
Acetone wash volume, ml 340
Acetone blank concentration, mg/g (equation 5-4) 0.021
Acetone wash blank, mg (equation 5-5) 0.3

CONTAINER NUMBER	WEIGHT OF PARTICULATE COLLECTED, g		
	FINAL WEIGHT	TARE WEIGHT	WEIGHT GAIN
1 745	0.4280	0.3457	0.0853
2 IMP WASH	40.5561	70.5524	0.0037
	69.3710	69.3568	0.0202
TOTAL			0.1092
		Less acetone blank	0.0003
		Weight of particulate matter	0.1089

	VOLUME OF LIQUID WATER COLLECTED	
	IMPINGER VOLUME, ml.	SILICA GEL WEIGHT, g
FINAL	370	257.5
INITIAL	200	247.0
LIQUID COLLECTED	170	10.5
TOTAL VOLUME COLLECTED	180.5	g* ml

* CONVERT WEIGHT OF WATER TO VOLUME BY DIVIDING TOTAL WEIGHT INCREASE BY DENSITY OF WATER (1g/ml).

$$\frac{\text{INCREASE, g}}{1\ \text{g/ml}} = \text{VOLUME WATER, ml}$$

ESS

ENVIRONMENTAL
SOURCE SAMPLERS

APPENDIX E - CALIBRATION DATA

ESS

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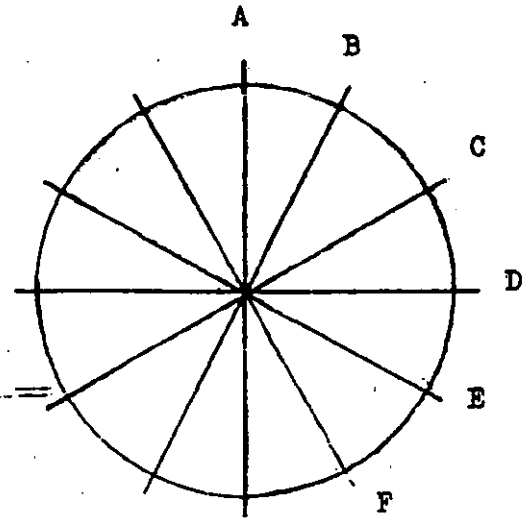
SOURCE SAMPLERS

NOZZLE MEASUREMENT DATA



A 0.265

B 0.265

C 0.263

D 0.264

E 0266

F 0.266

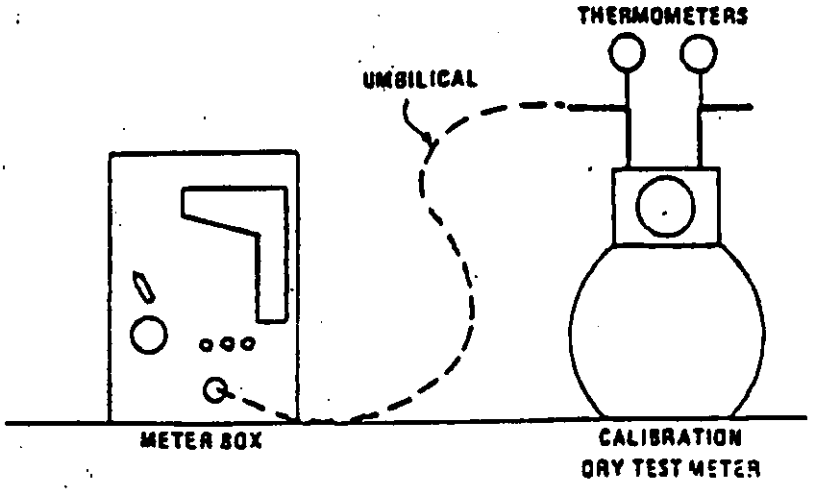
AVG. 0.265

DATE 6-1-87

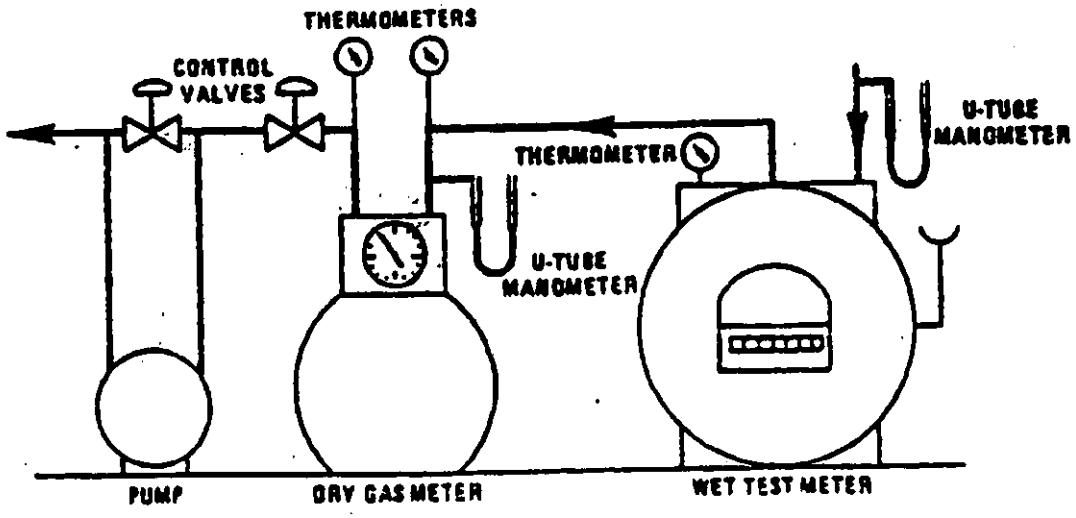
MEASURED BY R. Hamlin

ESS

ENVIRONMENTAL
SOURCE SAMPLERS



Meter box calibration set-up.



Equipment arrangement for dry-gas meter calibration.

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DRY GAS METER CALIBRATION

Date 5-22-87

Metering System Identification: S-Y

Barometric pressure, P_b = 29.50 in. Hg

Orifice manometer setting ΔH in. H_2O	Spirometer (wet meter) gas volume (V_w) ft^3	Dry gas meter volume (V_m) ft^3	Temperatures: Spirometer (wet meter) (t_w) °F	Temperatures: Dry Gas Meter Inlet (t_d) °F	Temperatures: Dry Gas Meter Outlet (t_1) °F	Temperatures: Dry Gas Meter Average (t_m) °F	Time (θ) min
1.0	6.410	6.477	74	—	—	85	12
2.5	6.701	6.832	74	—	—	90	8
4.0	6.331	6.512	74	—	—	96	6

Calculations

ΔH in. H_2O	Y: $\frac{V_w P_b (t_m + 460)}{V_m (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H_@$: $\frac{0.0317\ \Delta H}{P_b (t_m + 460)} \left[\frac{(t_w + 460)\theta}{V_w}\right]^2$
1.0	1.007	1.970
2.5	1.004	1.985
4.0	1.002	1.980
Average	1.004	1.978

Y • Ratio of reading of wet test meter to dry test meter; tolerance for individual values ±0.02 from average.

$\Delta H_@$ • Orifice pressure differential that equates to 0.75 cfm of air @ 68°F and 29.92 inches of mercury, in. H_2O; tolerance for individual values ±0.20 from average.

ESS
ENVIRONMENTAL
SOURCE SAMPLERS

DRY GAS METER CALIBRATION

Date 6-3-87 Metering System Identification: S-4

Barometric pressure, P_b = 29.53 in. Hg

Orifice manometer setting ΔH in. H_2O	Spirometer (wet meter) gas volume (V_w) ft^3	Dry gas meter volume (V_m) ft^3	Temperatures: Spirometer (wet meter) (t_w) °F	Temperatures: Dry Gas Meter: Inlet (t_o) °F	Temperatures: Dry Gas Meter: Outlet (t_i) °F	Temperatures: Dry Gas Meter: Average (t_m) °F	Time (θ) min
1.0	6.400	6.475	72	—	—	84	12
2.5	6.690	6.818	72	—	—	89	8
4.0	6.328	6.504	72	—	—	95	6

Calculations

ΔH in. H_2O	Y: $\frac{V_w P_b (t_m + 460)}{V_m (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	ΔH@: $\frac{0.0317\ \Delta H}{P_b (t_m + 460)} \left[\frac{(t_w + 460)\theta}{V_w}\right]^2$
1.0	1.006	1.966
2.5	1.004	1.981
4.0	1.003	1.971
Average	1.004	1.973

Y = Ratio of reading of wet test meter to dry test meter; tolerance for individual values ±0.02 from average.

ΔH@ = Orifice pressure differential that equates to 0.75 cfm of air @ 68°F and 29.92 inches of mercury, in. H_2O; tolerance for individual values ±0.20 from average.

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ENVIRONMENTAL
SOURCE SAMPLERS

TEMPERATURE SENSOR CALIBRATION DATA

Date 5-15-87 Thermocouple identification S-4D6m

Ambient temperature 82 Signature R. Hall

Calibration Source	Reference[1] Temperature, °F	Thermocouple Temperature, °F	Temperature[2] Difference (%)
ICE BATH	32	32	0.0
Room TEMP	82	82	0.0
WARM WATER	117	116	0.2

[1] mercury in glass ASTM thermometer

[2] $\frac{(\text{ref temp, °F} + 460) - (\text{test thermocouple temp, °F} + 460)}{\text{ref temp, °F}}$

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ENVIRONMENTAL
SOURCE SAMPLERS

TEMPERATURE SENSOR CALIBRATION DATA

Date 5-15-87 Thermocouple identification B4 inp

Ambient temperature 82 Signature R. Hurley

Calibration Source	Reference[1] Temperature, °F	Thermocouple Temperature, °F	Temperature[2] Difference (%)
ICE BATH	32	35	0.6
COOL WATER	60	65	1.0
ROOM TEMP	82	85	0.6

[1] mercury in glass ASTM thermometer

[2] $\frac{(\text{ref temp, }^{\circ}\text{F} + 460) - (\text{test thermocouple temp, }^{\circ}\text{F} + 460)}{\text{ref temp, }^{\circ}\text{F} + 460}$

ESS

ENVIRONMENTAL
SOURCE SAMPLERS

TEMPERATURE SENSOR CALIBRATION DATA

Date 5-15-87 Thermocouple identification S-Y Source

Ambient temperature 82 Signature R. Hudd

Calibration Source	Reference[1] Temperature, °F	Thermocouple Temperature, °F	Temperature[2] Difference (%)
Room Temp	82	82	0.0
Boiling Water	212	211	0.1
Hot Oil	392	391	0.1

[1] mercury in glass ASTM thermometer

[2] $\frac{(\text{ref temp, °F} + 460) - (\text{test thermom. temp, °F} + 460)}{\text{ref temp, °F} + 460}$

ENVIRONMENTAL
SOURCE SAMPLERS

TYPE S PITOT TUBE INSPECTION

PITOT TUBE IDENTIFICATION 6-1 DATE 1-17-87

PITOT TUBE ASSEMBLY LEVEL? Yes

PITOT TUBE OPENINGS DAMAGED? No

α_1 = 2.0° (<10°) α_2 = 4.0° (<10°)

β_1 = 4.0° (<5°) β_2 = 4.0° (<5°)

γ = 1.5° θ = 1.0° A = 1.122 in.

$z = A \sin\gamma$ = 0.0294 in. (<1/8 in.)

$w = A \sin\theta$ = 0.0196 in. (<1/32 in.)

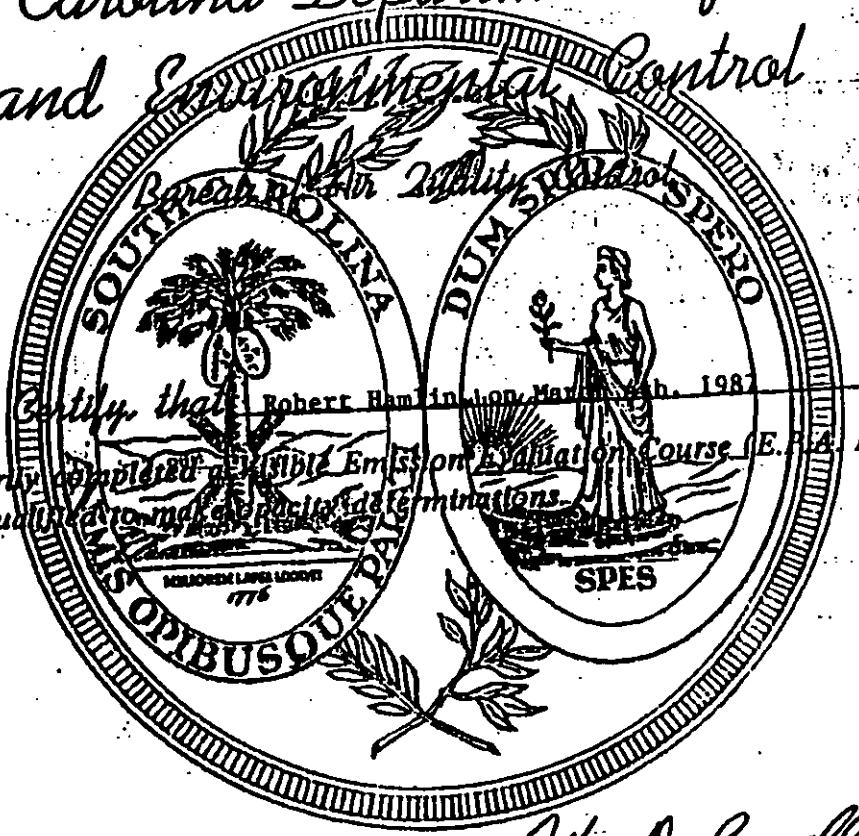
P_A 0.591 in.: P_b 0.516 in.

D_t = 0.382 in.

CALIBRATION REQUIRED? No

South Carolina Department of Health and Environmental Control

Bureau of Air Quality Control



This is to certify that Robert Hamlin on March 4th, 1987

satisfactorily completed the Visible Emission Evaluation Course (E.P.A. Method 9)
and is duly qualified to make opacity determinations.

Carlos O. Purnell

BUREAU OF AIR QUALITY CONTROL

NAME Robert Hamlin JR. RUN# 1W SUNGLASSES NO

COURSE LOCATION COLUMBIA, SC

DATE 3/4/87 SKY BLUE - CLEAR WIND S-10 NW/NE

DISTANCE AND DIRECTION TO STACK 80' N

VISIBLE EMISSIONS TEST SHEET

ING NUMBER	VALUE																				ERROR
1	0	5	10	15	20	25	30	35	40	45	(50)	55	60	65	70	75	80	85	90	95	100	1
2	0	5	10	15	(20)	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	2 1
3	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	3 1
4	0	5	10	15	20	25	30	35	40	(45)	50	55	60	65	70	75	80	85	90	95	100	4 2
5	0	5	10	15	20	25	30	35	40	45	(50)	55	60	65	70	75	80	85	90	95	100	5
6	0	5	10	15	20	25	30	35	40	45	50	55	60	65	(70)	75	80	85	90	95	100	6
7	0	5	(10)	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	7 1
8	0	5	10	15	20	(25)	(30)	35	40	45	50	55	60	65	70	75	80	85	90	95	100	8 1
9	0	5	10	15	20	25	30	35	40	(45)	(50)	55	60	65	70	75	80	85	90	95	100	9 1
10	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	10 1
11	0	5	10	15	20	(25)	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	11 1
12	0	5	10	15	20	25	30	35	40	45	50	55	(60)	65	70	75	(80)	85	90	95	100	12
13	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	13
14	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	14 1
15	0	5	10	15	20	25	30	35	40	45	50	(55)	60	65	70	75	80	85	90	95	100	15 1
16	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	16
17	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	17
18	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	18 1
19	0	5	10	15	20	25	30	35	40	(45)	50	55	60	65	70	75	80	85	90	95	100	19 2
20	0	5	10	15	20	25	30	35	40	45	(50)	55	60	65	70	75	80	85	90	95	100	20 1
21	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	21 1
22	0	5	10	15	20	25	30	(35)	40	45	50	55	60	65	70	75	80	85	90	95	100	22 1
23	0	5	10	(15)	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	23 1
24	0	5	10	15	20	(25)	(30)	35	40	45	50	55	60	65	70	75	80	85	90	95	100	24 1
25	0	5	10	15	20	25	30	35	(40)	(45)	50	55	60	65	70	75	80	85	90	95	100	25

DEVIATION 28

26	0	5	10	15	20	25	30	35	40	45	(50)	55	60	65	70	75	80	85	90	95	100	26
27	0	5	10	15	20	(25)	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	27
28	0	5	(10)	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	28 1
29	0	5	10	15	20	25	30	35	40	45	(50)	55	60	65	70	75	80	85	90	95	100	29 2
30	0	5	10	15	20	25	30	35	40	45	50	55	(60)	65	70	75	80	85	90	95	100	30
31	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	31 2
32	0	5	10	15	20	25	30	35	40	45	(50)	55	60	65	70	75	80	85	90	95	100	32 1
33	0	(5)	(10)	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	33 1
34	0	5	10	15	(20)	(25)	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	34 2
35	0	5	10	15	20	25	(30)	35	40	45	50	55	60	65	70	75	80	85	90	95	100	35 1
36	0	5	10	15	20	25	30	35	40	45	(50)	55	60	65	70	75	80	85	90	95	100	36 1
37	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	(80)	(85)	(90)	95	100	37
38	0	5	10	15	(20)	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	38 1
39	(0)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	39
40	0	5	10	15	20	25	(30)	35	40	(45)	50	55	60	65	70	75	80	85	90	95	100	40 3
41	0	5	10	15	20	25	30	35	40	(45)	50	55	60	65	70	75	80	85	90	95	100	41 1
42	0	5	10	15	20	25	30	(35)	40	45	50	55	60	65	70	75	80	85	90	95	100	42 2
43	0	5	10	15	20	25	30	(35)	40	45	50	55	60	65	70	75	80	85	90	95	100	43 2
44	0	5	10	15	20	25	30	35	40	45	50	55	(60)	65	70	75	80	85	90	95	100	44
45	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	(95)	100	45 1
46	0	5	10	15	20	(25)	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	46 1
47	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	47 2
48	0	5	10	(15)	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	48 2
49	0	5	10	15	20	(25)	30	(35)	40	45	50	55	60	65	70	75	80	85	90	95	100	49 2
50	(0)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	50

FINAL DEVIATION

DEVIATION 28