Background Report Reference

AP-42 Section Number: 9.6.1

Background Chapter: 4

Reference Number: 3

Title: Results of the March 29, 1990 Particulate Emission Compliance Test on the Rogers Dryer at the Land O'Lakes Cheese division Plany Located in Spencer, Wisconsin

Interpoll Laboratories, Inc.

April 1990

AP-42 Section 9.6.1
Reference Report Sect. 4
Reference 3

Land O'Lakes
Spencer, WI

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Rogers Dryer
March 29, 1990

RESULTS OF THE MARCH 29, 1990 PARTICULATE EMISSION COMPLIANCE TEST ON THE ROGERS DRYER AT THE LAND O' LAKES CHEESE DIVISION PLANT LOCATED IN SPENCER, WISCONSIN

Drying Cheddar Cheese

Submitted to:

LAND O' LAKES
Box 116
Minneapolis, Minnesota 55440

Attention: John Schmeling

Received 5/3/90

Approved by:

Kathleen Eickstadt

Report Number 0-3004
April 18, 1990
KE/des

Kathleen Eickstadt
Senior Data Analyst
Field Testing Division

TABLE OF CONTENTS

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 (^{0}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/Nm^3	milligrams per dry standard cubic meter
ug/Nm^3	micrograms per dry standard cubic meter
microns (um)	micrometer
MIN.	minutes
ng	nanograms
ohm-cm	ohm-centimeter
PM	particulate matter
PPH	pounds per hour
PPM	parts per million
ppmC	parts per million carbon
ppm.d	parts per million, dry
ppm.w	parts per million, wet
ppt	parts per trillion
PSI	pounds per square inch
SQ.FT.	square feet
ug	micrograms
v/v	percent by volume
w/w	percent by weight
<	$\leq$ (when following a number)

Standard conditions are defined as 68 ^{0}F (20 ^{0}C) and 29.92 IN. of mercury pressure.

1 INTRODUCTION

On March 29, 1990 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 D. Smith and C. Mosser. Coordination between testing activities and plant operation was provided by Carl Mueler of Land O' Lakes Inc. The test was witnessed by Joe Ancel 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 and 9, CFR Title 40, Part 60, Appendix A (revised July 1, 1988). 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 stainless steel-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 tests ports are located approximately 2.4 diameters downstream of the nearest flow disturbance and approximately 1.2 diameters 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 4.57 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 results reported herein are accurate and closely reflect the actual values which existed at the time the test was performed.

TABLE 1. Summary of the Results of the March 29, 1990 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	03-29-90	03-29-90	03-29-90
Time runs were done (HRS)	830/1003	1038/1142	1210/1312
Product Output* (LBS/HR) – Cheddar Cheese	2373	2500	2500
Volumetric flow			
actual (ACFM)	47057	48775	48163
standard (DSCFM)	40756	40696	40147
Gas temperature (DEG-F)	104	104	104
Moisture content (%V/V)	6.82	7.13	7.12
Gas composition (%V/V,dry)			
carbon dioxide	0.60	0.60	0.60
oxygen	20.30	20.30	20.40
nitrogen	79.10	79.10	79.00
Isokinetic variation (%)	103.2	100.0	100.0
Particulate concentration			
actual (GR/ACF)	.0139	.0104	.00913
standard (GR/DSCF)	.0160	.0125	.0110
Part. emission rate (LB/HR)	5.60	4.35	3.77

Note: Dry + Organic/Inorganic Wet Catch

* Moisture Content of Product = 2.7%

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 PC 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.

3.1 Results of Orsat and Moisture Analysis

Interpoll Report No. 0-3004
Land O Lakes Inc
Minneapolis, Minnesota

Test No. 1
Rogers Dryer Stack

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

Date of run	Run 1 03-29-90	Run 2 03-29-90	Run 3 03-29-90
Dry basis (orsat)			
carbon dioxide.....	0.60	0.60	0.60
oxygen.....	20.30	20.30	20.40
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.10	79.10	79.00
Wet basis (orsat)			
carbon dioxide.....	0.56	0.56	0.56
oxygen.....	18.92	18.85	18.95
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	73.71	73.46	73.38
water vapor.....	6.82	7.13	7.12
Dry molecular weight.....	28.91	28.91	28.91
Wet molecular weight.....	28.16	28.13	28.14
Specific gravity.....	0.973	0.972	0.972
Water mass flow.....(LB/HR)	8366	8759	8631

3.2 Results of Particulate Loading Determinations

Interpoll Report No. 0-3004
Land O Lakes Inc
Minneapolis, Minnesota

Test No. 1
Rogers Dryer Stack

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

	Run 1	Run 2	Run 3
Date of run	03-29-90	03-29-90	03-29-90
Time run start/end.....(HRS)	830/1003	1038/1142	1210/1312
Static pressure.....(IN.WC)	-0.19	-0.19	-0.19
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)	50.0	52.0	51.0
desiccant.....(GRAMS)	18.0	17.0	17.0
total.....(GRAMS)	68.0	69.0	68.0
Total particulate material..			
.....collected(grams)	0.0455	0.0343	0.0297
Gas meter coefficient.....	1.0014	1.0014	1.0014
Barometric pressure..(IN.HG)	29.72	28.72	28.72
Avg. orif.pres.drop..(IN.WC)	1.78	1.79	1.76
Avg. gas meter temp..(DEF-F)	78.5	83.1	87.0
Volume through gas meter....			
at meter conditions...(CF)	44.74	45.18	44.90
standard conditions.(DSCF)	43.81	42.40	41.83
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.248	.248	.248
Avg.stack gas temp ..(DEG-F)	104	104	104
Volumetric flow rate.....			
actual.....(ACFM)	47057	48775	48163
dry standard.....(DSCFM)	40756	40696	40147
Isokinetic variation.....(%)	103.2	100.0	100.0
Particulate concentration...			
actual.....(GR/ACF)	0.01387	0.01041	0.00913
dry standard.....(GR/DSCF)	0.01603	0.01248	0.01096
Particle mass rate...(LB/HR)	5.60	4.35	3.77

APPENDIX A

RESULTS OF PRELIMINARY VOLUMETRIC FLOW RATE DETERMINATIONS

Interpoll Report No. 0-3004
Land O Lakes Inc
Minneapolis, Minnesota

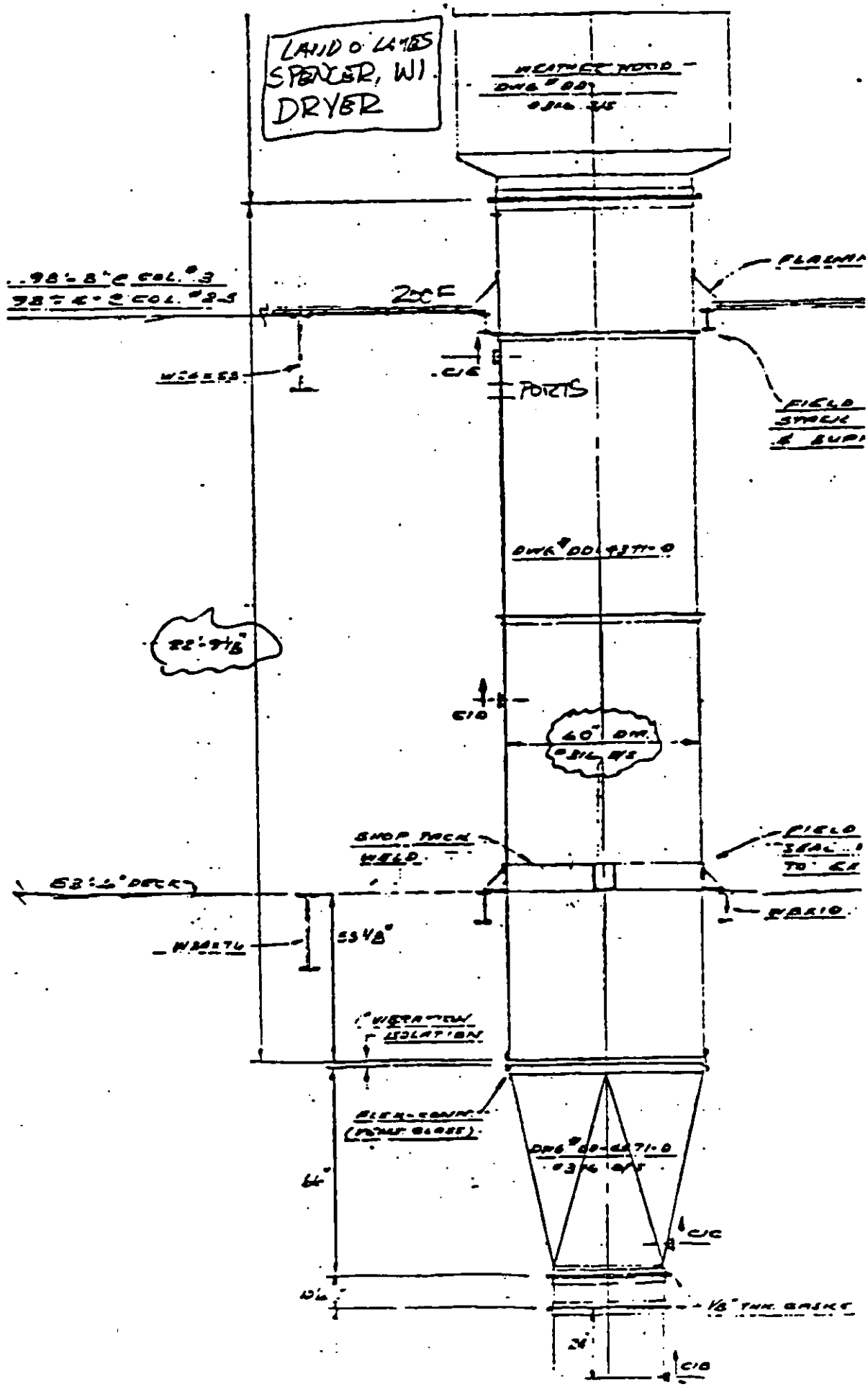
Test No. 1
Rogers Dryer Stack

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

Date of Determination.....	03-29-90
Time of Determination.....(HRS)	720
Barometric pressure.....(IN.HG)	29.72
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)	-.19
Avg. gas temp.....(DEG-F)	103
Moisture content.....(% V/V)	6.82
Avg. linear velocity.....(FT/SEC)	40.6
Gas density.....(LB/ACF)	.06810
Molecular weight.....(LB/LBMOLE)	28.91
Mass flow of gas.....(LB/HR)	192297
Volumetric flow rate.....	
actual.....(ACFM)	47061
dry standard.....(DSCFM)	40832

APPENDIX B

LOCATION OF TEST PORTS

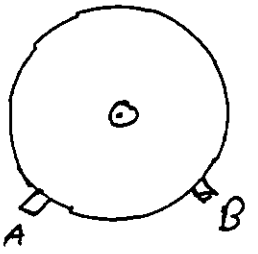

LAND O LAKES
SPENCER, WI.
DRYER
WEATHER HOOD
98'-8" C COL. #3
98'-4" C COL. #3-5
ZOC
FLASHI
W16x58
C16
POINTS
FIELD
STACK
& SUPI
DWG #00-93T1-0
22'-9 1/8"
C10
40" DIA.
SHOP PACK
WELD
FIELD
SEAL
TO C.
53'-6" DECK
W36x74
53 1/8"
4" INSTALLATION
ELECTRONIC
(POWDER COAT)
DWG #00-GA71-0
66"
C16
10 1/2"
1/8" THK. GASKET
24"
C10

APPENDIX C

METHODS 2 - 5 FIELD DATA SHEETS

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job LAND O' LAKES / SPENCER
Source ROGERS DRYER STACK
Test 1 Run 1 Date 3-29-90
Stack dimen. 59.5 IN.
Dry bulb ____ °F Wet bulb ____ °F
Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
Barometric pressure 28.72 in Hg
Static pressure -.19 in WC
Operators D. SMITH & C. MOSSER
Pitot No. 214-6 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: 0720 hrs	
A - 1	.021	1.25	5.25	.66	103
2	.067	3.99	7.99	.67	103
3	.118	7.02	11.02	.68	103
4	.177	10.53	14.53	.67	102
5	.250	14.87	18.87	.56	102
6	.356	21.18	25.18	.40	103
7	.644	38.32	42.32	.34	103
8	.750	44.63	48.63	.32	104
9	.823	48.97	52.96	.33	104
10	.882	52.48	56.48	.34	104
11	.933	55.51	59.51	.33	104
12	.979	58.25	62.25	.32	103
B - 1				.50	103
2				.48	102
3				.49	102
4				.50	102
5				.50	103
6				.48	103
7				.46	103
8				.49	103
9				.52	102
10				.54	102
11				.51	102
12				.48	102
Temp. meas. tool & S/N: PDT-3 DIGITAL T/C				Time end: 0735 hrs	

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LAND O' LAKES / SPENCER Date 3-29-90 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: 0.00 cfm at 10 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: #2021

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

No. of probe wash bottles: 1
Sample recovered by: DWAYNE A. SMITH
1 UMB. RINSE

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	543	493	50
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1426	1408	18
Total			68

Integrated Gas Sampling Data:

Bag Pump No. B6 Box No. 28 Bag No. 1

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

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

Time start: 0830 (HRS) Time end: 1003 (HRS)

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

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

CF-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job LAND O' LAKES / SPENCER Operator D. SMITH & C. MOSSER Pitot No. 204-6 Cp .840
Source ROGERS DRYER STACK Meter Box No. 5 ΔH 1.82 IN WC Bar. Press. 28.72 inHg H2O 5 %
Date 3-29-90 Test 1 Run 1 Counter coeff. 1.0014 Nozzle No. B-7 Nozzle Dia .278 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dev. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Cen/In	Cen/Out	Oxygen (x v/v)	UMB
	(0830	(654.40												
B - 12	2.5	656.25	.48	1.76	6.25	5.0	100	248	251	43	72	71	20.1	240
11	5	658.14	.51	1.87	8.16	5.3	102				73	72	20.2	
10	7.5	660.11	.53	1.95	0.12	5.5	101				74	72	20.3	
9	10	662.05	.52	1.91	2.05	5.4	101	252	250	44	75	73	20.3	241
8	12.5	663.96	.50	1.85	3.96	5.3	100				76	73	20.3	
7	15	665.80	.46	1.70	5.79	5.0	100				77	73	20.3	
6	17.5	667.64	.46	1.69	7.62	5.0	104	256	254	43	78	75	20.5	238
5	20	669.52	.49	1.80	9.50	5.1	104				79	76	20.4	
4	22.5	671.42	.50	1.84	1.41	5.1	106				80	76	20.4	
3	25	673.32	.50	1.84	3.32	5.1	106	257	255	44	81	76	20.5	240
2	27.5	675.21	.48	1.77	5.20	5.2	106				82	77	20.5	
1	30	677.09	.49	1.81	7.09	5.2	106				82	77	20.5	
A - 12	32.5	678.65	.32	1.18	8.63	4.2	106	256	255	45	81	77	20.4	241
11	35	680.21	.34	1.25	0.21	4.2	106				82	78	20.4	
10	37.5	681.77	.33	1.22	1.77	4.2	106				82	78	20.4	
9	40	683.34	.33	1.22	3.33	4.2	106	255	256	46	83	78	20.4	241
8	42.5	684.88	.32	1.19	4.87	4.1	104				83	78	20.4	
7	45	686.45	.34	1.26	6.45	4.2	104				83	79	20.4	
6	47.5	688.16	.39	1.45	8.16	5.0	104	256	256	47	84	79	20.4	241
5	50	690.22	.58	2.15	0.23	6.8	104				84	79	20.4	
4	52.5	692.46	.67	2.48	2.45	7.5	105				85	80	20.3	
3	55	694.70	.68	2.52	4.70	7.6	105	255	255	49	85	80	20.3	241
2	57.5	696.92	.66	2.45	6.91	7.5	105				86	80	20.3	
1	60	699.14	.67	2.49	9.14	7.6	105	255	256	50	86	80	20.3	241
	(1003													
	θ = 60	Vm = 44.74		ΔH = 1.78							Avg. = 78.5			

S-0037R

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LAND O' LAKES Date 3-29-90 Test 1 Run 2
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: 0.00 cfm at 10 in. Hg. (vac)

Particulate Catch Data:

No.s of filters used: #2022

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

No. of probe wash bottles: 1
Sample recovered by: DWAYNE A. SMITH.
1 UMB. RINSE

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	555	503	52
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1406	1389	17
Total			69

Integrated Gas Sampling Data:

Bag Pump No. 66 Box No. 28 Bag No. 2
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 1038 (HRS) Time end: 1142 (HRS)
Sampling rate: 400 cc/min Operator: D.S.
S/N of O_2 Analyzer used to monitor train outlet: 6

CF-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job LAND O' LAKES / SPENCER Operators D. SMITH & C. MOSSER Pitot No. 214-6 Cp .840
Source ROGERS DRYER STACK Meter Box No. 5 ΔH 1.87 IN WC Bar. Press. 28.72 inHg H2O 7.0 x
Date 3-29-90 Test 1 Run 2 Canister cont. 1.0019 Nozzle No. B-7 Nozzle Dia .298 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F)						Oxygen (x v/v)	
							Stack	Probe	Oven	Impg.	Can/In	Can/Out		umb
	(1038)	(699.35)												
A - 12	2.5	700.94	.35	1.25	0.92	4.0	105	254	256	42	79	78	20.4	257
11	5	702.56	.37	1.32	2.54	4.1	105				80	79	20.3	
10	7.5	704.13	.34	1.21	4.10	4.0	105				81	79	20.3	
9	10	705.63	.33	1.18	5.63	4.0	105	256	257	43	82	79	20.3	241
8	12.5	707.20	.34	1.22	7.19	4.0	102				83	80	20.3	
7	15	708.82	.38	1.37	8.85	4.2	102				84	80	20.3	
6	17.5	710.89	.58	2.09	0.89	6.8	102	258	256	45	84	80	20.2	241
5	20	713.12	.68	2.45	3.10	6.8	103				83	80	20.2	
4	22.5	715.28	.67	2.41	5.29	6.8	103				83	80	20.2	
3	25	717.45	.67	2.41	7.48	6.8	103	257	257	46	83	80	20.2	241
2	27.5	719.64	.65	2.34	9.64	6.8	103				83	80	20.2	
1	30	721.81	.66	2.37	1.81	6.8	104				82	80	20.2	
B - 12	32.5	723.73	.50	1.79	3.70	6.0	104	258	256	45	83	81	20.2	241
11	35	725.63	.52	1.87	5.63	6.1	104				83	81	20.2	
10	37.5	727.60	.55	1.98	7.62	6.4	104				85	82	20.2	
9	40	729.59	.54	1.95	9.59	6.4	104	256	255	46	87	82	20.2	241
8	42.5	731.49	.51	1.84	1.51	6.3	104				88	83	20.1	
7	45	733.38	.48	1.74	3.38	5.4	104				88	83	20.2	
6	47.5	735.15	.44	1.59	5.17	5.0	104	257	256	48	89	83	20.1	242
5	50	737.05	.49	1.77	7.06	5.4	104				89	84	20.2	
4	52.5	738.92	.48	1.74	8.93	5.3	104				90	84	20.1	
3	55	740.79	.47	1.70	0.78	5.2	105	257	256	49	90	84	20.1	241
2	57.5	742.65	.48	1.74	2.65	5.3	105				90	84	20.1	
1	60	744.53	.48	1.74	4.53	5.3	105	257	256	50	91	85	20.1	241
	(1142)													
	θ = 60	Vs = 45.18		ΔH = 1.79							Avg. = 83.1			

S-0037R

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LAND O' LAKES / SPENCER Date 3-29-90 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: 0.00 cfm at 9 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: #2042

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

No. of probe wash bottles: 1
Sample recovered by: DWAYNE A. SMITH
1 UMB. RINSE

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	545	494	51
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1443	1426	17
Total			68

Integrated Gas Sampling Data:

Bag Pump No. B6 Box No. 28 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 1210 (HRS) Time end: 1312 (HRS)
Sampling rate: 400 cc/min Operator: D.S.
S/N of O_2 Analyzer used to monitor train outlet: 6

CF-D11

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job LAND O' LAKES / SPENCER
Source ROGERS DRYER STACK
Date 3-29-90 Test 1 Run 3

Operators D SMITH & C. MOSSER
Meter Box No. 5 ΔH 2.82 IN WC
Coeff. 1.0074

Pitot No. 214-6 Cp .840
Bar. Press. 28.72 inHg H2O 70 %
Nozzle No. B-2 Nozzle Dia .248 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dev. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (v/v)	umb
	1210	744.70												
B-12	2.5	746.57	.48	1.73	6.56	5.0	104	251	249	43	84	83	20.2	235
11	5	748.46	.52	1.87	8.49	5.2	104				85	83	20.2	
10	7.5	750.44	.53	1.91	0.45	5.8	104				87	83	20.3	
9	10	752.42	.53	1.92	2.41	5.8	103	255	254	44	88	84	20.3	240
8	12.5	754.34	.51	1.85	4.34	5.8	103				88	84	20.3	
7	15	756.22	.48	1.74	6.21	5.2	103				88	84	20.4	
6	17.5	758.04	.45	1.63	8.03	5.0	103	256	255	46	88	84	20.4	241
5	20	759.87	.47	1.70	9.87	5.1	105				89	84	20.4	
4	22.5	761.72	.47	1.70	1.72	5.1	106				89	85	20.4	
3	25	763.59	.48	1.73	3.59	5.1	106	257	256	48	89	85	20.4	242
2	27.5	765.43	.46	1.66	5.43	5.0	106				89	85	20.4	
1	30	767.28	.47	1.70	7.28	5.0	106				89	85	20.2	
A-12	32.5	768.86	.34	1.23	8.85	4.1	106	258	257	47	89	85	20.3	241
11	35	770.46	.35	1.26	0.45	4.2	106				89	85	20.2	
10	37.5	771.98	.32	1.16	1.98	4.0	106				90	85	20.2	
9	40	773.51	.32	1.16	3.51	4.0	106	259	257	49	90	86	20.2	241
8	42.5	775.08	.33	1.20	5.07	4.0	105				90	86	20.3	
7	45	776.71	.37	1.34	6.72	4.3	104				90	86	20.3	
6	47.5	778.75	.57	2.07	8.76	6.1	104	259	257	50	90	86	20.3	241
5	50	780.93	.65	2.36	0.95	6.9	103				91	86	20.3	
4	52.5	783.11	.63	2.29	3.10	6.8	103				91	86	20.3	
3	55	785.26	.64	2.33	5.26	6.8	103	258	256	51	91	87	20.3	241
2	57.5	787.44	.65	2.36	7.45	6.9	104				91	87	20.3	
1	60	789.60	.63	2.29	9.60	6.8	104	257	256	51	91	87	20.3	241
	1312													
	θ = 60	Vm = 44.90		ΔH = 1.76							Avg. = 87.0			

S-0037R

APPENDIX D

LABORATORY DATA SHEETS

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job LAND O' LAKES
Team Leader DWAYNE A. SMITH
Date Submitted 3-30-90
Test No. 1

Source ROGERS DRYER
Test Site ROGERS DRYER STACK
Date of Test 3-29-90
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 _____	1 BLANK COMBINED WITH UMB. RINSE BLANK
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 _____	1 BLANK #2044
4 — 3 ACETONE 7 TOTAL	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 _____	1 BLANK DI
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-0163RRR	
—	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☐ Other _____	
—	Audit Samples ☐ Sulfur Dioxide ☐ Oxides of Nit. ☐ Other _____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other _____	

Source Information

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

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job: Land O'Lakes
Team Leader: D.S.
Date Submitted: 3-30-90
Test No.: 1
Date of Analysis: 4/2/90

Source: Rogers Dryer
Test Site: Stack
Date of Test: 3-29-90
No. of Runs Completed: 3
Technician: RL

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	9266-08	1	0.00	.60	20.90	.60	20.30	1.00
		2	0.00	.60	20.90	.60	20.30	1.00
	☑ B ☐ F	Avg				.60	20.30	
1/2	9266-13	1	0.00	.60	20.90	.60	20.30	1.00
		2	0.00	.60	20.90	.60	20.30	1.00
	☑ B ☐ F	Avg				.60	20.30	
1/3	9266-18	1	0.00	.60	21.00	.60	20.40	.83
		2	0.00	.60	21.00	.60	20.40	.83
	☑ B ☐ F	Avg				.60	20.40	
		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 $F_o = \frac{20.9 - O_2}{CO_2}$

Fo Check (250 ml all glass)

EPA Method 3 Guidelines

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

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Impinger Catch/Wisconsin Protocol

Job: Land O' Lakes
Team Leader: D.S.
Date Submitted: 4-1-90
Test No.: 1
Date of Analysis: 4-5-90
Source: Rogers Dryer
Test Site: Stack
Date of Test: 3-29-90
No. of Runs Completed: 3
Technician: RG

		Solvent Phase	Aqueous Phase
0	Test 1 Run 0 Field Blank Log Number 9266-03 Comments	Dish No. 3 Dish Tare Wt. 57.8141 g Dish+Sample Wt 57.8148 g Sample Wt. 0.0007 g	Dish No. 17 Dish Tare Wt. 46.3757 g Dish+Sample Wt. 46.3763 g Sample Wt. 0.0006 g
1	Test 1 Run 1 Log Number -04 Comments	Dish No. 100 Dish Tare Wt. 45.9684 g Dish+Sample Wt. 45.9781 g Sample Wt. 0.0097 g	Dish No. 108 Dish Tare Wt. 46.4217 g Dish+Sample Wt. 46.4237 g Sample Wt. 0.0020 g
2	Test 1 Run 2 Log Number -11 Comments	Dish No. 101 Dish Tare Wt. 44.7961 g Dish+Sample Wt. 44.8076 g Sample Wt. 0.0115 g	Dish No. 117 Dish Tare Wt. 47.3716 g Dish+Sample Wt. 47.3734 g Sample Wt. 0.0018 g
3	Test 1 Run 3 Log Number -16 Comments	Dish No. 107 Dish Tare Wt. 44.0717 g Dish+Sample Wt. 44.0796 g Sample Wt. 0.0079 g	Dish No. 119 Dish Tare Wt. 47.7701 g Dish+Sample Wt. 47.7736 g Sample Wt. 0.0035 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

Blank Solvent Wt. ____ g

Results Solvent Phase:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0090	0.0108	0.0072		

Results Aqueous Phase:

Field Blk.	Run 1	Run 2	D-3 Run 3	Run 4	Run 5
	0.0014	0.0018	0.0029		

LSC-03WYR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job Land O'Lakes
Team Leader D.S.
Date Submitted 3-30-90
Test No. 1
Date of Analysis 4-2-90
Transport Leakage ☒ None ☐ _____ ml

Source Rogers Dryer
Test Site Stack
Date of Test 3-29-90
No. of Runs Completed 3
Technician RE
Solvent Acetone

0	Test 1 Run 0 Field Blank Log Number 9266-01 Vol. of Solvent 80 ml *Solvent Residue 0.0 ug/ml	Dish No. 20 Dish Tare Wt. 48.4159 g Dish+Sample Wt. 48.4159 g Sample Wt. 0.0000 g
1	Test 1 Run 1 Vol. of Solvent 140 ml Log Number 9266-04 Comments	Dish No. 21 Dish Tare Wt. 49.6104 g Dish+Sample Wt. 49.6399 g Sample Wt. 0.0295 g
2	Test 1 Run 2 Vol. of Solvent 90 ml Log Number 9266-09 Comments	Dish No. 22 Dish Tare Wt. 51.3680 g Dish+Sample Wt. 51.3862 g Sample Wt. 0.0182 g
3	Test 1 Run 3 Vol. of Solvent 100 ml Log Number 9266-14 Comments	Dish No. 25 Dish Tare Wt. 44.3454 g Dish+Sample Wt. 44.3574 g Sample Wt. 0.0120 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 0.0 ug/ml = [(Sample Wt. 0.0000 g)(10^6)]/Vol. of Sol. 80 ml
EPA-M5 Acetone Residue Blank Spec. < 7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0295	0.0182	0.0120		

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job: Land O'Lakes — Source: Rogers Dryer
Team Leader: D.S. — Test Site: Stack
Date Submitted: 3-30-90 — Date of Test: 3-29-90
Test No.: 1 — No. of Runs Completed: 3
Date of Analysis: 4-2-90 — Technician: R.G.

0	Test 1 Run 0 Field Blank Log Number 9266-02 Comments	Filter No. 2044 Filter Type 4"GF Filter Tare Wt. .9138 g Filter+Sample Wt. .9139 g Sample Wt. 0.0001 g
1	Test 1 Run 1 Log Number 9266-05 Comments	Filter No. 2021 Filter Type 4"GF Filter Tare Wt. .9188 g Filter+Sample Wt. .9244 g Sample Wt. 0.0056 g
2	Test 1 Run 2 Log Number 9266-10 Comments	Filter No. 2022 Filter Type 4"GF Filter Tare Wt. .9084 g Filter+Sample Wt. .9125 g Sample Wt. 0.0041 g
3	Test 1 Run 3 Log Number 9266-15 Comments	Filter No. 2042 Filter Type 4"GF Filter Tare Wt. .9197 g Filter+Sample Wt. .9273 g Sample Wt. 0.0076 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
	0.0056	0.0041	0.0076		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0455	0.0343	0.0297		

APPENDIX E

PROCESS RATE DATA

(Provided by the Client)

	Run 1	Run 2	Run 3
Product Output	2373 lbs/hr	2500 lbs/hr	2500 lbs/hr
Moisture Content	2.7%	2.7%	2.7%

LEE DEBEAN

3/29/90

LAND O' LAKES / SPENCER WIS.
ROGERS DRYER STACK
TEST #1 RUNS 1-3

LAND O'LAKES, INC. - CHEESE DIVSION

DRYER PRODUCTION LOG - (~~DRY~~ ~~WHEY~~) cheddar Cheese

DATE: 3-29-90 LOT NO: 0089A PRODUCT: 49359 ~~MOIST~~ DRYER: Rogers STARTED SPRAYING: 3:47

NO. OF NOZZLES: 5 CORE SIZE: _____ ORIFICE: 2-61, 3-63 FINISHED SPRAYING: _____

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

TIME	4:05	4:30	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	1:00	1:30	2:00	2:30
HOMOGENIZER PRESSURE	8000	8000	8200	8000	7800	7900	7900	7800	7900	8000		7800	8000	7800	7800	8000	7700	7900	7200	7600		
H.P.P. PRESSURE LBS.	7000	7000	7100	7200	6800	6900	6900	6700	6900	7000		6800	7000	6800	6900	7000	6700	6900	6700	6600		
DRYER INLET AIR °F.	297°	305°	297°	297°	299°	303°	303°	299°	303°	301°		303°	300°	296°	300°	298°	299°	299°	299°	301°		
DRYER EXHAUST AIR °F.	191°	197°	197°	195°	195°	196°	196°	193°	193°	194°		193°	193°	192°	192°	193°	195°	193°	193°	193°		
FLUID BED DRYER °F.	66.7		65.5		64.2		65.4		64.6			65.0		65.2		67.8		66.9		66.1		
FLUID BED COOLER °F.	34.4		34.2		33.5		34.2		33.0			33.2		34.2		34.6		36.1		35.6		
POWDER PACKAGE °F.																						
POWDER PACKAGE NO. (5#)	1	21	53	82	109	135	159	185	208	232		264	288	313	338	362	389	413	435	463		
POWDER % MOISTURE	3.0	2.8	2.7	2.7	2.8	2.8	2.6	2.7	2.6	2.6		2.7	2.7	2.7	2.7	2.6	2.7	2.7	2.8	2.7		
Digital % MOISTURE	3.6	3.3	3.2	3.1	3.1	2.8	2.7	2.9	3.0	2.7		2.8	2.8	3.0	2.9	2.7	2.7	2.8	2.7	2.7		
SLURRY °F.	148°	148°	150°	150°	150°	150°	149°	149°	149°	148°		150°	150°	150°	150°	150°	151°	151°	149°	149°		
SLURRY BATCH NO.	11	12	26	32	39	46	53	60	68	73		81	87	95	100	108	116	124	128	135		
SLURRY & TOTAL SOLIDS																						
SLURRY & BUTTER FAT																						
FLUID BED 10# Butter	-.3 / 1.3		-.2 / 1.3		-.2 / 1.3		-.4 / 1.4		-.1 / 1.4				-.4 / 1.4		-.4 / 1.4		-.4 / 1.4		-.4 / 1.4			
RECYCLE	1.9	1.9	1.8	1.9	1.9	1.9	1.8	1.7	1.8	1.9		1.8	1.8	2.0	1.9	1.8	1.8	1.8	1.8	1.9		
[redacted] - - [redacted] Exhaust	394 / 560	396 / 564	391 / 551	393 / 553	396 / 551	395 / 549	392 / 548	395 / 545	388 / 507	387 / 524		382 / 508	376 / 549	380 / 554	379 / 549	371 / 536	373 / 537	371 / 537	369 / 534	366 / 531		
% Burner Output																						
[redacted] - - [redacted]	72.4	75.8	69.1	69.9	70.7	74.3	73.3	68.8	71.5	66.8		67.8	64.1	63.0	64.1	62.3	62.3	63.5	62.9	61.2		
OPERATOR - - PACKAGE	SD 196																					
INGREDIENTS:	7:00 - 3° (193°)																					

APPENDIX F

PROCEDURES

Particulate Loadings and Emission Rates

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

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

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

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

After sampling is complete, the filter is removed and placed in a clean container. The nozzle and inlet side of the filter holder are quantitatively washed with acetone and the washings are stored in a second container. A brush is often used in the cleaning step to help dislodge deposits. The samples are returned to the laboratory where they are logged in and analyzed. The volume of the acetone rinse ("probe wash") is noted and then the rinse is quantitatively transferred to a tared 120 cc porcelain evaporating dish and the acetone evaporated off at 97-105 °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.

Version 1.3
1/88

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):

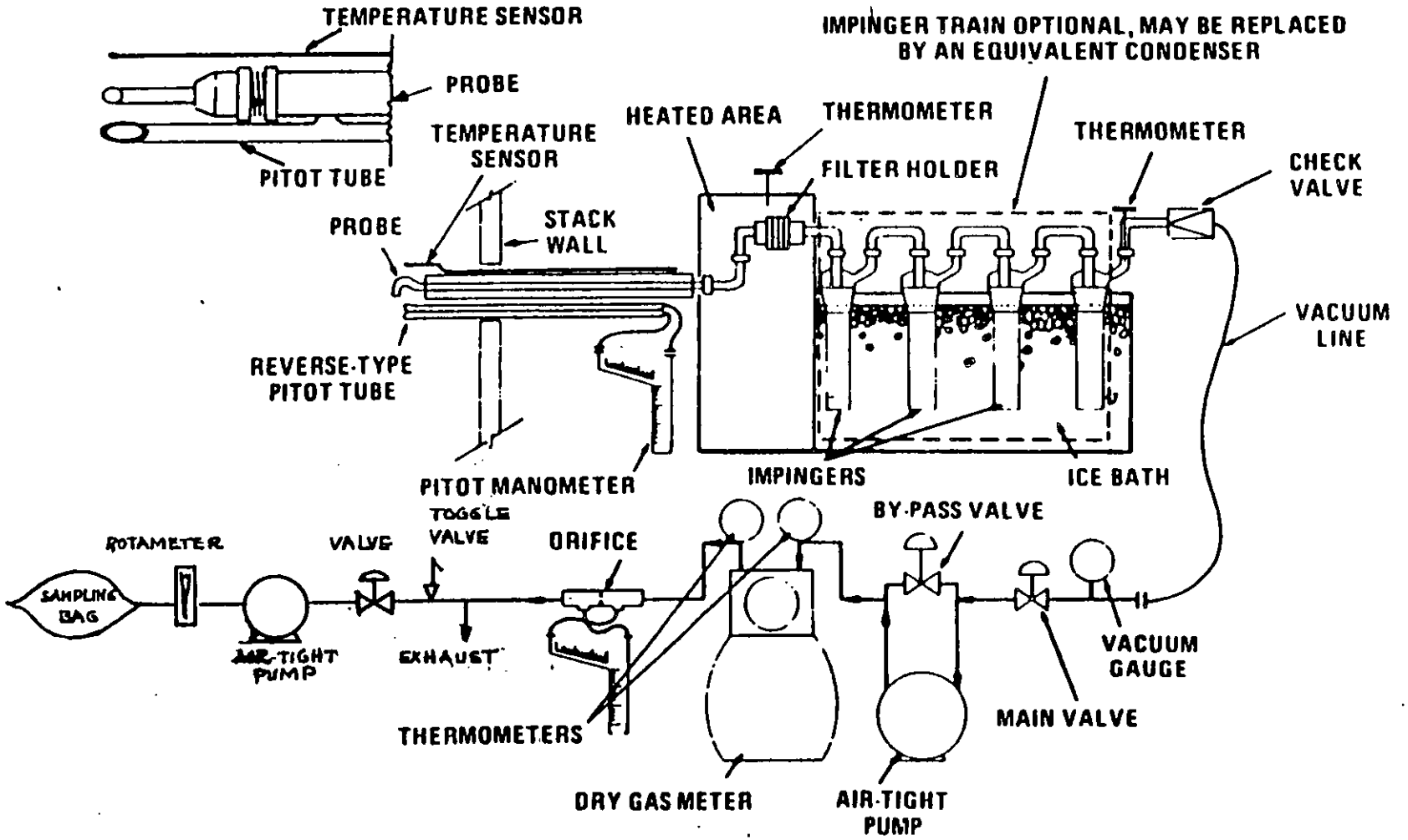
$$\text{grams} = \frac{(\text{grams recovered from aliquot}) \times (\text{total volume (ml) or grams of sample})}{(\text{aliquot volume (ml) or grams used})}$$

   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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SYMBOLS

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

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

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

C_p = Pitot tube coefficient, dimensionless

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

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

EA = Excess air, percent by volume

γ = Dry test meter correction factor, dimensionless

G_d = Specific gravity (relative to air), dimensionless

I = Isokinetic variation, percent by volume

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

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

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

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

M_p = Total amount of particulate matter collected, g

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

P_g = Stack static gas pressure, IN. WC.

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

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

A_a = Actual volumetric stack gas flow rate, ACFM

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

RH = Relative humidity, %

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

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

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

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

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

θ = Total sampling time, min.

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

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

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

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

$\bar{V}_s$ = 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 -

Interpoll Laboratories, Inc.

(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: April 18, 1990

Meter Box No.: 5 (Rockwell Dry Test Meter Serial No. 649078)

Date of Last Calibration: February 26, 1990
Calibration Technician: D. Van Hoever
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.)
February 27, 1990	0-2962	499.81	641.25	141.44	141.44
February 28, 1990	0-2963	641.50	735.73	94.23	235.67
March 2, 1990	0-2965	737.50	893.30	155.80	391.47
March 6&7, 1990	0-2969	893.95	1315.25	421.30	812.77
March 21&22, 1990	0-2998	315.60	645.87	330.27	1143.04
March 29, 1990	0-3004	646.20	789.60	143.40	1286.44

* Total volume through meter since last calibration.

Date 2/26/90

Bar. Press. 29.27 in. Hg

INTERPOLL LABORATORIES, INC.
METER CALIBRATION SHEET
EPA METHOD 5

Control Module No. 5
Serial No. DTM 676477
Wet Test Meter No. AL-20
Technician [signature]

ΔH (in. WC)		Gas Volume Wet Test Meter (ft^3)	* Cal. Index θ (%)	* Diff. Wet Test Meter ΔP_w (in.WC)	Gas Volume Dry test meter (ft^3)		Gas temperatures			Time θ (min/sec)	Meter Coeff. Y	Orifice Const. ΔH@	C_f
							Wet Test	Dry Test					
nominal	actual				V_{d1}	V_{df}	t_w (°F)	t_{d1} (°F)	t_{do} (°F)				
0.5	.5	2	99.70	0.01	476.41	478.42	70.7	78	74	5/05.14	1.0006	1.85	
1.2	1.2	3	99.77	0.03	492.90	495.91	70.5	79	74	4/54.71	1.0025	1.84	
2.0	2.0	3	99.87	0.05	476.38	479.39	71	78	74	3/48.99	.9996	1.85	
3.3	3.3	5	100.00	0.08	480.38	486.39	71	80	74	5/02.07	1.0007	1.90	
4.7	4.7	5	100.20	0.11	487.39	492.40	70.5	81	75	4/15.59	1.0020	1.93	
		8	8	4	8	6	7	8	8	16	11/11	1.0014	1.87

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

Approved by Perry Lonnes Date 3-5-90

* Based on AL-20 wet test meter calibration in August 1989 against Bell Prover (NBS Traceable) - Carl Poe Co.

S0102R 8/89

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: March 29, 1990 Nozzle Number 8-4
Technician: D. Smith

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

Position	Diameter (inches)
1	0.247
2	0.248
3	0.248
Average:	0.248

Interpoll Laboratories
(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 6-21

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .469 IN.
3. Base to Side B opening plane (P_B) .462 IN.

Alignment:

4. α_1 <10° 0
5. α_2 <10° 0

6. B_1 < 5° 2
7. B_2 < 5° 1

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

Distance from Pitot to Probe Components:

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

Date of Inspection: 12-8-89

Inspected by: [signature]

Interpoll Laboratories. Inc.
(612) 786-6060

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job LAND O' LAKES / SPENCER WIS. Date 3-29-90

Operator DWAYNE A. SMITH Module No. 5

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

Bar press 28.72 in. Hg. Y = 1.0014 ^H@ 1.87 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
[redacted]	(646.20)	[redacted]	
2.5	648.11	73	71
5.0	650.00	75	72
7.5	651.93	76	73
10	653.85	77	73
[redacted]	V_m= 7.65	Avg(t_m)= 73.8	°F

Calculate Y_{en} as follows:

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

7.66
.23315927

$$Y_{en} = \frac{1.786}{(1.0014)(7.65)}\left[\frac{(73.8) + 460}{(28.72)}\right]^{0.5}$$

$$Y_{en} = 1.005$$

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

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

S-432R

Interpoll Laboratories, Inc.

Temperature Measurement Device Calibration Sheet

Unit under test:

Vendor ATKINS

Model 39658-K — Serial Number POT-3

Range -112.0 °F to +1999 °F — Thermocouple Type

Date of Calibration 2-5-90 — Technician E TROWBRIDGE

Method of Calibration:

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

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

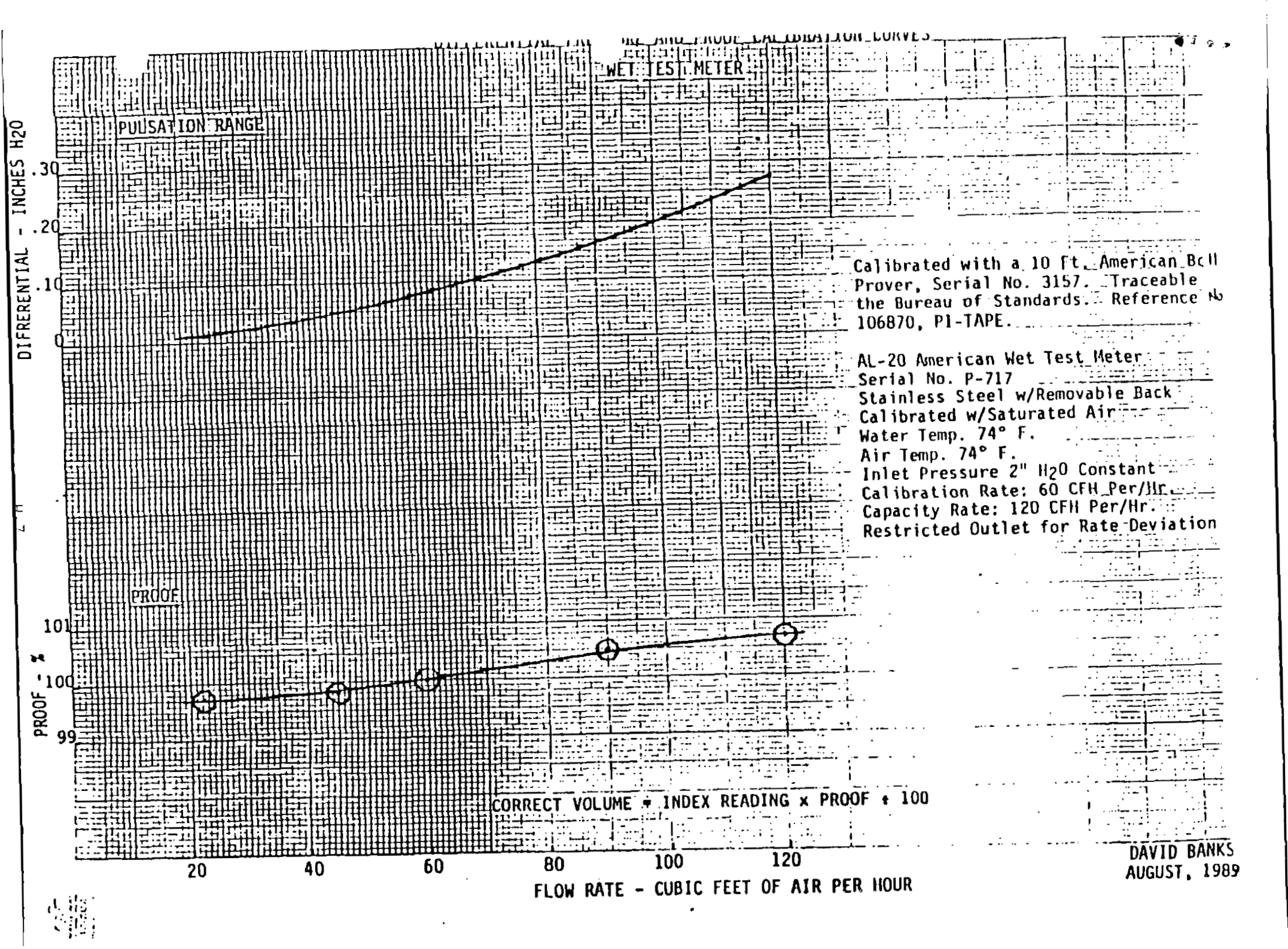
Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation Δt (°F)	Deviation (%)
0	0	3.0	3	.65
100	100	98	2	.35
200	200	200	—	—
300	300	299	1	.13
400	400	394	6	.69
500	500	493	7	.72
600	600	594	6	.56
700	700	694	6	.51
800	800	797	3	.23
900	900	898	2	.14
1000	1000	1001	1	.06
1100	1100	1104	4	.25
1200	1200	1207	7	.42
1300	1300	1306	6	.34
1400	1400	1409	9	.48
1500	1500	1505	5	.25
1600	1600	1604	4	.19
1700	1700	1697	3	.13
1800	1800	1794	6	.26
1900	1900	1885	15	.63
2000	2000	1978	22	.89
2100				
		Averages:		

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

% dev = 100 Δt / (460 + t)

☒ Unit in tolerance

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


WET TEST METER
PULSATION RANGE
PROOF
DIFFERENTIAL - INCHES H20
.30
.20
.10
0
PROOF - %
101
100
99
20
40
60
80
100
120
FLOW RATE - CUBIC FEET OF AIR PER HOUR
CORRECT VOLUME = INDEX READING x PROOF ÷ 100
Calibrated with a 10 Ft. American Bell Prover, Serial No. 3157. Traceable the Bureau of Standards. Reference No 106870, PI-TAPE.
AL-20 American Wet Test Meter
Serial No. P-717
Stainless Steel w/Removable Back
Calibrated w/Saturated Air
Water Temp. 74° F.
Air Temp. 74° F.
Inlet Pressure 2" H2O Constant
Calibration Rate: 60 CFH Per/Hr.
Capacity Rate: 120 CFH Per/Hr.
Restricted Outlet for Rate Deviation
DAVID BANKS
AUGUST, 1989