Background Report Reference

AP-42 Section Number: 9.6.1

Background Chapter: 4

Reference Number: 2

Title: Results of the December 28, 1988 Particulate Emission Compliance Test on the Rogers Dryer at the Land O'Lakes Plant Located in SPencer, Wisconsin

Interpoll Laboratories, Inc.

December 1988

AP-42 Section 9.6.1
Reference
Report Sect. 4
Reference 2

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RESULTS OF THE DECEMBER 28, 1988 PARTICULATE EMISSION COMPLIANCE TEST ON THE ROGERS DRYER AT THE LAND O' LAKES PLANT LOCATED IN SPENCER WISCONSIN

Drying Cheddar Cheese

Submitted to:

LAND O' LAKES
P.O. Box 116
Minneapolis, Minnesota 55440

Attention: Dale Harris

Approved by:

Kathleen Eickstadt

Kathleen Eickstadt
Senior Data Analyst
Field Testing Division

Report Number 8-2695
December 30, 1988
KE/klq

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ABBREVIATIONS

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

Standard conditions are defined as 68 °F (20 °C) and 29.92 IN. of mercury pressure.

1 INTRODUCTION

On December 28, 1988 Interpoll Laboratories personnel conducted a particulate emission compliance test on the Rogers Dryer at the Land O' Lakes Plant located in Spencer, Wisconsin. On-site testing was performed by E. Trowbridge and C. Mosser. Coordination between testing activities and plant operation was provided by Dale Harris of Land O' Lakes Inc. The test was witnessed by Neal Baudhuin of the Wisconsin Department of Natural Resources.

The dryer tested is a C. E. Rogers custom designed spray dryer. It is direct fired with natural gas and has a rated capacity of 1980 LB/HR of dry product. Particulate emissions from the dryer are controlled by a C. E. Rogers wet venturi scrubber.

Evaluations were performed in accordance with EPA Methods 1 - 5, CFR Title 40, Part 60, Appendix A (revised July 1, 1987). A preliminary determination of the gas linear velocity profile was made before the first particulate determination to allow selection of the appropriate nozzle diameter required for isokinetic sample withdrawal. An Interpoll Labs sampling train which meets or exceeds specifications in the above-cited reference was used to extract particulate samples by means of a heated glass-lined probe. Wet catch samples were collected in the back half of the Method 5 sampling train and analyzed as per Wisconsin DNR protocol.

An integrated flue gas sample was extracted simultaneously with each particulate sample using a specially designed gas sampling system. Integrated flue gas samples were collected in 44-liter Tedlar bags housed in a protective aluminum container. After sampling was complete, the bags were sealed and returned to the laboratory for Orsat analysis. Prior to sampling, the Tedlar bags are leak checked at 15 IN.HG. vacuum with an in-line rotameter. Bags with any detectable inleakage are discarded.

Testing on the Dryer was conducted from two test ports oriented at 90 degrees on the Stack. These test ports are located approximately twelve feet downstream of the nearest flow disturbance and approximately six feet upstream of the stack exit. A 24-point traverse was used to collect representative particulate samples. Each traverse point was sampled 2.5 minutes to give a total sampling time of 60 minutes per run.

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

2 SUMMARY AND DISCUSSION

The important results of the particulate emission compliance test are summarized in Table 1. As will be noted, the particulate emission rate averaged 5.4 LB/HR.

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

TABLE 1. Summary of the Results of the December 28, 1988 Particulate Emission Compliance Test on the Rogers Dryer at the Land O'Lakes Plant Located in Spencer, Wisconsin.

ITEM		Run 1	Run 2	Run 3
Date of test		12-28-88	12-28-88	12-28-88
Time runs were done	(HRS)	1308/1411	1445/1548	1605/1709
Process rate	(LB/HR) Cheddar Cheese	2005	2005	2005
Volumetric flow				
actual	(ACFM)	44985	45558	45960
standard	(DSCFM)	38171	38534	38062
Gas temperature	(DEG-F)	110	110	110
Moisture content	(%V/V)	4.33	4.65	6.62
Gas composition	(%V/V,dry)			
carbon dioxide		0.62	0.75	0.40
oxygen		20.18	20.28	20.42
nitrogen		79.20	78.97	79.18
Isokinetic variation	(%)	98.2	100.2	101.3
Particulate concentration				
actual	(GR/ACF)	.0154	.0129	.0129
standard	(GR/DSCF)	.0181	.0153	.0156
Part. emission rate	(LB/HR)	5.94	5.04	5.09

* Dry + organic/inorganic wet catch

3 RESULTS

The results of all field and laboratory evaluations are presented in this section. Gas composition (Orsat and moisture) are presented first followed by the computer printout of the particulate determinations. Preliminary measurements including test port locations are given in the appendices.

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

The particulate emission rate has been calculated using the product of the concentration times flow method (as recommended by the EPA) rather than the ratio of areas method.

Test No. 1
Rogers Dryer Stack

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

	Run 1	Run 2	Run 3
Date of run	12-28-88	12-28-88	12-28-88
Dry basis (orsat)			
carbon dioxide.....	0.62	0.75	0.40
oxygen.....	20.18	20.28	20.42
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.20	78.97	79.18
Wet basis (orsat)			
carbon dioxide.....	0.59	0.72	0.37
oxygen.....	19.31	19.34	19.07
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	75.77	75.29	73.94
water vapor.....	4.33	4.65	6.62
Dry molecular weight.....	28.91	28.93	28.88
Wet molecular weight.....	28.43	28.42	28.16
Specific gravity.....	0.982	0.982	0.973
Water mass flow.....(LB/HR)	4847	5277	7570

FO	1.161	0.827	1.200

Test No. 1
Rogers Dryer Stack

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

	Run 1	Run 2	Run 3
Date of run	12-28-88	12-28-88	12-28-88
Time run start/end.....(HRS)	1308/1411	1445/1548	1605/1709
Static pressure.....(IN.WC)	-0.28	-0.28	-0.28
Cross sectional area (SQ.FT)	19.31	19.31	19.31
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	20.0	27.0	44.0
desiccant.....(GRAMS)	16.0	13.0	14.0
total.....(GRAMS)	36.0	40.0	58.0
Total particulate material..			
.....collected(grams)	0.0441	0.0382	0.0390
Gas meter coefficient.....	1.0045	1.0045	1.0045
Barometric pressure..(IN.HG)	28.65	28.65	28.65
Avg. orif.pres.drop..(IN.WC)	1.35	1.45	1.46
Avg. gas meter temp..(DEF-F)	76.9	81.6	86.3
Volume through gas meter....			
at meter conditions...(CF)	39.52	41.06	41.35
standard conditions.(DSCF)	37.50	38.63	38.57
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.243	.243	.243
Avg.stack gas temp ..(DEG-F)	110	110	110
Volumetric flow rate.....			
actual.....(ACFM)	44985	45558	45960
dry standard.....(DSCFM)	38171	38534	38862
Isokinetic variation.....(%)	98.2	100.2	101.3
Particulate concentration...			
actual.....(GR/ACF)	0.01539	0.01290	0.01292
dry standard.....(GR/DSCF)	0.01815	0.01526	0.01560
Particle mass rate...(LB/HR)	5.94	5.04	5.09

APPENDIX A

RESULTS OF PRELIMINARY VOLUMETRIC FLOW RATE DETERMINATIONS

Interpoll Report No. 8-2695
Land O'Lakes Inc
Spencer, Wisconsin

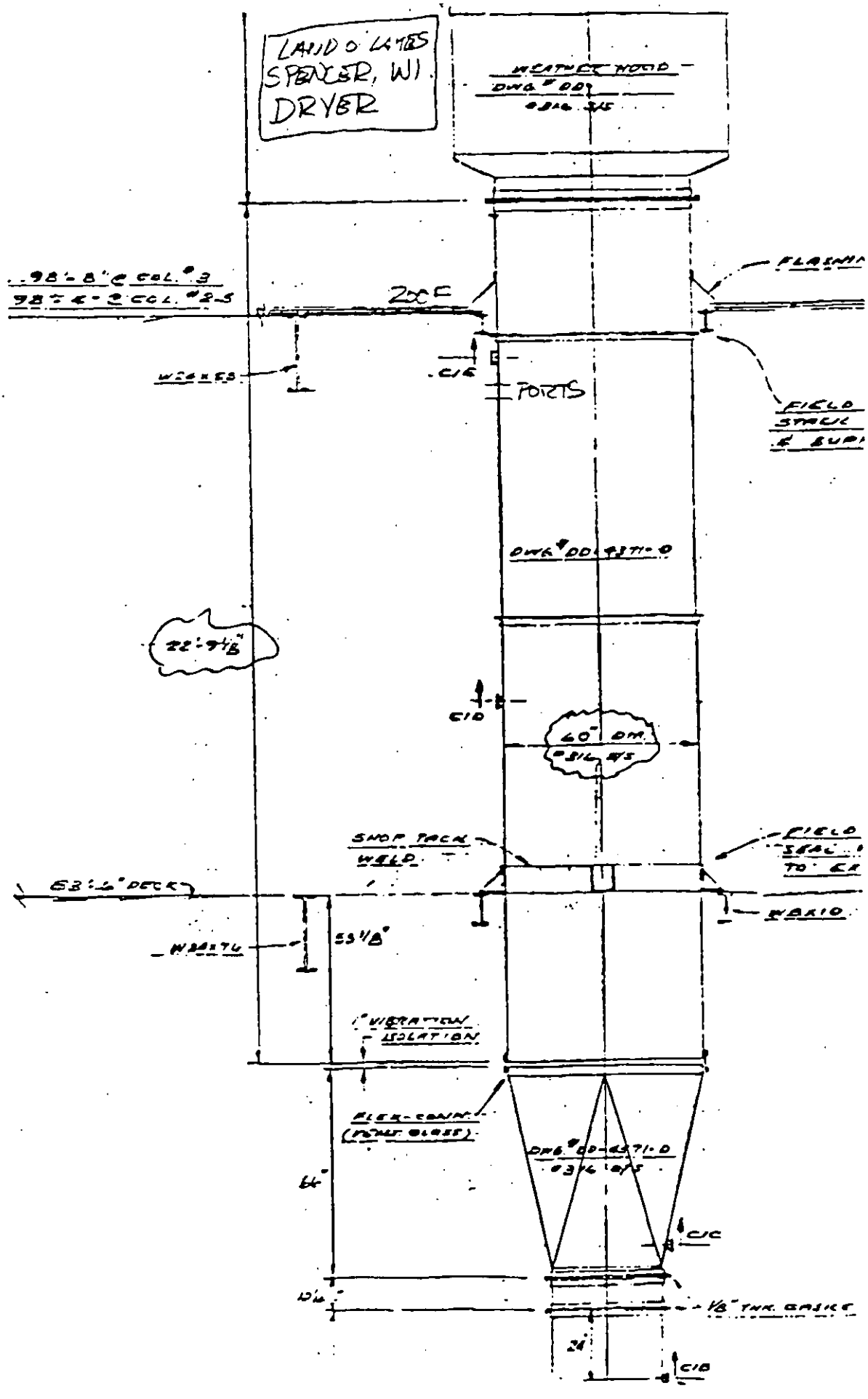
Test No. 1
Rogers Dryer Stack

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

Date of Determination.....	12-28-88
Time of Determination.....(HRS)	1145
Barometric pressure.....(IN.HG)	28.65
Pitot tube coefficient.....	.84
Number of sampling ports.....	2
Total number of points.....	24
Shape of duct.....	Round
Stack diameter.....(IN)	59.5
Duct area.....(SQ.FT)	19.31
Direction of flow.....	UP
Static pressure.....(IN.WC)	-.28
Avg. gas temp.....(DEG-F)	110
Moisture content.....(% V/V)	4.33
Avg. linear velocity.....(FT/SEC)	39.0
Gas density.....(LB/ACF)	.06545
Molecular weight.....(LB/LBMOLE)	28.91
Mass flow of gas.....(LB/HR)	177266
Volumetric flow rate.....	
actual.....(ACFM)	45141
dry standard.....(DSCFM)	38279

APPENDIX B

LOCATION OF TEST PORTS


LAND O' LAKES
SPENCER, WI
DRYER
WEATHER HOOD
DWG # DD-
98'-8" C COL. #3
98'-6"-2 COL. #2-5
20'-0"
FLASHING
WELDED
C/C
POINTS
FIELD STACK & SUPP
DWG # DD-437-0
22'-9 1/8"
C/C
40" DIA.
SHOP TACK WELD
FIELD SEAL TO EA
63'-6" DECK
W 8 X 10
W 8 X 24
53 1/8"
4" VIBRATION ISOLATION
FLEX-CONN. (POINT BLOSS)
DWG # DD-437-0
44"
C/C
10 1/4"
1/8" THK. GASKET
24"
C/C

APPENDIX C

METHODS 2 - 5 FIELD DATA SHEETS

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job LAND O'LAKES, SPENCER, WISC

Source Rogers DRYER

Test 1 Run 1 Date 12-28-88

Stack dimen. 59½ IN.

Dry bulb 119 °F Wet bulb ____ °F

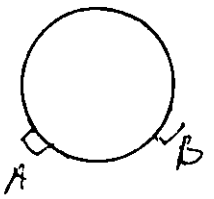
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.

Barometric pressure 29.65 in Hg

Static pressure -.28 in WC

Operators E. TREWBRIDGE - C. MOSSOR

Pitot No. 21-6 Cp .840



Schematic of Cross Section

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length: 4 in.		Time start: 1145 hrs	
A 1	.021	1.25	5.25	.23	108
2	.067	3.99	7.99	.31	105
3	.118	7.02	11.02	.3√	110
4	.177	10.53	14.53	.34	110
√	.250	14.87	18.87	.37	110
6	.356	21.18	25.18	.37	110
7	.644	38.32	42.32	.44	110
8	.750	44.63	48.63	.52	110
9	.823	48.97	52.96	.55	110
10	.882	52.48	56.48	.56	110
11	.933	55.51	59.51	.40	110
12	.979	58.25	62.25	.54	110
B 1				.44	108
2				.51	108
3				.56	110
4				.53	110
5				.52	110
6				.45	110
7				.36	110
8				.36	110
9				.3√	110
10				.3√	110
11				.34	110
12				.29	110
Temp. meas. tool & S/N: PDF-4				Time end: 1200 hrs	

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

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LAND O'LAKES Date 12-28-88 Test 1 Run 1
Source ROGERS DRYER STACK No. of traverse points 24
Method 5 Filter holder: GLASS Filter type: 4" GLASS FIBER

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☑
Postest: 0 cfm at ✓ in. Hg. (vac) ☑

Particulate Catch Data:

No.s of filters used: 0624

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

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

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	115	100	15
Impinger No. 2	105	100	5
Impinger No. 3	0	0	0
Condenser			
Desiccant	1332	1316	16
Total			36

Integrated Gas Sampling Data:

Bag Pump No. 86 Box No. 1 Bag No. 1

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

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

Time start: 1309 (HRS) Time end: 1410 (HRS)

Sampling rate: 400 cc/min Operator: ET

S/N of O_2 Analyzer used to monitor train outlet: 6

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job LAND O'LAKES
Source RISERS DRYER STACK
Date 12-24-88 Test 1 Run 1

Operators ELLOWBridge-GAESSER
Meter Box No. 8 ΔH@ 1.82 IN WC
Calibration coeff.: 1.0045

Pitot No. 21-6 Cp .840
Bar. Press. 28.65 inHg H2O x
Nozzle No. 8-4 Nozzle Dia .293 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgm. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Dryer	Impg.	Gas/In	Gas/Out	Oxygen (v/v)
	308	322.00											
B 12	2.5	325.75	.47	1.47	3.71	3.5	110	245	240	56	70	68	20.4
11	✓	329.57	.54	1.69	7.55	3.8	110				74	68	20.4
10	7.5	327.45	.55	1.74	7.42	3.8	110				78	68	20.3
9	10	329.28	.52	1.64	9.24	3.7	110	235	230	59	80	70	20.3
8	12.5	330.99	.47	1.49	0.97	3.5	110				80	70	20.3
7	15	332.50	3.5	1.11	2.47	2.5	110				80	70	20.3
6	17.5	333.98	.33	1.05	3.93	2.5	110	240	235	60	80	70	20.3
5	20	335.40	34	1.08	5.40	2.5	110				80	70	20.2
4	22.5	336.80	.30	.95	6.79	2.1	110				80	70	20.2
3	25	338.16	.29	.92	8.16	2.0	110	240	240	60	80	70	20.2
2	27.5	339.56	.30	.95	9.55	2.0	108				80	70	20.2
1	30	340.82	.25	.79	0.82	2.0	108				82	72	20.2
A 12	32.5	342.40	.38	1.21	2.38	2.8	110	240	240	60	82	72	20.2
11	35	343.90	.35	1.11	3.89	2.5	110				84	72	20.2
10	37.5	345.44	.35	1.11	5.40	2.5	110				84	72	20.2
9	40	346.99	.37	1.18	6.94	2.6	110	240	240	58	84	74	20.1
8	42.5	348.50	.36	1.15	8.48	2.6	110				84	74	20.1
7	45	350.10	.39	1.24	0.07	3.0	111				84	74	20.2
6	47.5	352.00	.56	1.79	1.97	3.8	110	240	240	60	86	76	20.2
5	50	353.83	.52	1.67	3.82	3.7	110				86	76	20.2
4	52.5	355.75	.55	1.76	5.72	3.8	110				86	76	20.2
3	55	357.68	.56	1.80	7.63	4.0	108	245	240	60	86	76	20.2
2	57.5	359.40	.54	1.74	9.51	3.9	108				86	76	20.2
1	60	361.52	.54	1.74	1.40	3.9	108				86	76	20.2
	(14 11)												
	θ = 60	Vm = 39.52		ΔH = 1.35							Avg. = 72.9		

C-3

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LAND O'LAKES
Source AOGOLS DRYER STACK
Method 5 Filter holder: GLASS
Date 12-28-88 Test 1 Run 2
No. of traverse points 24
Filter type: 4" GLASS FIBER

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
Postest: 0 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 0649

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

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

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	120	100	20
Impinger No. 2	107	100	7
Impinger No. 3	0	0	0
Condenser			
Desiccant	1260	1247	13
Total			40

Integrated Gas Sampling Data:

Bag Pump No. 86 Box No. 1 Bag No. 2

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

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

Time start: 1446 (HRS) Time end: 1547 (HRS)

Sampling rate: 400 cc/min Operator: ET

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

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job LAND O'LAKES
Source RAGER DRYER STACK
Date 12-28-88 Test 1 Run 2

Operators ET-CM.
Meter Box No. 8 ΔH 1.82 IN WC
Counter coeff. 1.0095

Pitot No. 21-6 Cp .840
Bar. Press. 28.65 inHg H2O .5 x
Nozzle No. 6-4 Nozzle Dia .203 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgs. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (x v/v)
	1445	361.90											
A 12	2.5	363.52	.37	1.24	3.50	2.9	110	240	240	56	78	76	20.4
11	5	365.10	.35	1.16	5.03		110				80	76	20.2
10	7.5	366.55	.32	1.06	6.50	2.5	110				82	76	20.2
9	10	368.10	.37	1.23	8.08	3.0	110	240	240	58	84	76	20.1
8	12.5	369.66	.36	1.20	9.65	3.0	110				86	76	20.2
7	15	371.27	.38	1.27	11.26	3.2	110				86	76	20.2
6	17.5	373.20	.55	1.83	13.19	4.0	110	240	250	60	86	76	20.1
5	20	375.12	.53	1.77	15.09	4.0	110				86	78	20.0
4	22.5	377.00	.56	1.87	17.04	4.2	110				86	78	20.0
3	25	379.02	.56	1.87	19.00	4.2	110	240	250	60	86	78	20.0
2	27.5	380.93	.55	1.84	20.94	4.1	108				86	78	20.0
1	30	382.86	.54	1.81	22.86	4.0	108				86	78	20.1
B 12	32.5	384.70	.48	1.60	24.67	3.8	110	240	250	60	86	78	20.0
11	35	386.60	.54	1.80	26.59	4.0	110				86	78	20.1
10	37.5	388.50	.54	1.80	28.51	4.0	110				86	78	20.0
9	40	390.45	.55	1.83	30.45	4.1	110	240	250	60	86	78	20.1
8	42.5	392.40	.57	1.90	32.42	4.4	110				86	78	20.1
7	45	394.18	.45	1.50	34.17	3.7	110				86	78	20.1
6	47.5	395.75	.36	1.20	35.74	3.1	110	240	250	60	86	78	20.0
5	50	397.26	.34	1.13	37.27	3.0	110				86	78	20.0
4	52.5	398.73	30	1.00	38.71	2.7	108				88	80	20.0
3	55	400.14	.29	.97	40.12	2.6	108	240	250	60	88	80	20.0
2	57.5	401.54	.30	1.01	41.56	2.7	108				88	80	20.0
1	60	402.96	.28	.94	42.96	2.6	108				88	80	20.1
	(1548)												
	θ = 60	Vm = 41.06		ΔH = 1.45							Avg. = 81.6		

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LAND O'LAKES — Date 12-28-88 Test 1 Run 3
Source ROGERS DRYER STACK — No. of traverse points 24
Method 5 Filter holder: GLASS — Filter type: 4" GLASS FIBER

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☑
Postest: 0 cfm at ✓ in. Hg. (vac) ☑

Particulate Catch Data:

No.s of filters used: 0667

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

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

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	140	100	40
Impinger No. 2	104	100	4
Impinger No. 3	0	0	0
Condenser			
Desiccant	1346	1332	14
Total			58

Integrated Gas Sampling Data:

Bag Pump No. B6 Box No. ✓ Bag No. 3

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

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

Time start: 1606 (HRS) Time end: 1708 (HRS)

Sampling rate: 400 cc/min Operator: ET

S/N of O_2 Analyzer used to monitor train outlet: 6

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job GAND O'LAKES
Source Boiler's Dryer Stack
Date 12-29-88 Test 1 Run 3

Operators ET-CM
Meter Box No. 8 ΔH 1.82 IN WC
Coeficient coeff. 1.0045

Pitot No. 7-6 Cp .841
Bar. Press. 28.60 inHg H2O x
Nozzle No. S-4 Nozzle Dia .243 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas In	Gas Out	Oxygen (x v/v)
	60	403.20											
B 12	2.5	405.20	.48	1.60	5.00	4.0	110	240	240	58	82	80	19.9
11	5	406.90	.55	1.93	6.93	4.2	110				84	80	19.9
10	7.5	408.90	.58	1.93	8.92	4.4	110				86	80	20.0
9	10	410.82	.54	1.80	0.84	4.3	110	240	245	60	86	80	19.9
8	12.5	412.67	.49	1.64	2.67	4.0	110				84	80	20.0
7	15	414.40	.42	1.40	4.37	3.7	110				80	80	19.9
6	17.5	416.00	.38	1.27	5.98	3.3	110				86	80	19.9
5	20	417.52	.33	1.10	7.44	3.0	110				88	80	19.9
4	22.5	419.20	.35	1.17	9.04	3.1	110				88	80	19.9
3	25	420.50	.32	1.07	0.53	3.0	108	240	245	60	88	80	20.0
2	27.5	422.00	.32	1.07	2.02	3.0	108				88	80	20.0
1	30	423.42	.30	1.01	3.46		108				86	80	19.9
A 12	32.5	425.20	.35	1.17	5.01	3.1	110	240	245	60	88	80	19.9
11	35	426.55	.36	1.20	6.59	3.1	110				88	80	19.9
10	37.5	428.10	.34	1.14	8.12	3.0	110				88	80	19.9
9	40	429.62	.34	1.14	9.65	3.0	110	240	245	60	88	80	19.9
8	42.5	431.25	.36	1.20	1.22	3.3	110				88	80	20.0
7	45	432.86	.39	1.30	2.86	3.4	110				88	80	19.9
6	47.5	434.80	.56	1.87	4.82	4.2	110	240	245	62	88	80	20.0
5	50	436.77	.55	1.84	6.76	4.2	110				90	82	19.9
4	52.5	438.70	.55	1.85	8.71	4.2	110				90	82	20.0
3	55	440.66	.56	1.88	0.68	4.3	110	240	245	62	90	82	20.0
2	57.5	442.60	.54	1.81	2.61	4.3	110				90	82	20.0
1	60	444.55	.54	1.82	4.55	4.3	108				90	82	20.0
	(1209)												
	θ = 10	Va = 41.35		ΔH = 1.46							Avg. = 86.3		

C-7

APPENDIX D

LABORATORY DATA SHEETS

Interpoll Laboratories
(612) 786-6020

7207

Chain of Custody
Sample Deposition Sheet

Job LAND O LAKES
Team Leader E Trawinski
Date Submitted 12-28-88
Test No. 1

Source Kraft Dryer
Test Site Stack
Date of Test 12-28-88
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
4	Probe Wash: ☒ Acetone ☐ D.I. Water	☒ As per EPA M-5 ☐ Other _____	
4	Filter: ☒ 4" G.F. ☐ S.S. Thimble ☐ 2.5" G.F. ☐ 47 mm G.F.	☒ As per EPA M-5 ☐ As per EPA M-17 ☐ Other _____	
4	Impinger Catch: ☒ D.I. Water ☐ 3% H_2O_2 ☐ 4M5 Hg Only ☐ 4M5 Metals ☐ 1.0 N NaOH ☐ Other _____	☐ MN Protocol ☒ WI Protocol ☐ EPA M-6 or 8 ☐ Acid Gases ☐ Formaldehyde ☐ Metals ☐ Other _____	
3	Integrated Gas sample	☒ As per EPA M-3 ☐ As per EPA M-10 ☐ Other _____	
	Oxides of Nitrogen (NO_x)	☐ As per EPA M-7A ☐ Other _____	Date _____ Time (HRS) _____
	☐ Fuel Sample ☐ Aggregate	☐ Attached fuel Form #S-016ZRRR	
	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☐ Other _____	
	Audit Samples ☐ Sulfur Dioxide ☐ Oxides of Nit. ☐ Other _____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other _____	

Source Information

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

_____

S-278RRRR

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job Land O'Lakes
Team Leader ET
Date Submitted
Test No. 1
Date of Analysis 2-27-88

Source Roger Dryer
Test Site Stack
Date of Test 12-26-88
No. of Runs Completed 3
Technician Mark Keshler

Test/ Run	Sample Log Number and Type	No. of An.	Buret Readings (ml) Zero Pt.	After CO_2	After O_2	Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
1/1		1	0.00	0.62	20.80	0.62	20.18	1.161
	7207-07	2	0.00	0.62	20.80	0.62	20.18	1.161
	☑ B ☐ F	Avg				0.62	20.18	
1/2		1	0.00	0.75	21.03	0.75	20.28	0.827
	-11	2	0.00	0.75	21.03	0.75	20.28	0.827
	☑ B ☐ F	Avg				0.75	20.28	
1/3		1	0.00	0.40	20.82	0.40	20.42	1.200
	-15	2	0.00	0.40	20.82	0.40	20.42	1.200
	☑ B ☐ F	Avg				0.40	20.42	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

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

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

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

EPA Method 3 Guidelines

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

LSC-04-BR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Impinger Catch/Wisconsin Protocol

Job: Land O'Lakes — Source: Rogers Dryer
Team Leader: ET — Test Site: Stack
Date Submitted: — Date of Test: 12-28-88
Test No.: 1 — No. of Runs Completed: 3
Date of Analysis: 12-29-88 — Technician: Mark Koehler

		Solvent Phase	Aqueous Phase
0	Test 1 Run 0 Field Blank Log Number 7207-03 Comments	Dish No. 49 Dish Tare Wt. 48.6894 g Dish+Sample Wt. 48.6894 g Sample Wt. 0.0000 g	Dish No. 63 Dish Tare Wt. 43.8738 g Dish+Sample Wt. 43.8739 g Sample Wt. 0.0001 g
1	Test 1 Run 1 Log Number Comments -06	Dish No. 54 Dish Tare Wt. 46.6442 g Dish+Sample Wt. 46.6485 g Sample Wt. 0.0043 g	Dish No. 65 Dish Tare Wt. 46.9748 g Dish+Sample Wt. 46.9770 g Sample Wt. 0.0022 g
2	Test 1 Run 2 Log Number -10 Comments	Dish No. 55 Dish Tare Wt. 47.7723 g Dish+Sample Wt. 47.7783 g Sample Wt. 0.0010 g	Dish No. 66 Dish Tare Wt. 48.3084 g Dish+Sample Wt. 48.3120 g Sample Wt. 0.0036 g
3	Test 1 Run 3 Log Number -14 Comments	Dish No. 58 Dish Tare Wt. 50.2237 g Dish+Sample Wt. 50.2266 g Sample Wt. 0.0029 g	Dish No. 69 Dish Tare Wt. 47.9879 g Dish+Sample Wt. 47.9909 g Sample Wt. 0.0030 g
4	Test Run Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g
5	Test Run Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g

Results Solvent Phase: Blank Solvent Wt. ____ g

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
0.0000	0.0043	0.0010	0.0029 D-3		

Results Aqueous Phase:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
0.0001	0.0021	0.0035	0.0029		

LSC-03WYR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job Land O'Lakes
Team Leader ET
Date Submitted
Test No. 1
Date of Analysis 12-29-88
Transport Leakage [x] None [ ] ml

Source Roger Dryer
Test Site Stack
Date of Test 12-28-88
No. of Runs Completed 3
Technician Mark Gaebler
Solvent Acetone

0	Test 1 Run 0 Field Blank Log Number 7207-01 Vol. of Solvent 150 ml *Solvent Residue 2.0 ug/ml	Dish No. 2 Dish Tare Wt. 46.7646 g Dish+Sample Wt. 46.7649 g Sample Wt. 0.0003 g
1	Test 1 Run 1 Vol. of Solvent 140 ml Log Number -04 Comments	Dish No. 5 Dish Tare Wt. 45.2256 g Dish+Sample Wt. 45.2464 g Sample Wt. 0.0208 g
2	Test 1 Run 2 Vol. of Solvent 120 ml Log Number -08 Comments	Dish No. 8 Dish Tare Wt. 46.6985 g Dish+Sample Wt. 46.7179 g Sample Wt. 0.0194 g
3	Test 1 Run 3 Vol. of Solvent 70 ml Log Number -12 Comments	Dish No. 23 Dish Tare Wt. 42.8535 g Dish+Sample Wt. 42.9725 g Sample Wt. 0.0190 g
4	Test Run Vol. of Solvent ml Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g
5	Test Run Vol. of Solvent ml Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g

*Solvent Residue 2.0 ug/ml = [(Sample Wt. 0.0003 g)(106)]/Vol. of Sol. 150 ml
EPA-M5 Acetone Residue Blank Spec. ≤ 7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0205	0.0192	0.0189		

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job: Land O'Lakes
Team Leader: CT
Date Submitted:
Test No.: 1
Date of Analysis: 12 29-88

Source: Rogers Dryer
Test Site: Stack
Date of Test: 12-28-88
No. of Runs Completed: 3
Technician: Mark Koehler

0	Test 1 Run 0 Field Blank Log Number 7207-02 Comments	Filter No. 0650 Filter Type 4" Filter Tare Wt. 0.9292 g Filter+Sample Wt. 0.9292 g Sample Wt. 0.0000 g
1	Test 1 Run 1 Log Number -05 Comments	Filter No. 0624 Filter Type 4" Filter Tare Wt. 0.9548 g Filter+Sample Wt. 0.9720 g Sample Wt. 0.0172 g
2	Test 1 Run 2 Log Number -09 Comments	Filter No. 0649 Filter Type 4" Filter Tare Wt. 0.9354 g Filter+Sample Wt. 0.9499 g Sample Wt. 0.0145 g
3	Test 1 Run 3 Log Number -13 Comments	Filter No. 0667 Filter Type 4" Filter Tare Wt. 0.9489 g Filter+Sample Wt. 0.9632 g Sample Wt. 0.0143 g
4	Test Run Log Number Comments	Filter No. Filter Type Filter Tare Wt. g Filter+Sample Wt. g Sample Wt. g
5	Test Run Log Number Comments	Filter No. Filter Type Filter Tare Wt. g Filter+Sample Wt. g Sample Wt. g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0172	0.0145	0.0143		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0441	0.0382	0.0390		

LSC-02PR

APPENDIX E

PROCESS DATA

DATE: 12-28-98 LOT NO: 83631X PRODUCT: 49221 DRYER: Rogers STARTED SPRAYING: 5:45 am

NO. OF NOZZLES: 4 CORE SIZE: ORIFICE: 1-48, 2-49, 1-52 w/so FINISHED SPRAYING: 10:5

TOTAL POUNDS PRODUCED: HOURS DRYING: PRODUCTION PER HOUR: POUNDS REWORK:

TIME	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	:	:	:	:	:	:
HOMOGENIZER PRESSURE	8200	8100	7900	8200	8200	8100	8300	8400	8200	8200	8100	8400	8000	8200	8200	8400						
H.P.P. PRESSURE LBS.	7200	7100	6900	7200	7200	7100	7200	7000	7200	7200	7100	7100	7000	7200	7200	7200						
DRYER INLET AIR °F.	282	281	281	280	280	280	285	280	278	278	278	281	282	276	281	280						
DRYER EXHAUST AIR °F.	188	189	189	182	187	187	190	189	187	187	187	187	190	188	187	185						
FLUID BED DRYER °F.	501		529		519	—	538		533		513		486		520							
FLUID BED COOLER °F.	39.7		361		349	-	36.8		367		355		343		342							
POWDER PACKAGE °F.																						
POWDER PACKAGE NO.	441	462	482	502	522	549	567	584	601	621	642	662	682	705	725	748	775					
POWDER % MOISTURE	2.6	2.5	2.6	2.6	2.6	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.4	2.6						
Digital % MOISTURE																						
SLURRY °F.	146	147	145	146	146	142	146	146	146	146	145	145	145	145	145	145						
SLURRY BATCH NO.	118	122	127	132	137	142	148	152	160	165	168	174	180	184	A2	—						
SLURRY % TOTAL SOLIDS																						
SLURRY % BUTTER FAT																						
Final bed																						
Exhaust																						
Vacuum	-.7	-.8	-.8	-.7	-.7	-.8	-.7	-.6	-.7	.7	.7	.7	.7	.6	.6	.6	-					

OPERATOR - - DRYER

OPERATOR - - COOKER

OPERATOR - - PACKAGE

COMMENTS:

DATE: 12-28-88 LOT NO: 83631K PRODUCT: 4G221 DRYER: Krayer STARTED SPRAYING: 5:45AM

NO. OF NOZZLES: 4 CORE SIZE: ORIFICE: 1 4G22-2.48SD-1.525D FINISHED SPRAYING: 1:55

TOTAL POUNDS PRODUCED: 38750 HOURS DRYING: 19.33 PRODUCTION PER HOUR: 2005 POUNDS REWORK: 1314

TIME	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30
HOMOGENIZER PRESSURE	8200	8200	8200	8200	8100	8000	8100	8200	8100	8200	8300	8200	8100	8300	8100	8100	8100	8100	8100	8100	8200	8200
H.P.P. PRESSURE LBS.	7200	7100	7200	6900	7100	7000	7000	7800	7100	7200	7300	7200	7100	7200	7000	7100	7100	7100	7000	7100	7000	7200
DRYER INLET AIR °F.	286°	282°	280°	280°	284°	281°	281°	285°	287°	285°	285°	286°	287°	285°	285	285°	281°	284°	283°	283	283	283
DRYER EXHAUST AIR °F.	185	191°	185°	187°	190	187°	186°	188°	188°	189°	187	188	187°	188	189°	187°	188	187°	188°	187°	189°	188°
FLUID BED DRYER °F.	52.4		50.8		53.1		52.8		51.3		50.0		51.0		52.7		52.8		53.0		51.4	-
FLUID BED COOLER °F.	32.3		31.2		35.1		35.6		34.6		34.1		34.5		36.7		36.0		35.1		33.5	-
POWDER PACKAGE °F.																						
POWDER PACKAGE NO.	1	17	34	51	71	91	111	129	150	170	190	211	234	252	273	293	311	330	351	374	401	421
POWDER % MOISTURE	2.7	2.6	2.6	2.6	2.7	2.7	2.6	2.7	2.6	2.6	2.7	2.6	2.7	2.6	2.7	2.6	2.6	2.6	2.5	2.6	2.5	2.5
Digital % Moisture	Disconnected																					
SLURRY °F.	150°	150°	150	150	150°	150	150	150	146°	148°	147°	147	147	148	149	149°	146°	145	146	146	145°	146
SLURRY BATCH NO.	8	13	18	24	31	35	40	45	50	55	60	65	71	75	82	85	90	94	99	104	108	113
SLURRY % TOTAL SOLIDS																						
SLURRY % BUTTER FAT																						
FLUID BED TOP / BOTTOM	.3/.6		.3/.6		.3/.6		.3/.6		.3/.6		.3/.7		.3/.6		.3/.6		.3/.7		.3/.9		.3/.7	
Vacuum	-.7	-.7	-.8	-.6	-.6	-.6	-.6	-.7	-.6	-.7	-.6	-.7	-.7	-.8	-.7	-.9	-.7	-.8	.9	.8	-.7	-.8

OPERATOR - - DRYER

OPERATOR - - COOKER

OPERATOR - - PACKAGE

COMMENTS: SP 186°
7:13 am 0 -1°(187)

[illegible]

·23 OCTOBER 1987

SCRUBBER DATA LOG

TO DETERMINE PSYCHROMETRIC CONTACT EFFICIENCY

P①

Line		Symbol	12:28 (Before start Test AM)	12:28
	DATE / TIME		10 USAM	12:35 PM
1	AIR °FDB TO BURNER	t_2	22°	22°
2	AIR %RH " "	%RH	43%	44%
3	AIR °FDB FROM BURNER	t_3	287°	295°
4	GAS PRESS. TO ORIFICE	P_1	13 to 14	13 to 14
5	ORIFICE ΔP	ΔP	2.5	2.6
6	SLURRY %TS	—	42.8	42.6
7	POWDER #/hr	—	2000	2100
8	POWDER %M	—	2.6	2.7
9	AIR °FDB, CHMB. EXIT	T_1	200°	198°
10				
11	AIR °FDB F.BED SUP., COLD	TFBC	35.4	34.5
12	" " " " R'HT.	TFBH	54.5	53.6
13	AIR " F.BED EXH.	TFBE	73°	73°
14				
15	AIR °FDB, MIX TO VENTURI	TSD1	187°	185°
16	" " SCRUB. STACK	TSD2	101°	101°
17				
18	CIRC. WATER TEMP	TW	93°	93°
19	PRESS. TO SPRAYS	PW	60	60
20				
21	SOLIDS RECOVERED, #/hr	—		
22	SOLIDS TO VENTURI "	—		
23	SOLIDS OUT STACK, "	—		
24				
25				
26				
27				
28				
29				
30				

L15 CAN BE CALCULATED IF THERMOM. NOT AVAILABLE

L22 & 23 NOT NORMALLY AVAILABLE EXCEPT VIA "STACK TEST"

'23 OCT 86

SCRUBBER DATA LOG
TO DETERMINE PSYCHROMETRIC CONTACT EFFICIENCY

P①

LINE		SYMBOL	12-28	12-23	12-20
	DATE / TIME		1:45 PM	4:45 PM	7:45 PM
1	AIR °FDB TO BURNER	t_2	22°	21°	21°
2	AIR %RH " "	%RH	45%	45%	45%
3	AIR °FDB FROM BURNER	t_3	285°	282°	280°
4	GAS PRESS. TO ORIFICE	P_1	13-13.5	13	13
5	ORIFICE ΔP	ΔP	2.5	2.6	2.4
6	SLURRY %TS	—	42.4	42.8	42.9
7	POWDER #/hr	—	2050	2750*	2000
8	POWDER %M	—	2.6	2.5	2.6
9	AIR °FDB, CHMB. EXIT	T_1	197°	196°	192°
10					
11	AIR °FDB, F.BED SUP., COLD	T_{FBC}	35.6	34.5	34.8
12	" " " ", R'HT.	T_{FBH}	52.3	50.5	51.7
13	AIR " , F.BED EXH.	T_{FBE}	72°	77°	75°
14					
15	AIR °FDB, MIX TO VENTURI	T_{SD1}	185°	185°	185°
16	" " , SCRUB. STACK	T_{SD2}	100°	100°	100°
17					
18	CIRC. WATER TEMP	T_W	93°	93°	93°
19	PRESS. TO SPRAYS	P_W	60	59	60
20					
21	SOLIDS RECOVERED, #/hr	—			
22	SOLIDS TO VENTURI "	—			
23	SOLIDS OUT STACK, "	—			
24					
25					
26					
27					
28					
29					
30					

L15 CAN BE CALCULATED IF THERMOM. NOT AVAILABLE

L 22 & 23 NOT NORMALLY AVAILABLE EXCEPT VIA "STACK TEST"

Tillom

SCRUBBER DATA LOG
LOCATION OF P.I. SYMBOLS

BAKER

LAND O' LAKES, INC. SPENCER, WI.

PRODUCT _____

DATE _____
TIME _____
BY _____

P_1
ΔP

T_1 °F INLET AIR TEMP.

T_2 %RH

T_3 EXHAUST AIR TEMP.

T_{SD1}

T_{SD2}

T_{FBE}

T_{FBM}

T_{FBC}

P_W

T_W

%TS

#/hr %DM

AMPS

MAIN DRYING CHAMBER

INLET AIR FLOW

EXHAUST AIR FLOW

INLET FAN

EXHAUST FAN

DAMPER

NOZZLES

RECEIVER

VORTEX B. P. VALVE(S)

CHAMBER CIP PUMP 'A'

TURN CHAMBER CIP PUMP 'B'

SCRUBBER PUMP 'C'

FLOID BED CIP PUMP 'D'

APPENDIX F

PROCEDURES

PARTICULATE LOADINGS AND EMISSION RATES

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

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

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

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

3a P1(1-5)

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

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

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Version 1.3
1/98

Interpoll Laboratories
(612)786-6020

Condensible Organic Compounds Analysis

(State of Wisconsin - EPA Method 5)

Method II-8672-WI

Equipment: Separatory funnel - 500 cc with Teflon stopcock

Powder funnel - 75 mm ID with a glass wood plug

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

Reagents: Methylene chloride

Sodium sulfate - (ACS) granular anhydrous (purified by heating for four hours in a shallow tray)

SAMPLING:

An all-glass impinger assembly is used in the back half of the EPA Method 5 sampling train when an organic wet catch is to be collected. The impinger assembly consists of a modified impinger, a Greenburg Smith impinger followed by another modified impinger. The third impinger should have a temperature measuring device at the outlet upstream of a final impinger or desiccant column to monitor the temperature of the outlet gas stream. Prior to the start of the test, each of the first two impingers should be charged with 100 g of Class I water. The Method 5 train should be operated as provided for in EPA Method 5. Ice should be added to the impinger bath to keep the temperature of the gas at the outlet at or less than 68 ^{o}F. After the post test leak check, the impinger train is removed and impinger contents poured into a tared all-glass sample bottle and closed with a Teflon-lined cap. The sample bottle is then weighed and the total condensate calculated by subtraction of the bottle tare weight and the

weight of initial water added to the impingers (200 g). A label is affixed and the sample is returned to the laboratory for analysis. The sample should be stored at 4 °C if the analysis is not conducted within 48 hours.

ANALYSIS:

1. Sample bottles are removed from storage and the contents quantitatively transferred to a clean 500 cc separatory funnel equipped with a Teflon stopcock.

2. Rinse the sample container with distilled water and add to separatory funnel.

3. Then rinse the sample container with acetone and pour through sodium sulfate into a tare beaker marked A.

4. The sample is then extracted consecutively with three 50 cc aliquots of methylene chloride. The extraction is performed according to normal laboratory practice observing the customary safety precaution of releasing excess pressure after each shaking.

5. After each of the three extractions are completed, the organic solvent should be dried by passing it through a funnel containing anhydrous sodium sulfate and collecting it and two 50 cc rinses in the tared beaker marked A (the same one used to catch the acetone container rinse).

6. Evaporate to dryness in a hood at 70 °F or less. Do not evaporate so quickly as to allow evaporative cooling to lower the temperature of the container below the dew point otherwise water will be condensed in the container.

7. Desiccate for two hours in a sealed desiccator and final weigh. Report all results in grams. All weighings should be made to nearest 0.1 mg (four places).

8. The remaining liquid in the separatory funnel is then transferred to a tared beaker marked B and is evaporated to dryness at 220 °F ± 10 °F. The analyst may take an aliquot of the sample, transferring it to a tared beaker and evaporate to dryness at 220 °F ± 10 °F. If an aliquot is used, the weight of the sample and aliquot will have to be taken to correct for the total sample weight.

9. After the drying step, the sample is cooled in a desiccator and weighted to a constant weight to the nearest 0.1 mg.

   Calculation (if aliquot is taken):

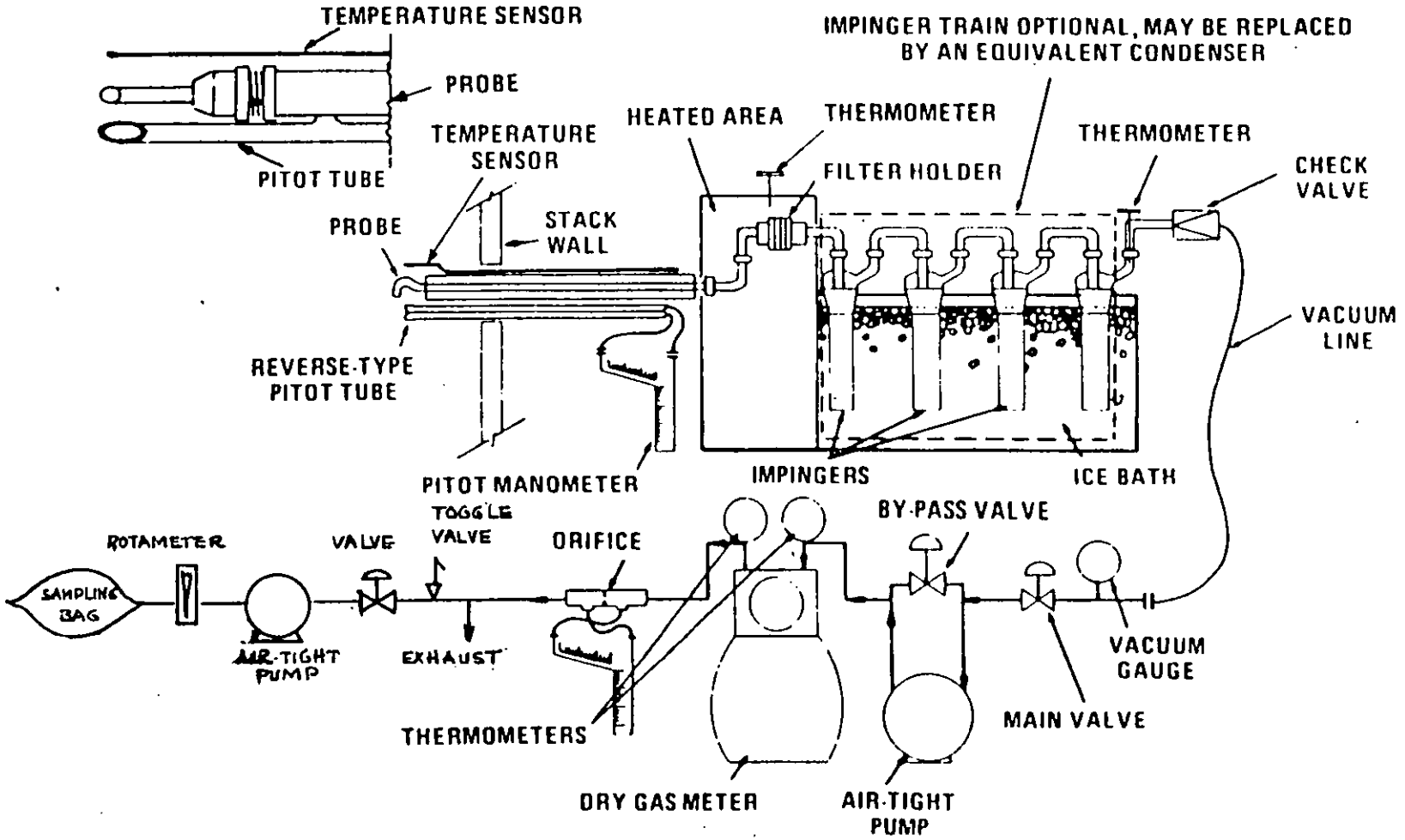
$$\text{grams} = \frac{(\text{grams recovered from aliquot}) \times (\text{total volume (ml) or grams of sample})}{(\text{aliquot volume (ml) or grams used})}$$

   If volume is used, it must be used for both the aliquot and sample. The same goes for using weight.

10. A field blank should be analyzed in an identical manner. If a field blank is not submitted, take an aliquot of Class I water equal in volume to the samples and analyze in a similar manner.

11. The results for container A are to be marked in the organic section of Interpoll Form #LSC-036.

12. The results for container B are to be marked in the inorganic section of Interpoll Form #LSC-036.



Particulate-sampling train.

APPENDIX G

CALCULATION EQUATIONS

CALCULATION EQUATIONS

METHOD 2

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

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

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

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

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

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

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

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

CALCULATION EQUATIONS

METHOD 3

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

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

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

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

CALCULATION EQUATIONS

METHOD 5

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

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

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

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

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

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

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

$$(\dot{m}_p)_2 = \frac{1.3228 \times 10^{-1}\ M_p\ A}{0\ A_n}$$

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

SYMBOLS

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

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

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

C_p = Pitot tube coefficient, dimensionless

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

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

EA = Excess air, percent by volume

γ = Dry test meter correction factor, dimensionless

G_d = Specific gravity (relative to air), dimensionless

I = Isokinetic variation, percent by volume

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

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

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

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

M_p = Total amount of particulate matter collected, g

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

P_g = Stack static gas pressure, IN. WC.

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

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

A_a = Actual volumetric stack gas flow rate, ACFM

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

RH = Relative humidity, %

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

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

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

$T_s(avg)$ = Absolute average stack temperature, ^oF

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

θ = Total sampling time, min.

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

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

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

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

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

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

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

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

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

γ = Dry test meter correction coefficient, dimensionless

ρ = Actual gas density, LB/ACF

APPENDIX H

SAMPLING TRAIN CALIBRATION DATA

Date 12-3-88

Bar. Press. 29.48 in. Hg

INTERPOLL LABORATORIES
METER CALIBRATION SHEET
EPA METHOD 5

Control Module No. 8
Serial No. DTM 964552
Wet Test Meter No. AL-20
Technician E Tsuneda

ΔH (in. WC)		Gas Volume Wet Test Meter (ft^3)	Cal. Index Φ (%)	Diff. Wet Test Meter ΔP_w (in.WC)	Gas Volume Dry test meter (ft^3)		Gas temperatures			Time θ (min/sec)	Meter Coeff. Y	Orifice Const. ΔH@	C_f
							Wet Test	Dry Test					
nominal	actual				V_{di}	V_{df}	t_w (°F)	t_{di} (°F)	t_{do} (°F)				
0.5	.5	2	99.87	.04	621.000	622.988	80	86	80	4/55.60	1.0089	1.76	
1.2	1.2	3	99.88	.06	617.000	619.990	80	86	80	4/47.38	1.0045	1.77	
2.0	2.0	3	99.89	.07	623.500	626.502	80	88	80	3/45.98	1.0004	1.82	
3.3	3.3	5	99.90	.085	627.500	632.496	80	94	82	4/58.07	1.0061	1.86	
4.7	4.7	5	99.95	.12	633.500	638.505	80	96	82	4/11.66	1.0030	1.89	
	2	3	4	5	6	7	8	9	10	11/12	1.0045	1.82	

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

Approved by _____ Date 12-5-88

Gas Meter Bimetallic Thermometer Calibration/Verification*

Inlet ☐ ≥ ± 5°F (Out of control) ☐ Recalibrated
☑ ≤ ± 5°F (in control) ☑ No action required

Outlet ☐ ≥ ± 5°F (Out of control) ☐ Recalibrated
☑ ≤ ± 5°F (in control) ☑ No action required

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

H-1

Interpoll Laboratories
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: December 28, 1988

Meter Box No.: 8 (Rockwell Dry Test Meter Serial No. 964652)

Date of Last Calibration: December 3, 1988
Calibration Technician: E. Trowbridge
Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
December 6-9, 1988	8-2678	638.60	1211.69	573.09	573.09
December 13, 1988	8-2685	212.00	319.37	107.37	680.46
December 28, 1988	8-2695	322.00	444.55	122.55	803.01

* Total volume through meter since last calibration

Interpoll Laboratories
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Nozzle Calibration
Data Sheet

Date of Calibration: December 28, 1988 Nozzle Number 8-4
Technician: E. Trowbridge

Nozzle rotated by 60 degree increments and diameter measured to nearest 0.001 inch. Observed readings and average:

Position	Diameter (inches)
1	0.242
2	0.243
3	0.245
Average:	0.243

Interpoll Laboratories
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S-Type Pitot Tube Inspection Sheet

Pitobe No. 6-21

Pitot tube dimensions:

1. External tubing diameter (D_t) 0.316 IN.
2. Base to Side A opening plane (P_A) 0.464 IN.
3. Base to Side B opening plane (P_B) 0.462 IN.

Alignment:

4. α_1 <10° 0 Degrees
5. α_2 <10° 0 Degrees

6. B_1 < 5° 1 Degrees
7. B_2 < 5° 1 Degrees

8. Z <.125" 0.02 IN.
9. W <.0625" 0.01 IN.

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle 0.762 IN.
11. Pitot to probe sheath 3.00 IN.
12. Pitot to thermocouple (parallel to probe) 3.00 IN.
13. Pitot to thermocouple (perpendicular to probe) 0.762 IN.

Date of Inspection: May 26, 1988

Inspected by: E. Trowbridge

S-348(1)

INTERPOLL LABORATORIES

TEMPERATURE MEASUREMENT DEVICE CALIBRATION SHEET

Unit Under Test Calibrated Against:

- [x] ASTM mercury in glass thermometer
- [x] Type K thermocouple/L + N potentiometer
- [ ] Stirred ice bath
- [ ] Other _____

Date 10-18-88

Technician Ron Rosenthal

Unit under test (type and number): PDT-4 AIKINS 39658-4

Desired Temperature (°F)	Standard Device Actual Reading (°F)	Unit Under Test Reading (°F)	Deviation* (%)
32 (ice bath)	32	31.6	1.25
70	70	69.4	0.86
120	120	119.5	0.25
200	200	200	0.00
300	300	300	0.00
400	400	397	0.75
500	500	497	0.60
800	800	799	0.12

Temperature correlation between standard device and unit under test was obtained by using a thermostalled and insulated aluminum block designed to provide uniform temperature. The temperature measurement devices were then inserted into two adjacent wells in the block. The temperature was programmed upward by a variable voltage control unit.

*Note - unit under test must agree within 1.5% of the standard device.

- [x] Unit in tolerance
- [ ] Unit was not in tolerance; recalibrated

H-5