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Background Report Reference

AP-42 Section Number: 9.6.1

Background Chapter: 4

Reference Number: 6

Title: Results of the November 8, 1988
Particulate Emission Compliance Test
on the Whey Dryer at the Ellsworth
Coop Creamery in Ellsworth, WI

Interpoll Laboratories, Inc.

December 1988

Ellsworth Coop
Ellsworth, WI
Whey Dryer

NOV, 1988

Received 12/22/1985

Conteroll

CORRESPONDENCE/MEMORANDUM

STATE OF WISCONSIN

Date: January 30, 1989
To: Dean Packard - AM/3

File Ref: 4530-3

From: Thomas E. Woletz

FEB 2 1989

Subject: Particulate Stack Test Conducted on the Ellsworth Co-op Creamery
New Whey Dryer on November 8, 1988

I. SOURCE

Ellsworth Co-op Creamery
232 N. Wallace Street
Ellsworth, WI 54011

Air Emission Inventory #648020010

Contact: DuWayne Brenne, Maintenance Supt.
Phone: (715) 273-4311

II. SOURCE DESCRIPTION

The source is a two stage C.E. Rogers whey dryer with a rated output capacity of 4,000 lbs per hour. The particulate sampling was conducted on the first stage of the process. Exhausts from this first stage main chamber pass through twin cyclones situated in parallel prior to exhaust to the ambient air.

III. SAMPLING OPERATION

A. Purpose of the Test

The purpose of the test was to show compliance with section NR 415.05(2)(a) Wis. Adm. Code which restricts emissions of particulate matter to 8.08 lbs per hour.

B. Sampling Firm

Interpoll, Inc.
4500 Ball Road, N.E.
Circle Pines, MN 55014

Crew Chief: Ron Rosenthal (612) 786-6020

C. Date of Test

The test was performed on November 8, 1988. The temperature was 40°F at the beginning of the first run and 50°F at the end of the second run. It was cloudy at the beginning of the first run but by the end of the last run it had cleared. The wind was from the west northwest at the beginning of the first run and switched to the west southwest at the end of the second run. The first run began at 11:05 a.m. and the second run ended at 3:15 p.m.

D. Test Methods

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 conducted prior to the first particulate determination to allow selection of the appropriate nozzle diameter required for a isokinetic sample withdrawal. 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. Orsat analysis were conducted offsite at the Interpoll Lab.

Testing on the whey dryer was conducted from a set of five test ports on the rectangular stack (28.0"x31.25"). The ports are located 60 inches (2.03 duct diameters) downstream of the nearest flow disturbance and 63.5 inches (2.1 duct diameter) upstream of the stack exit. A 25-point traverse was used to collect representative particulate samples. Each traverse point was sampled four minutes to give a total sampling time of 100 minutes per run. The sampling time was increased because of poor flow distribution at the test site. Only two particulate determinations were performed due to the length of each run. The length of the testing runs stretched the creamery's ability to sustain production. It was agreed that if two test runs showed conclusive compliance, the Department would accept the results as a valid compliance determination.

E. Test Witness

Mr. Tom Woletz of the Western District Office in Eau Claire was the Department of Natural Resources representative at the test.

IV. SUMMARY OF THE RESULTS

<u>Run Number</u>	<u>Emission Rate</u> <u>lbs/Hr</u>	<u>Isokinetic</u> <u>Ratio</u>
1	4.56	94.2
2	3.63	98.3
Average	4.09	96.25%

V. APPLICABLE EMISSION LIMIT

The applicable emission limit for this emission source is the process weight limit of 8.08 lbs/hr as calculated by the method set forth in section NR 415.05(2)(a) of the Wisconsin Administrative Code. The average particulate emission rate for the two runs is in compliance with this limit.

The isokinetic ratio for all three runs was within the 90% - 110% range acceptable to the Department.

The opacity was 0% for the second run of the stack test.

The stack test report contained some of the information about the test --- the witnessing form was used for the remainder. I checked their data and the results for each run on the computer and the results were consistent with those calculated by Interpoll.

AM6\TW015.twm

Joe Perez - AM/3
U.S. EPA Region V

Test No. 1
 Exhaust Gas Stack

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

	Run 1	Run 2
Date of run	11-08-88	11-08-88
Time run start/end.....(HRS)	1105/1257	1330/1515
Static pressure.....(IN.WC)	-0.75	-0.75
Cross sectional area (SQ.FT)	6.08	6.08
Pitot tube coefficient.....	.940	.940
Water in sample gas		
condenser.....(ML)	0.0	0.0
impingers.....(GRAMS)	21.0	25.0
desiccant.....(GRAMS)	11.0	10.0
total.....(GRAMS)	32.0	35.0
Total particulate material..		
.....collected(grams)	0.0455	0.0378
Gas meter coefficient.....	0.9946	0.9946
Barometric pressure..(IN.HG)	28.98	28.98
Avg. orif.pres.drop..(IN.WC)	0.55	0.53
Avg. gas meter temp..(DEF-F)	56.1	66.0
Volume through gas meter....		
at meter conditions...(CF)	36.94	37.03
standard conditions.(DSCF)	36.44	35.84
Total sampling time....(MIN)	100.00	100.00
Nozzle diameter.....(IN)	.125	.125
Avg.stack gas temp ..(DEG-F)	116	117
Volumetric flow rate.....		
actual.....(ACFM)	32425	30752
dry standard.....(DSCFM)	27590	26000
Isokinetic variation.....(%)	94.2	98.3
Particulate concentration...		
actual.....(GR/ACF)	0.01639	0.01375
dry standard.....(GR/DSCF)	0.01926	0.01627
Particle mass rate...(LB/HR)	4.56	3.63

RECEIVED

DEC 21 1988

DNR-WCD

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

TEL: (612) 786-6020

FAX: (612) 786-7854

RESULTS OF THE NOVEMBER 8, 1988
PARTICULATE EMISSION COMPLIANCE TEST
ON THE WHEY DRYER AT THE ELLSWORTH
COOP CREAMERY IN ELLSWORTH, WISCONSIN

Submitted to:

ELLSWORTH COOP CREAMERY
232 North Wallace
Ellsworth, Wisconsin 54011

Attention: Duane Brenne
Supervisor, Whey Department

Approved by:



Kathleen Eickstadt
Senior Data Analyst
Field Testing Division

Report Number 8-2658
December 9, 1988
KE/kiq

TABLE OF CONTENTS

	ABBREVIATIONS	iii
1	INTRODUCTION	1
2	SUMMARY AND DISCUSSION	3
3	RESULTS	5
	3.1 Results of Orsat and Moisture Analyses	6
	3.2 Results of Particulate Loading Determinations	7

APPENDICES:

- A - Results of Preliminary Volumetric Flow Rate Determinations
- B - Location of Test Ports
- C - Methods 2 - 5 Field Data Sheets
- D - Laboratory Data Sheets
- E - Process Data
- F - Procedures
- G - Calculation Equations
- H - Sampling Train Calibration Data

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 ⁶ BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
LTPD	long tons per day
MW	megawatt
mg/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
<	< (when following a number)

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

1 INTRODUCTION

On November 8, 1988 Interpoll Laboratories personnel conducted a particulate emission compliance test on the new Whey Dryer at the Ellsworth Coop Creamery located in Ellsworth, Wisconsin. On-site testing was performed by R. Rosenthal and D. Smith. Coordination between testing activities and plant operation was provided by Duane Brenne of the Ellsworth Coop Creamery. The test was witnessed by Tom Woletz of the Wisconsin Department of Natural Resources.

The Whey Dryer tested is a C.E. Rogers cone type dryer. It is direct-fired with natural gas and has a rated capacity of 4000 LB/HR of dry product. Particulate emissions are controlled by a baghouse.

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 Whey Dryer was conducted from a set of five test ports on the rectangular stack. These test ports are located five feet downstream of the nearest flow disturbance and 5'-3 1/2" upstream of the stack exit. A 25-point traverse was used to collect representative particulate samples. Each traverse point was sampled four minutes to give a total sampling time of 100 minutes per run (the sampling time was increased because of poor flow distribution at this test site). Only two particulate determinations were performed due to the length of each 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 4.1 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 November 8, 1988 Particulate Emission Compliance Test on the Exhaust Gas Stack at the Ellsworth Cooperative Creamery in Ellsworth, Wisconsin.

ITEM	Run 1	Run 2
Date of test	11-08-88	11-08-88
Time runs were done (HRS)	1105/1257	1330/1515
Process rate LB/HR	3600.0	3500.0
Volumetric flow actual (ACFM)	32425	30752
standard (DSCFM)	27590	26000
Gas temperature (DEG-F)	116	117
Moisture content (%V/V)	3.98	4.40
Gas composition (%V/V, dry)		
carbon dioxide	0.42	0.21
oxygen	20.46	20.61
nitrogen	79.12	79.18
Isokinetic variation (%)	94.2	98.3
Particulate concentration		
actual (GR/ACF)	.0164	.0138
standard (GR/DSCF)	.0193	.0163
Part. emission rate (LB/HR)	4.56	3.63

* 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
 Exhaust Gas Stack

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

Date of run	Run 1 11-08-88	Run 2 11-08-88
-------------	-------------------	-------------------

Dry basis (orsat)

carbon dioxide.....	0.42	0.21
oxygen.....	20.46	20.61
carbon monoxide.....	0.00	0.00
nitrogen.....	79.12	79.18

Wet basis (orsat)

carbon dioxide.....	0.40	0.20
oxygen.....	19.65	19.70
carbon monoxide.....	0.00	0.00
nitrogen.....	75.97	75.69
water vapor.....	3.98	4.40
Dry molecular weight.....	28.89	28.86
Wet molecular weight.....	28.45	28.38
Specific gravity.....	0.983	0.980
Water mass flow..... (LB/HR)	3204	3358

FO	1.048	1.381
----	-------	-------

Test No. 1
 Exhaust Gas Stack

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

	Run 1	Run 2
Date of run	11-08-88	11-08-88
Time run start/end.....(HRS)	1105/1257	1330/1515
Static pressure.....(IN.WC)	-0.75	-0.75
Cross sectional area (SQ.FT)	6.08	6.08
Pitot tube coefficient.....	.840	.840
Water in sample gas		
condenser.....(ML)	0.0	0.0
impingers.....(GRAMS)	21.0	25.0
desiccant.....(GRAMS)	11.0	10.0
total.....(GRAMS)	32.0	35.0
Total particulate material..		
.....collected(grams)	0.0455	0.0378
Gas meter coefficient.....	0.9946	0.9946
Barometric pressure..(IN.HG)	28.98	28.98
Avg. orif.pres.drop..(IN.WC)	0.55	0.53
Avg. gas meter temp..(DEF-F)	56.1	66.0
Volume through gas meter....		
at meter conditions...(CF)	36.94	37.03
standard conditions.(DSCF)	36.44	35.84
Total sampling time....(MIN)	100.00	100.00
Nozzle diameter.....(IN)	.125	.125
Avg.stack gas temp ..(DEG-F)	116	117
Volumetric flow rate.....		
actual.....(ACFM)	32425	30752
dry standard.....(DSCFM)	27590	26000
Isokinetic variation.....(%)	94.2	98.3
Particulate concentration...		
actual.....(GR/ACF)	0.01639	0.01375
dry standard.....(GR/DSCF)	0.01926	0.01627
Particle mass rate...(LB/HR)	4.56	3.63

APPENDIX A

RESULTS OF PRELIMINARY VOLUMETRIC FLOW RATE DETERMINATIONS

Test No. 1
Exhaust Gas Stack

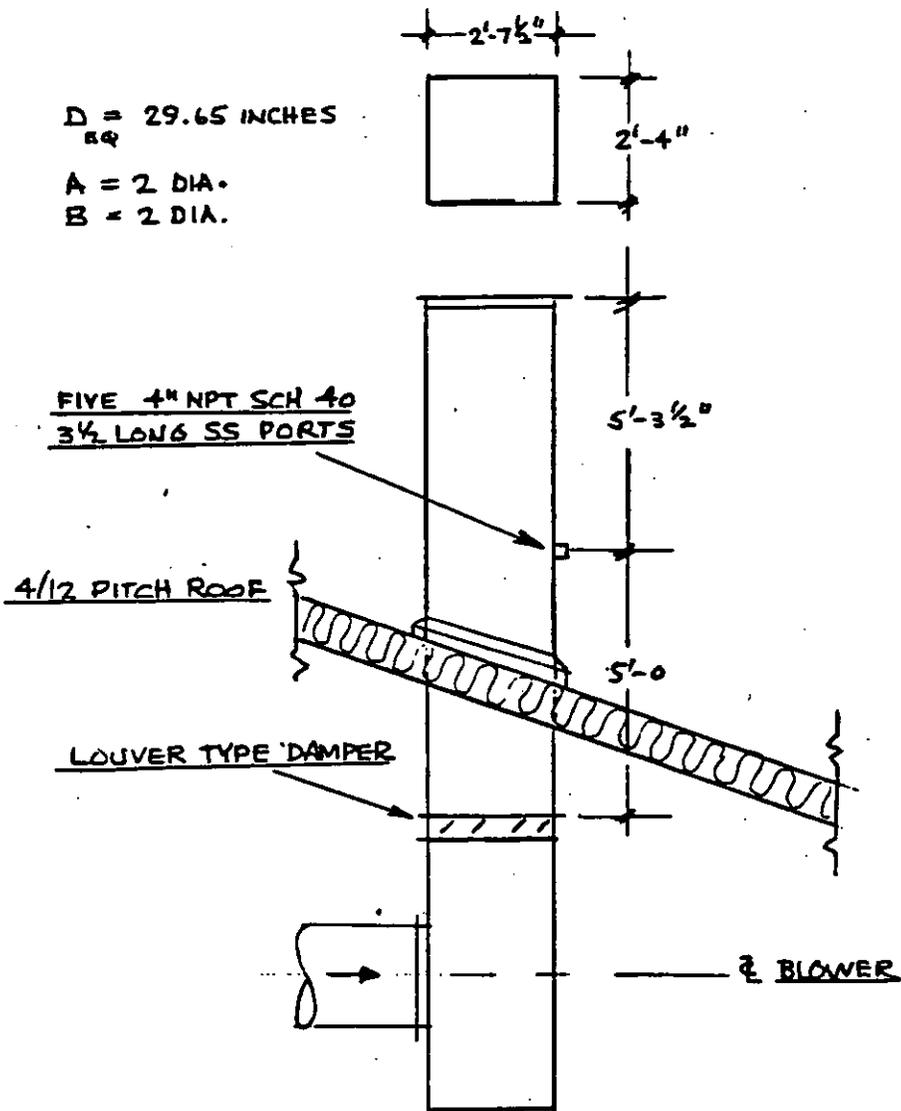
Results of Volumetric Flow Rate Determination-----Method 2

Date of Determination.....	11-08-88
Time of Determination..... (HRS)	1000
Barometric pressure..... (IN.HG)	28.98
Pitot tube coefficient.....	.84
Number of sampling ports.....	5
Total number of points.....	25
Shape of duct.....	Rectangular
Duct width..... (IN)	28
Duct length..... (IN)	31.25
Duct area..... (SQ.FT)	6.08
Direction of flow.....	UP
Static pressure..... (IN.WC)	-.75
Avg. gas temp..... (DEG-F)	118
Moisture content..... (% V/V)	3.98
Avg. linear velocity..... (FT/SEC)	89.4
Gas density..... (LB/ACF)	.06521
Molecular weight..... (LB/LBMOLE)	28.89
Mass flow of gas..... (LB/HR)	127565
Volumetric flow rate.....	
actual..... (ACFM)	32603
dry standard..... (DSCFM)	27630

APPENDIX B

LOCATION OF TEST PORTS

ELLSWORTH COOP CREAMERY
WHEY DRYER STACK



D = 29.65 INCHES
 BQ
 A = 2 DIA.
 B = 2 DIA.

FIVE 4" NPT SCH 40
3 1/2 LONG SS PORTS

4/12 PITCH ROOF

LOUVER TYPE DAMPER

BLOWER

4/12

LP 7/88

NOT TO SCALE

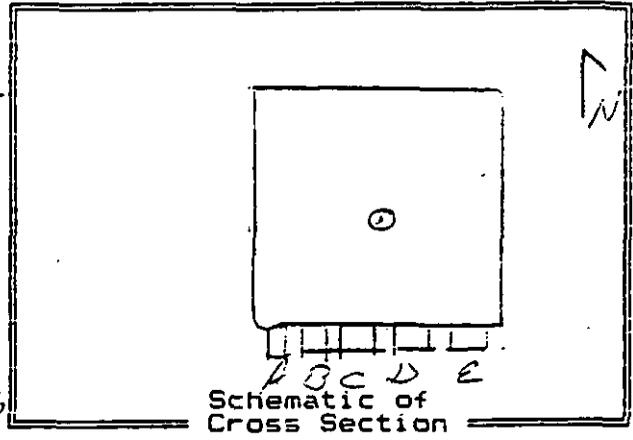
(WEST ELEV VIEW)

APPENDIX C

METHODS 2 - 5 FIELD DATA SHEETS

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job Ellsworth COOP CREAMERY
 Source EXHAUST GAS STACK
 Test 1 Run 1-3 Date 11-3-85
 Stack dimen. 28 x 31.25 IN.
 Dry bulb 116 deg-F
 Wet bulb 100 deg-F
 Barometric pressure 28.98 in Hg
 Static pressure -.75 in WC
 Operators RON ROSENTHAL, DWAYNE
 Pitot No. 1/2-174 Cp 84



5.6 27.000

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (deg-F)
		Port length: 2.75 in.		Time start: 10:00 hrs	
A	1	2.80	6.55	7.00	120
	2	8.40	12.15	6.50	120
	3	14.00	17.75	5.00	120
	4	19.60	23.35	2.80	120
	5	25.20	28.95	1.30	120
B	1			4.60	116
	2			3.80	116
	3			2.50	116
	4			1.50	116
	5			1.10	117
C	1			3.90	117
	2			2.90	117
	3			1.20	117
	4			.65	117
	5			.48	118
D	1			4.50	118
	2			4.40	118
	3			1.10	118
	4			.40	118
	5			.28	120
E	1			3.70	120
	2			2.60	120
	3			1.20	120
	4			1.20	120
	5			.33	120
Temp. measure device: <u>Digital TC PDT-2</u>				Time end: <u>10:30</u> hrs	

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job Ellsworth 0000 Creamery Date 11-8-85 Test 1 Run 1
 Source Exhaust Gas Stack No. of traverse points 25
 Method 5 Filter holder: 41 Filter type: 4" g.f.

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac)
 Posttest: 1.00 cfm at 5 in. Hg. (vac)

Particulate Catch Data:

No.s of filters used: 1 # (0529) Recovery solvent(s)
 acetone _____
 other(s) _____
 No. of probe wash bottles: 1
 Sample recovered by: DWAYNE A. SMITH

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	517	496	21
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1340	1329	11
Total			32

Integrated Gas Sampling Data:

Bag Pump No. B3 Box No. 8 Bag No. 1
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 21 in. Hg.
 Time start: 1105 (HRS) Time end: 1257 (HRS)
 Sampling rate: 300 cc/min Operator: RR
 S/N of O₂ Analyzer used to monitor train outlet: 5

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INTERPOL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job Ellsworth Coop Creamery Operator R.R. D.S. Pitot No. 346-17 CP 84
 Source Exhaust Gas Stack Motor Box No. 3 Bar. Press. 25.5 inHg H₂O 5 K
 Date 11-8-88 Street 1st Run 1 Gas Motor Serial No. 9748 Nozzle No. 6-2 Nozzle Dia 1.25 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Hood (fpm)	Drifted Meter (inHg)	Dep. Vol. (cf)	VAC. (inHg)	Temperatures (°F)				Oxygen (xv/v)		
							Stack	Probe	Down	Inpp.			
A-5	1105	862.50	7.00	1.39	5.10	4.5	120	250	250	42	48	46	20.2
A-4	4	865.19	6.20	1.26	7.57	4.4	105				53	44	20.2
A-3	8	867.66	5.50	1.10	7.88	4.0	118				56	46	20.2
A-2	12	872.50	6.75	1.35	7.45	4.2	118	250	250	43	58	46	20.1
A-1	20	875.16	7.50	1.51	5.16	4.2	118				60	47	20.1
B-5	24	876.14	1.05	.21	6.19	1.5	114				56	48	20.1
B-4	28	877.40	1.60	.32	7.45	2.0	114	250	250	43	57	48	20.0
B-3	32	879.00	2.50	.50	9.03	2.0	114				59	48	20.0
B-2	36	880.89	3.65	.74	0.93	3.0	114				61	49	19.9
B-1	40	883.10	4.70	.96	3.10	3.5	114	250	250	45	63	50	19.9
C-5	44	883.70	.34	.06	3.69	1.0	114				60	51	20.0
C-4	48	884.54	.55	.11	4.43	1.0	118				60	51	20.3
C-3	52	885.61	1.20	.24	5.53	1.5	116	250	250	46	61	52	20.3
C-2	56	887.25	2.50	.51	7.12	2.2	117				62	52	20.1
C-1	60	889.14	4.05	.82	9.13	3.0	117				66	53	20.1
D-5	64	889.59	.20	.04	9.58	1.5	117	250	250	48	62	53	20.2
D-4	68	890.08	.32	.06	0.15	1.5	117				61	54	20.2
D-3	72	891.12	.98	.20	1.15	1.5	118				62	54	20.2
D-2	76	892.12	1.05	.21	2.18	1.5	118	250	250	50	63	55	20.1
D-1	80	893.77	2.50	.51	3.77	2.0	118				65	55	20.1
E-5	84	894.18	1.18	.03	4.20	1.0	118				64	56	20.1
E-4	88	894.83	.42	.08	4.85	1.0	116	250	250	53	63	56	20.1
E-3	92	895.91	1.10	.22	5.91	1.5	116				64	56	20.1
E-2	96	897.48	2.40	.49	7.48	2.2	116				67	57	20.1
E-1	100	899.44	3.80	.78	9.45	3.0	116	250	250	55	70	58	20.1
							Avg. = 56.1						

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job ELLSWORTH COOP CREAMERY Date 11-8-88 Test 1 Run 2
 Source EXHAUST GAS STACK No. of traverse points 25
 Method S Filter holder: 4" Filter type: 4" g.f.

Sample Train Leak Checks:

Pretest: { 0.02 cfm at 15 in. Hg. (vac)
 Posttest: { 0.0 cfm at 5 in. Hg. (vac)

Particulate Catch Data:

No.s of filters used: 1 # (0563) Recovery solvent(s) acetone _____
 other(s) _____

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

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	521	496	25
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1350	1340	10
Total			35

Integrated Gas Sampling Data:

Bag Pump No. B3 Box No. 8 Bag No. 2
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 21 in. Hg.
 Time start: 1330 (HRS) Time end: 1515 (HRS)
 Sampling rate: 300 cc/min Operator: RR
 S/N of O₂ Analyzer used to monitor train outlet: 5

CF-023

S-0046RR

APPENDIX D

LABORATORY DATA SHEETS

T 85 L
11/25/88

Chain of Custody
Sample Deposition Sheet

Job ELLSWORTH COOP CREAMERY Source Exhaust gas STACK
 Team Leader RON ROSENTHAL Test Site STACK
 Date Submitted 11-8-88 Date of Test 11-8-88
 Test No. 1 No. of Runs Completed 2

No. of Samples	Type of Sample	Analysis Required	Comments
3	Probe Wash: <input checked="" type="checkbox"/> Acetone <input type="checkbox"/> D.I. Water	<input checked="" type="checkbox"/> As per EPA M-5 <input type="checkbox"/> Other _____	1 BULK
3	Filter: <input checked="" type="checkbox"/> 4" G.F. <input type="checkbox"/> S.S. Thimble <input type="checkbox"/> 2.5" G.F. <input type="checkbox"/> 47 mm G.F.	<input checked="" type="checkbox"/> As per EPA M-5 <input type="checkbox"/> As per EPA M-17 <input type="checkbox"/> Other _____	1 BULK
5	Impinger Catch: <input checked="" type="checkbox"/> D.I. Water <input type="checkbox"/> 3% H ₂ O <input type="checkbox"/> 4MS Hg Only <input type="checkbox"/> 4MS Metals <input type="checkbox"/> 0.1 N NaOH <input type="checkbox"/> Other _____	<input type="checkbox"/> MN Protocol <input type="checkbox"/> SWI Protocol <input type="checkbox"/> EPA M-6 or 8 <input type="checkbox"/> Acid Gases <input type="checkbox"/> Formaldehyde <input type="checkbox"/> Metals <input type="checkbox"/> Other _____	1 BULK
2	Integrated Gas sample	<input checked="" type="checkbox"/> As per EPA M-3 <input type="checkbox"/> As per EPA M-10 <input type="checkbox"/> Other _____	
	Oxides of Nitrogen (NO _x)	<input type="checkbox"/> As per EPA M-7A <input type="checkbox"/> Other _____	Date _____ Time (HRS) _____
	Fuel Sample	<input type="checkbox"/> Attached fuel Form #S-0163RRR	
	Particle Size	<input type="checkbox"/> X-Ray Sedigraph <input type="checkbox"/> Bahco Method <input type="checkbox"/> Other _____	
	Audit Samples <input type="checkbox"/> Sulfur Dioxide <input type="checkbox"/> Oxides of Nit. <input type="checkbox"/> Other _____	<input type="checkbox"/> As per EPA M-6 <input type="checkbox"/> As per EPA M-7A <input type="checkbox"/> Other _____	

Source Information

- Type of Source: Boiler Asphalt Plant Incinerator Dryer
 Other _____
- Fuel: Coal Wood Gas Oil RDF Other _____
- Is sample combustible? No Yes
- Does sample need special handling? No Yes If yes, explain _____

S-278RRRR

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job Ellsworth Camp Source Exhaust Gas
 Team Leader RR Test Site Casey Street
 Date Submitted _____ Date of Test 11-8-88
 Test No. 1 No. of Runs Completed 2
 Date of Analysis 11-10-88 Technician Mark T. Fisher

Test/Run	Sample Log Number and Type	No. of An.	Buret Readings (ml)			Conc. CO ₂ %v/v Dry	Conc. O ₂ %v/v Dry	F _o
			Zero Pt.	After CO ₂	After O ₂			
1/1	7006 -07 <input checked="" type="checkbox"/> B <input type="checkbox"/> F	1	0.00	0.42	20.88	0.42	20.46	1.046
		2	0.00	0.42	20.88	0.42	20.46	1.046
		Avg	████████████████████					
1/2	-11 <input checked="" type="checkbox"/> B <input type="checkbox"/> F	1	0.00	0.21	20.82	0.21	20.61	1.381
		2	0.00	0.21	20.82	0.21	20.61	1.381
		Avg	████████████████████					
	<input type="checkbox"/> B <input type="checkbox"/> F	1						
		2						
		Avg	████████████████████					
	<input type="checkbox"/> B <input type="checkbox"/> F	1						
		2						
		Avg	████████████████████					
	<input type="checkbox"/> B <input type="checkbox"/> F	1						
		2						
		Avg	████████████████████					
	<input type="checkbox"/> B <input type="checkbox"/> F	1						
		2						
		Avg	████████████████████					
	<input type="checkbox"/> B <input type="checkbox"/> F	1						
		2						
		Avg	████████████████████					
	<input type="checkbox"/> B <input type="checkbox"/> F	1						
		2						
		Avg	████████████████████					

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

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

EPA Method 3 Guidelines
Fuel Type F_o Range

Coal:	
Anthracite/Lignite	1.016-1.100
Bituminous	1.083-1.250
Oil:	
Distillate	1.260-1.410
Residual	1.210-1.370
Gas:	
Natural	1.600-1.836
Propane	1.434-1.586
Butane	1.405-1.550
Wood/Wood Bark	1.000-1.100

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

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Impinger Catch/Wisconsin Protocol

Job Ellsworth Coop Creamery Source Exhaust Gas
 Team Leader RR Test Site Stack
 Date Submitted _____ Date of Test 11-8-88
 Test No. 1 No. of Runs Completed 2
 Date of Analysis 11-10-88 Technician Mark Kushler

	Solvent Phase	Aqueous Phase
0	Test <u>1</u> Run <u>0</u> Field Blank Log Number <u>7006-03</u> Comments _____ Dish No. <u>79</u> Dish Tare Wt. <u>85.9320</u> g Dish+Sample Wt. <u>85.9322</u> g Sample Wt. <u>0.0002</u> g	Dish No. <u>53</u> Dish Tare Wt. <u>44.3965</u> g Dish+Sample Wt. <u>44.3968</u> g Sample Wt. <u>0.0003</u> g
1	Test <u>1</u> Run <u>1</u> Log Number <u>-06</u> Comments _____ Dish No. <u>84</u> Dish Tare Wt. <u>79.0120</u> g Dish+Sample Wt. <u>79.0132</u> g Sample Wt. <u>0.0010</u> g	Dish No. <u>55</u> Dish Tare Wt. <u>47.7777</u> g Dish+Sample Wt. <u>47.7795</u> g Sample Wt. <u>0.0015</u> g
2	Test <u>1</u> Run <u>2</u> Log Number <u>-10</u> Comments _____ Dish No. <u>41</u> Dish Tare Wt. <u>47.8896</u> g Dish+Sample Wt. <u>47.8923</u> g Sample Wt. <u>0.0025</u> g	Dish No. <u>64</u> Dish Tare Wt. <u>47.4052</u> g Dish+Sample Wt. <u>47.4057</u> g Sample Wt. <u>0.0002</u> g
3	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
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
<u>0.0002</u>	<u>0.0010</u>	<u>0.0025</u>			

Results Aqueous Phase:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
<u>0.0003</u>	<u>0.0015</u>	<u>0.0002</u>	<u>D-3</u>		

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job Ellsworth Coop Source Exhaust Gas
 Team Leader RR Test Site Stack
 Date Submitted _____ Date of Test 11-8-88
 Test No. 1 No. of Runs Completed 2
 Date of Analysis 11-10-88 Technician Mark Kachala
 Transport Leakage None _____ ml Solvent Acetone

0	Test <u>1</u> Run <u>0</u> Field Blank Log Number <u>7006-01</u> Vol. of Solvent <u>30 ml</u> *Solvent Residue <u>2.5 ug/ml</u>	Dish No. <u>1</u> Dish Tare Wt. <u>45.2872</u> g Dish+Sample Wt. <u>45.2874</u> g Sample Wt. _____ g
1	Test <u>1</u> Run <u>1</u> Vol. of Solvent <u>100 ml</u> Log Number <u>-04</u> Comments _____	Dish No. <u>10</u> Dish Tare Wt. <u>48.2549</u> g Dish+Sample Wt. <u>48.2877</u> g Sample Wt. _____ g
2	Test <u>1</u> Run <u>2</u> Vol. of Solvent <u>125 ml</u> Log Number <u>-04</u> Comments _____	Dish No. <u>14</u> Dish Tare Wt. <u>49.6184</u> g Dish+Sample Wt. <u>49.6535</u> g Sample Wt. _____ g
3	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ 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 2.5 ug/ml = [(Sample Wt. _____ g) (106)] / Vol. of Sol. _____ ml
 EPA-M5 Acetone Residue Blank Spec. (7.9 ug/ml)

Results:

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

	0.0328	0.0348	D-4		
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LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job Ellsworth Coop Creamery Source Exhaust Gas
 Team Leader RA Test Site Stack
 Date Submitted _____ Date of Test 11-8-88
 Test No. 1 No. of Runs Completed 2
 Date of Analysis 11-10-88 Technician Mark Kubler

0	Test <u>1</u> Run <u>0</u> Field Blank Log Number <u>7006-02</u> Comments _____	Filter No. <u>0570</u> Filter Type <u>4"</u> Filter Tare Wt. <u>0.9214</u> g Filter+Sample Wt. <u>0.9215</u> g Sample Wt. _____ g
1	Test <u>1</u> Run <u>1</u> Log Number _____ <u>-05</u> Comments _____	Filter No. <u>0529</u> Filter Type <u>4"</u> Filter Tare Wt. <u>0.9186</u> g Filter+Sample Wt. <u>0.9290</u> g Sample Wt. _____ g
2	Test <u>1</u> Run <u>2</u> Log Number _____ <u>-09</u> Comments _____	Filter No. <u>0563</u> Filter Type <u>4"</u> Filter Tare Wt. <u>0.9221</u> g Filter+Sample Wt. <u>0.9224</u> g Sample Wt. _____ g
3	Test _____ Run _____ Log Number _____ Comments _____	Filter No. _____ Filter Type _____ Filter Tare Wt. _____ g Filter+Sample Wt. _____ g Sample Wt. _____ 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
	0.0104	0.0003			

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0455	0.0378			

LSC-02PR

APPENDIX E

PROCESS DATA

DATE TIME OPERATOR	TANK NO.	TIME STORED	FEED TEMP.	DISCHARGE PRESSURE	MAIN DRYE TEMP. IN/OUT	ROTARY DRYER TEMP. IN/OUTLET	MOISTURE BELT FINISH	NOZZLES	PULSAIRE VACUUM	OUTSIDE AIR TEMP.	VACUUM MAIN ROTARY	SUCTION PRESSURE
10:30 AM	#2 Elliott	16 hrs	120° F	4000	244 244 111	250 399 162	12.0 3.4	10-57s 10-27A	3.7	38° F	0 8	40
11:30 AM	"	17	120	4100	244 221 111	254 462 162	12.6 3.2	"	3.8	44° F	0 8	40
12:30 AM	"	18	120	4100	244 213 112	252 332 161	12.0 3.2	"	3.9	47°	0 8	40
1:30 PM	"	19	120	4200	242 202 111	254 326 161	12.2 3.2	"	3.9	49°	0 8	40
2:30 PM	"	20	120	4200	242 192 111	251 321 160	12.4 3.4	"	3.9	51°	0 8	40
3:30 PM	"	21	120	4200	243 197 111	252 305 160	12.0 3.4	"	3.8	54°	0 8	40

L/S Smith

RECEIVED

NOV 14 1988

WINDMILL FARMERS MARK

Production

10 AM - 11 AM	- # 3400
11 AM - 12	- # 3600
12 - 1 PM	- # 3600
1 PM - 2 PM	- # 3500
2 PM - 3 PM	- # 3500

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 glass-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.

3a P2(7)

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 °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.

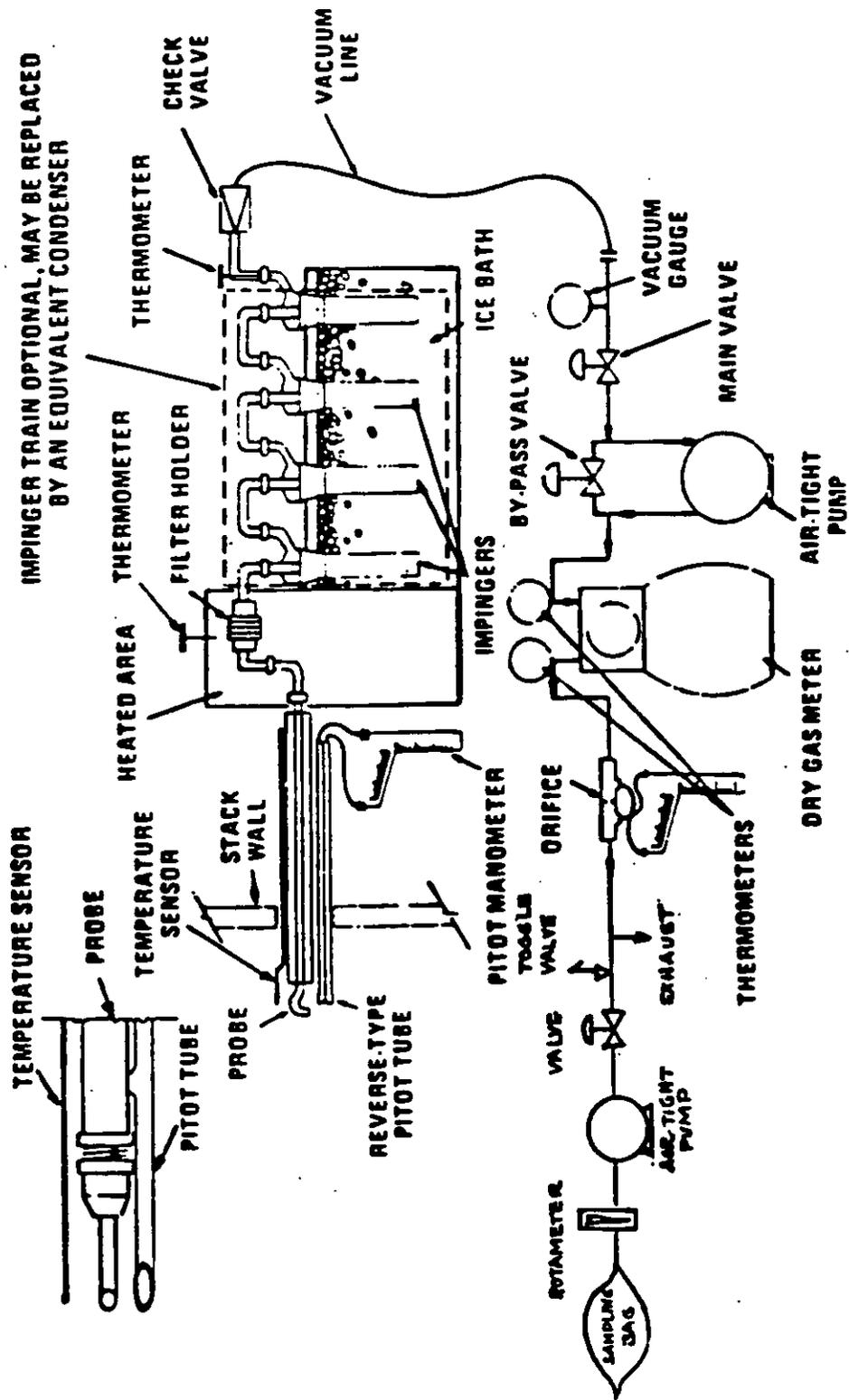
7. Desiccate for two hours in a sealed desiccator and final weigh. Report all results in grams. All weighings should be made to nearest 0.1 mg (four places).
8. The remaining liquid in the separatory funnel is then transferred to a tared beaker marked B and is evaporated to dryness at $220\text{ }^{\circ}\text{F} \pm 10\text{ }^{\circ}\text{F}$. The analyst may take an aliquot of the sample, transferring it to a tared beaker and evaporate to dryness at $220\text{ }^{\circ}\text{F} \pm 10\text{ }^{\circ}\text{F}$. 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 5

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

$$V_{w(std)} = 0.0472 V_{ls}$$

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

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

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

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

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

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

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

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

- Q_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, °F
 T_{wb} = Wet bulb temperature of stack gas, °F
 $T_{m(avg)}$ = Absolute average dry gas meter temperature, °R
 $T_{s(avg)}$ = Absolute average stack temperature, °R
 T_{std} = Standard absolute temperature, 528 °F (68 °F)
 θ = Total sampling time, min.
 V_{ic} = 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
 $vp_{t_{db}}$ = Vapor pressure at T_{db} , IN. HG
 $vp_{t_{wb}}$ = Vapor pressure at T_{wb} , IN. HG
 $\bar{\Delta H}$ = Average pressure differential across the orifice meter, IN. W.C.
 ΔP = Velocity pressure of stack gas, IN. W.C.
 γ = Dry test meter correction coefficient, dimensionless

APPENDIX H

SAMPLING TRAIN CALIBRATION DATA

Interpoll Laboratories
(612) 786-6020

Meter Box Calibration
Data Sheet

Date of Calibration: October 4, 1988
 Technician: J. Buresh
 Barometric Pressure: 29.50 IN.HG
 Meter Box No.: 3
 Dry Test Meter Serial No.: 35303
 Wet Test Meter No.: AL-20

Delta H Actual (in. WC)	Gas Volume Wet Meter (cf)	Cal. Index (%)	Diff. Wet Test Meter (in. WC)	Gas Volume		Gas Temperature of Meters		Time (min/sec)	Meter Coef.	Orifice Constant (in. WC)	
				Dry Test Meter Vd1 (cf)	Wet Test Meter Vd2 (cf)	Tw (deg-F)	Td1 Td2 (deg-F)				
.5	2	99.87	.04	569.50	240.500	74.0	83	73	5/01.24	0.9948	1.77
1.2	3	99.88	.06	566.00	238.050	74.0	83	72	4/54.48	0.9972	1.81
2.0	3	99.89	.07	562.60	244.060	73.9	82	70	3/49.90	0.9910	1.85
3.3	5	99.90	.085	572.30	249.585	73.9	92	74	5/01.91	0.9975	1.88
4.7	5	99.95	.12	578.00	255.095	73.7	94	76	4/15.95	0.9926	1.93

Gas Meter Bimetallic Thermometer Calibration/Verification* Average: 0.9946 1.86

Inlet	> ± 5°F (Out of control)	Recalibrated
X	≤ ± 5°F (in control)	X No action required
Outlet	> ± 5°F (Out of control)	Recalibrated
X	≤ ± 5°F (in control)	X No action required

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

Interpoll Laboratories
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: November 8, 1988

Meter Box No.: 3 (Rockwell Dry Test Meter Serial No. 35303)

Date of Last Calibration: October 4, 1988
Calibration Technician: J. Bureshidge
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.)
October 26, 1988	8-2652	583.25	715.53	132.28	132.28
November 3, 1988	8-2657	716.60	861.80	145.20	277.48
November 8, 1988	8-2658	862.50	936.73	74.23	351.71

* Total volume through meter since last calibration

Interpoll Laboratories
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: November 8, 1988

Nozzle Number 6-2

Technician: R. Rosenthal

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

Position	Diameter (inches)
1	0.125
2	0.126
3	0.124
Average:	0.125

INTERPOLL LABORATORIES

TEMPERATURE MEASUREMENT DEVICE CALIBRATION SHEET

Unit Under Test Calibrated Against:

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

Date 10-18-88

Technician Ron Rosenthal

Unit under test (type and number): DDT-2
ATKINS-39688

Desired Temperature (°F)	Standard Device Actual Reading (°F)	Unit Under Test Reading (°F)	Deviation* (%)
32 (ice bath)	32	32.3	0.94
70	70	69.0	1.42
120	120	119.0	0.83
200	200	200	0.00
300	300	299	0.33
400	400	397	0.75
500	500	496	0.80
800	800	799	0.13

Temperature correlation between standard device and unit under test was obtained by using a thermally isolated 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.

Unit in tolerance

Unit was not in tolerance; recalibrated