Background Report Reference

AP-42 Section Number: 9.6.1

Background Chapter: 4

Reference Number: 5

Title: Results of the March 29, 1988 Particulate Emission Compliance Test on the Whey Dryer at the F&A Dairy in Dresser, Wisconsin

Interpoll Laboratories, Inc.

April 1988

AP-42 Section 9.6.1
Reference
Report Sect. 4
Reference 5

F&A DAIRY Dresser

dried whey production

March '88 Whey Drying & Bagging System

FA

CORRESPONDENCE/MEMORANDUM

STATE OF WISCONSIN

DATE: July 15, 1988 FILE REF: 4530

TO: Files

FROM: Joe Brehm - AM/3 JB

SUBJECT: Review of the Stack Test Performed at F&A Dairy Products, Dresser

I. SOURCE

F&A Dairy Products, Inc.
P.O. Box 278
Highway 35
Dresser, WI 54009

Plant Contact: Mr. John Nelson, Manager, (715) 755-3485

FID No.: 649028820, Stack #S12, Process #P30

Test Date: March 29, 1988

II. SOURCE DESCRIPTION

The source tested was a sweet whey drying and bagging process, manufactured by Sterner Industries, Inc. The system includes a vertical spray dryer and fluidized bed, and the associated bagging operation for the dried whey. The dryer has a rated capacity of 5,000 lbs/hr of sweet whey at 50% moisture and can produce 2,500 lbs/of dry whey at 3% moisture. The dryer and fluidized bed are natural gas fired. During the test the system was operating at its rated capacity.

The drying system emissions are controlled by a venturi scrubber followed by a cyclonic separator. The pressure drop across the venturi was approximately 3.9 inches, W.C. The scrubber water recirculation to the venturi averaged 64 gallons per minute. Emissions from the bagging operation are controlled by a baghouse, with emissions from the baghouse vented back to the main exhaust duct, just before the venturi. There are also four product recovery cyclones which also help control emissions. There are two primary cyclones for the vertical spray dryer, one for the fluidized bed, and one for the product line located just before the storage hopper. Emissions from the cyclones are kept within the dryer system, they are not vented to the ambient air. The pressure drop across the cyclones was 4 inches, W.C.

III. SAMPLING OPERATION

A. Purpose of Test

The purpose of the test was to demonstrate compliance with the emission limits of permits No. 87-SJK-010 issued on May 4, 1987. The permit also required one Method 5 run to be performed to measure the particulate loading at the venturi inlet.

B. Sampling

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

Crew Chief: Mr. John Buresh, (612) 786-6020

C. Date of Test

The test was performed on March 29, 1988. It was a partly cloudy day with the winds from the west at 8 to 10 mph and an ambient temperature of 36° F.

D. Test Method

The test method used was EPA Method Five as found in the Federal Register, Volume 42, #160, August 18, 1977. The test was performed through the circular steel stack, 31 inches inside diameter. Twenty points were sampled, ten per port, for three minutes per point. Three such runs were done, which was acceptable.

E. Test Witness

Mr. Jim Ross of the Department's Northwest District Office, Spooner, was the test witness.

IV. SUMMARY OF RESULTS

The results listed are those as calculated by the Department.

Run Number	Emission Rate (lb/hr)	Emission Concentration Wet Basis (lb/1,000. lb gas)	Isokinetic Ratio (%)
1	2.55	0.0329	99.34
2	1.91	0.0245	98.62
3	1.55	0.0201	98.71
Ave.	2.00	0.0258	98.89

V. APPLICABLE EMISSION LIMIT

The emission limits that apply to this source are either 0.2 lbs/1,000 lbs exhaust gas as stated in s. NR 415.05(1)(m), Wis. Adm. Code, or using the process weight rate equation where the equation is $E = 3.59 P^{0.62}$, s. NR 415.05(2)(a)1., Wis. Adm. Code, whichever limit is more restrictive.

VI. DISCUSSION OF RESULTS

The emission concentration of 0.0258 lbs/1,000 lbs exhaust gas is well under the limit of 0.2 lbs/1,000 lbs. The process weight rate limit using 5,000 lbs as the process weight, is 6.3 lbs/hr, which is more restrictive and therefore the applicable limit. The isokinetic ratio of 98.89% is within the limits of 90%-110% that the Department uses to judge the validity of stack tests. I checked the field and laboratory test and found it to be complete and accurate. Interpoll did not check for saturated stack gas conditions, which existed, nor did they adjust the moisture collected in the sampling train accordingly. I made the corrections and ran the data through the Department's computer program. Those results are attached.

Visible emissions were at zero percent during the entire test.

A permit requirement of one Method Five run that was to be performed for particulate loading at the venturi inlet was not performed because there wasn't a proper sampling location.

The report contained all necessary calibration data for the test equipment. Operational data for the whey dryer system was obtained from the witnessing form.

JB:dl/PC14
D:\8807\AM9S&AWD.JGB

cc: Jim Ross - NWD
Joe Perez - AM/3
U.S. EPA - Region V

NAME OF SOURCE: F&A DAIRY

LOCATION OF SOURCE: DRESSER WI

PROCESS TESTED: WHEY DRYER

DATE OF TEST: 3-29-88

RUN NUMBER: 1

N NUMBER OF SAMPLING POINTS= 20

VM DGM VOL,METER COND DRY= 38.902 CFD

PB BAR PRESS,STATION= 28.95 IN HG

VL TOTAL VOL OF WATER COLLECTED= 62.4 ML

%CO2 % CARBON DIOXIDE BY VOL,DRY BASIS= .93 %

%O2 % OXYGEN BY VOL,DRY BASIS= 20.06 %

%CO % CARBON MONOXIDE BY VOL, DRY BASIS= 0 %

%N2 % NITROGEN BY VOL,DRY BASIS= 79.01 %

CP PITOT TUBE COEFFICIENT= .84

PS STACK PRESS= 28.94 IN HG

AS AREA OF THE SAMPLING SITE= 5.24 SQ FEET

MT TOTAL DRY PARTICULATE= .0438 GM

T TOTAL SAMPLING TIME= 60 MIN

AN AREA OF THE NOZZLE= .000199 SQ FEET

F&A DAIRY,WHEY DRYER,RUN: 1

PARTICULATE FIELD DATA

SAMPLING POINT NUMBER	STACK TEMP DEG F	VELOCITY PRESS IN H2O	SQ ROOT VEL PRESS	ORIFICE METER PRESS DROP IN H2O	DRY GAS METER TEMP DEG F INLET	OUTLET
1	104.0	0.940	0.96954	1.180	76.0	66.0
2	104.0	1.000	1.00000	1.250	78.0	67.0
3	104.0	1.050	1.02470	1.320	80.0	67.0
4	104.0	1.050	1.02470	1.320	80.0	67.0
5	104.0	1.070	1.03441	1.340	82.0	67.0
6	103.0	1.040	1.01980	1.310	83.0	68.0
7	103.0	1.100	1.04881	1.390	84.0	68.0
8	102.0	1.150	1.07238	1.460	84.0	69.0
9	102.0	1.100	1.04881	1.390	85.0	70.0
10	102.0	1.000	1.00000	1.270	85.0	70.0
11	103.0	1.050	1.02470	1.330	84.0	71.0
12	103.0	1.070	1.03441	1.360	85.0	71.0
13	103.0	1.090	1.04403	1.380	86.0	71.0
14	103.0	1.060	1.02956	1.350	87.0	72.0
15	103.0	1.060	1.02956	1.350	87.0	72.0
16	103.0	1.050	1.02470	1.340	88.0	73.0
17	103.0	1.200	1.09545	1.530	88.0	73.0
18	103.0	1.250	1.11803	1.590	88.0	73.0
19	103.0	1.200	1.09545	1.530	89.0	73.0
20	103.0	1.100	1.04881	1.400	90.0	74.0
AVERAGE	TS=		SR(VP)=	OP=	TM=	
VALUES	563.1 DEG R		1.039391	1.3695 IN H2O	537.275 DEG R	

F&A DAIRY,WHEY DRYER,RUN: 1

CALCULATED RESULTS

TS STACK TEMPERATURE = 103.1 DEG F

VMSTD DGM VOL,STD COND DRY= 37.11968 SCFD

VWSTD VOL OF WATER VAPOR,STD COND= 2.937168 SCF

%M % MOISTURE IN STACK GAS BY VOL,STD COND= 7.332499 %

MD MOLE FRACTION OF DRY GAS= .926675

MWD MOLECULAR WT OF STACK GAS,DRY BASIS= 28.9512 LB/LB-MOLE

MWS MOLECULAR WT OF STACK GAS,WET BASIS= 28.1482 LB/LB-MOLE

VS AVE STACK GAS VELOCITY,STACK COND= 62.05715 FPS

QACT ACTUAL STACK GAS FLOW RATE= 19510.77 CFM

QSTD AVE STACK GAS FLOW RATE,STD COND DRY= 16397.86 SCFMD

%EA AVE % EXCESS AIR= 2511.766 %

PMRA AVE PMR BY RATIO OF AREAS METHOD= 2.542663 LB/HR

PMRC AVE PMR BY CONC METHOD= 2.559439 LB/HR

PMR(AVE) AVE PMR,STD COND DRY= 2.551051 LB/HR

C EMISSION CONC,STD COND DRY= 1.820689E-02 GR/SCFD

DGR AVE STACK GAS RATE,STD COND DRY= 73872.23 LB/HR

LB/MLB EMISSION CONC,STD COND DRY= 3.453329E-02 LB/MLB OF DRY GAS

WGR AVE STACK GAS RATE,STD COND WET= 77506.45 LB/HR

LB/MLB EMISSION CONC,STD COND WET= 3.291405E-02 LB/MLB OF WET GAS

%ISR % ISOKINETIC RATIO= 99.34454 %

NAME OF SOURCE: F&A DAIRY

LOCATION OF SOURCE: DRESSER WI

PROCESS TESTED: WHEY DRYER

DATE OF TEST: 3-29-88

RUN NUMBER: 2

N NUMBER OF SAMPLING POINTS= 20

VM DGM VOL,METER COND DRY= 39.601 CFD

PB BAR PRESS,STATION= 28.95 IN HG

VL TOTAL VOL OF WATER COLLECTED= 57 ML

%CO2 % CARBON DIOXIDE BY VOL,DRY BASIS= .43 %

%O2 % OXYGEN BY VOL,DRY BASIS= 20.5 %

%CO % CARBON MONOXIDE BY VOL, DRY BASIS= 0 %

%N2 % NITROGEN BY VOL,DRY BASIS= 79.07 %

CP PITOT TUBE COEFFICIENT= .84

PS STACK PRESS= 28.94 IN HG

AS AREA OF THE SAMPLING SITE= 5.24 SQ FEET

MT TOTAL DRY PARTICULATE= .0327 GM

T TOTAL SAMPLING TIME= 60 MIN

AN AREA OF THE NOZZLE= .000199 SQ FEET

F&A DAIRY,WHEY DRYER,RUN: 2

PARTICULATE FIELD DATA

SAMPLING POINT NUMBER	STACK TEMP DEG F	VELOCITY PRESS IN H2O	SQ ROOT VEL PRESS	ORIFICE METER PRESS DROP IN H2O	DRY GAS METER TEMP DEG F INLET	OUTLET
1	102.0	1.000	1.00000	1.270	85.0	76.0
2	102.0	1.100	1.04881	1.400	88.0	76.0
3	102.0	1.100	1.04881	1.410	89.0	76.0
4	102.0	1.100	1.04881	1.410	90.0	76.0
5	102.0	1.110	1.05357	1.420	91.0	76.0
6	102.0	1.140	1.06771	1.460	92.0	77.0
7	102.0	1.250	1.11803	1.610	92.0	77.0
8	102.0	1.180	1.08628	1.520	92.0	77.0
9	102.0	1.070	1.03441	1.380	93.0	77.0
10	102.0	0.990	0.99499	1.270	93.0	78.0
11	95.0	1.000	1.00000	1.300	91.0	78.0
12	97.0	1.060	1.02956	1.380	91.0	78.0
13	99.0	1.050	1.02470	1.360	93.0	78.0
14	99.0	1.150	1.07238	1.490	93.0	79.0
15	99.0	1.180	1.08628	1.530	93.0	79.0
16	99.0	1.190	1.09087	1.540	94.0	79.0
17	99.0	1.100	1.04881	1.430	94.0	79.0
18	99.0	1.070	1.03441	1.390	94.0	79.0
19	99.0	1.100	1.04881	1.430	94.0	79.0
20	99.0	0.810	0.90000	1.050	94.0	80.0
AVERAGE VALUES	TS= 560.2 DEG R		SR(VP)= 1.041861	OP= 1.4025 IN H2O	TM= 544.75 DEG R	

F&A DAIRY,WHEY DRYER,RUN: 2

CALCULATED RESULTS

TS STACK TEMPERATURE = 100.2 DEG F

VMSTD DGM VOL,STD COND DRY= 37.27126 SCFD

VWSTD VOL OF WATER VAPOR,STD COND= 2.68299 SCF

%M % MOISTURE IN STACK GAS BY VOL,STD COND= 6.715156 %

MD MOLE FRACTION OF DRY GAS= .9328485

MWD MOLECULAR WT OF STACK GAS,DRY BASIS= 28.8888 LB/LB-MOLE

MWS MOLECULAR WT OF STACK GAS,WET BASIS= 28.1576 LB/LB-MOLE

VS AVE STACK GAS VELOCITY,STACK COND= 62.03387 FPS

QACT ACTUAL STACK GAS FLOW RATE= 19503.45 CFM

QSTD AVE STACK GAS FLOW RATE,STD COND DRY= 16586.33 SCFMD

%EA AVE % EXCESS AIR= 5474.268 %

PMRA AVE PMR BY RATIO OF AREAS METHOD= 1.89829 LB/HR

PMRC AVE PMR BY CONC METHOD= 1.924916 LB/HR

PMR(AVE) AVE PMR,STD COND DRY= 1.911603 LB/HR

C EMISSION CONC,STD COND DRY= 1.353753E-02 GR/SCFD

DGR AVE STACK GAS RATE,STD COND DRY= 74560.23 LB/HR

LB/MLB EMISSION CONC,STD COND DRY= 2.563837E-02 LB/MLB OF DRY GAS

WGR AVE STACK GAS RATE,STD COND WET= 77904.45 LB/HR

LB/MLB EMISSION CONC,STD COND WET= 2.453779E-02 LB/MLB OF WET GAS

%ISR % ISOKINETIC RATIO= 98.61678 %

NAME OF SOURCE: F&A DAIRY

LOCATION OF SOURCE: DRESSER WI

PROCESS TESTED: WHEY DRYER

DATE OF TEST: 3-29-88

RUN NUMBER: 3

N NUMBER OF SAMPLING POINTS= 20

VM DGM VOL,METER COND DRY= 39.411 CFD

PB BAR PRESS,STATION= 28.95 IN HG

VL TOTAL VOL OF WATER COLLECTED= 56.4 ML

%CO2 % CARBON DIOXIDE BY VOL,DRY BASIS= .5 %

%O2 % OXYGEN BY VOL,DRY BASIS= 20.48 %

%CO % CARBON MONOXIDE BY VOL, DRY BASIS= 0 %

%N2 % NITROGEN BY VOL,DRY BASIS= 79.02 %

CP PITOT TUBE COEFFICIENT= .84

PS STACK PRESS= 28.94 IN HG

AS AREA OF THE SAMPLING SITE= 5.24 SQ FEET

MT TOTAL DRY PARTICULATE= .0265 GM

T TOTAL SAMPLING TIME= 60 MIN

AN AREA OF THE NOZZLE= .000199 SQ FEET

F&A DAIRY,WHEY DRYER,RUN: 3

PARTICULATE FIELD DATA

SAMPLING POINT NUMBER	STACK TEMP DEG F	VELOCITY PRESS IN H2O	SQ ROOT VEL PRESS	ORIFICE METER PRESS DROP IN H2O	DRY GAS METER TEMP DEG F INLET	DRY GAS METER TEMP DEG F OUTLET
1	103.0	0.900	0.94868	1.160	89.0	80.0
2	103.0	0.990	0.99499	1.270	92.0	80.0
3	103.0	1.090	1.04403	1.400	93.0	80.0
4	103.0	1.040	1.01980	1.340	94.0	80.0
5	103.0	1.050	1.02470	1.350	94.0	80.0
6	103.0	0.990	0.99499	1.280	94.0	80.0
7	95.0	0.950	0.97468	1.240	94.0	80.0
8	95.0	1.150	1.07238	1.500	94.0	80.0
9	95.0	1.100	1.04881	1.440	94.0	80.0
10	100.0	1.030	1.01489	1.350	94.0	80.0
11	100.0	1.100	1.04881	1.430	92.0	80.0
12	100.0	1.070	1.03441	1.380	94.0	80.0
13	100.0	1.070	1.03441	1.390	94.0	80.0
14	100.0	1.050	1.02470	1.360	94.0	80.0
15	100.0	1.050	1.02470	1.360	94.0	80.0
16	100.0	1.200	1.09545	1.560	95.0	81.0
17	100.0	1.200	1.09545	1.560	95.0	81.0
18	100.0	1.250	1.11803	1.620	95.0	81.0
19	100.0	1.200	1.09545	1.560	95.0	81.0
20	100.0	0.850	0.92195	1.100	95.0	81.0
AVERAGE	TS=		SR(VP)=	DP=	TM=	
VALUES	560.15 DEG R		1.031564	1.3825 IN H2O	547 DEG R	

F&A DAIRY,WHEY DRYER,RUN: 3

CALCULATED RESULTS

TS STACK TEMPERATURE = 100.15 DEG F

VMSTD DGM VOL,STD COND DRY= 36.93799 SCFD

VWSTD VOL OF WATER VAPOR,STD COND= 2.654748 SCF

%M % MOISTURE IN STACK GAS BY VOL,STD COND= 6.705139 %

MD MOLE FRACTION OF DRY GAS= .9329486

MWD MOLECULAR WT OF STACK GAS,DRY BASIS= 28.8992 LB/LB-MOLE

MWS MOLECULAR WT OF STACK GAS,WET BASIS= 28.16839 LB/LB-MOLE

VS AVE STACK GAS VELOCITY,STACK COND= 61.40628 FPS

QACT ACTUAL STACK GAS FLOW RATE= 19306.13 CFM

QSTD AVE STACK GAS FLOW RATE,STD COND DRY= 16421.75 SCFMD

%EA AVE % EXCESS AIR= 5371.395 %

PMRA AVE PMR BY RATIO OF AREAS METHOD= 1.538369 LB/HR

PMRC AVE PMR BY CONC METHOD= 1.558404 LB/HR

PMR(AVE) AVE PMR,STD COND DRY= 1.548386 LB/HR

C EMISSION CONC,STD COND DRY= 1.106977E-02 GR/SCFD

DGR AVE STACK GAS RATE,STD COND DRY= 73846.99 LB/HR

LB/MLB EMISSION CONC,STD COND DRY= 2.096749E-02 LB/MLB OF DRY GAS

WGR AVE STACK GAS RATE,STD COND WET= 77152.73 LB/HR

LB/MLB EMISSION CONC,STD COND WET= 2.006911E-02 LB/MLB OF WET GAS

%ISR % ISOKINETIC RATIO= 98.71443 %

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

Telephone (612) 786-6020
Telecopier (612) 786-7854

RESULTS OF THE MARCH 29, 1988 PARTICULATE EMISSION COMPLIANCE TEST ON THE WHEY DRYER AT THE F & A DAIRY IN DRESSER, WISCONSIN

Submitted to:

STERNER INDUSTRIES
P.O. Box 70
Winsted, Minnesota 55395

Attention: Rolf Brown

Approved by:

Perry Lonnes, Ph.D.
President

Report Number 8-2528
April 12, 1988

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

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

I INTRODUCTION

On March 29, 1988, Interpoll Laboratories personnel conducted a particulate emission compliance test on the Whey Dryer at the F & A Dairy located in Dresser, Wisconsin. On-site testing was performed by J. Buresh and T. Hogan. Coordination between testing activities and plant operation was provided by John Nelson of F & A Dairy. The test was witnessed by Jim Ross of the Wisconsin Department of Natural Resources.

The Whey Dryer tested is a Sterner Industries tall form dryer. It is direct-fired with natural gas and has a rated capacity of 5000 LB/HR of wet product. Particulate emissions are controlled by a venturi wet scrubber.

Evaluations were performed in accordance with EPA Methods 1 - 5, CFR Title 40, Part 60, Appendix A (revised July 1, 1987). A preliminary determination of the gas linear velocity profile was made before the first particulate determination to allow selection of the appropriate nozzle diameter required for isokinetic sample withdrawal. An Interpoll 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. The back half of the Method 5 sampling train was used to collect samples for the determination of total condensible organic and inorganic compounds.

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. 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 two test ports oriented at 90 degrees on the stack. These test ports are located more than five diameters downstream of the nearest flow disturbance and ten diameters upstream of the stack exit. A 20-point traverse was used to extract representative particulate samples. Each traverse point was sampled three minutes to give a total sampling time of 60 minutes per run.

The important results of the tests 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 2.0 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 tests were performed.

TABLE 1. Summary of the Results of the March 29, 1988 Particulate Emission Compliance Test on the Whey Dryer at the F & A Dairy Located in Dresser, Wisconsin.

ITEM		Run 1	Run 2	Run 3
Date of test		03-29-88	03-29-88	03-29-88
Time runs were done	(HRS)	931/1035	1111/1215	1250/1354
Process rate	(KLB/HR) wet basis	5.18	4.87	5.01
Volumetric flow				
actual	(ACFM)	19516	19509	19305
standard	(DSCFM)	16403	16590	16437
Gas temperature	(DEG-F)	103	100	100
Moisture content	(%V/V)	7.33	6.72	6.66
Gas composition	(%V/V,dry)			
carbon dioxide		0.93	0.43	0.50
oxygen		20.06	20.50	20.48
nitrogen		79.01	79.07	79.02
Isokinetic variation	(%)	99.4	98.7	98.7
Particulate concentration				
actual	(GR/ACF)	.0153	.0115	.00943
standard	(GR/DSCF)	.0182	.0135	.0111
Part. emission rate	(LB/HR)	2.56	1.93	1.56

* Dry + wet catch as per Wisconsin DNR protocol.

3 RESULTS

The results of all field and laboratory evaluations are presented in this section. Gas composition results (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 (as recommended by the EPA) rather than the ratio of areas method.

Test No. 1
Whey Dryer Stack

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

Date of run	Run 1 03-29-88	Run 2 03-29-88	Run 3 03-29-88
Dry basis (orsat)			
carbon dioxide.....	0.93	0.43	0.50
oxygen.....	20.06	20.50	20.48
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.01	79.07	79.02
Wet basis (orsat)			
carbon dioxide.....	0.86	0.40	0.47
oxygen.....	18.59	19.12	19.12
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	73.22	73.76	73.76
water vapor.....	7.33*	6.72*	6.66*
Dry molecular weight.....	28.95	28.89	28.90
Wet molecular weight.....	28.15	28.16	28.17
Specific gravity.....	0.972	0.973	0.973
Water mass flow.....(LB/HR)	3683	4299	3768

* Free or condensed water in the gas stream.

FO	0.903	0.930	0.840

Test No. 1
Whey Dryer Stack

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

	Run 1	Run 2	Run 3
Date of run	03-29-88	03-29-88	03-29-88
Time run start/end.....(HRS)	931/1035	1111/1215	1250/1354
Static pressure.....(IN.WC)	-0.12	-0.12	-0.12
Cross sectional area (SQ.FT)	5.24	5.24	5.24
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	50.0	58.0	54.0
desiccant.....(GRAMS)	13.0	15.0	10.0
total.....(GRAMS)	63.0	73.0	64.0
Total particulate material..			
.....collected(grams)	0.0438	0.0327	0.0265
Gas meter coefficient.....	0.9980	0.9980	0.9980
Barometric pressure..(IN.HG)	28.95	28.95	28.95
Avg. orif.pres.drop..(IN.WC)	1.37	1.40	1.38
Avg. gas meter temp..(DEF-F)	77.2	84.7	87.0
Volume through gas meter....			
at meter conditions...(CF)	38.98	39.68	39.49
standard conditions.(DSCF)	37.11	37.26	36.92
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.191	.191	.191
Avg.stack gas temp ..(DEG-F)	103	100	100
Volumetric flow rate.....			
actual.....(ACFM)	19516	19509	19305
dry standard.....(DSCFM)	16403	16590	16437
Isokinetic variation.....(%)	99.4	98.7	98.7
Particulate concentration...			
actual.....(GR/ACF)	0.01530	0.01151	0.00943
dry standard.....(GR/DSCF)	0.01821	0.01354	0.01107
Particle mass rate...(LB/HR)	2.56	1.93	1.56

APPENDIX A

RESULTS OF PRELIMINARY VOLUMETRIC FLOW RATE DETERMINATIONS

Test No. 1
Whey Dryer Stack

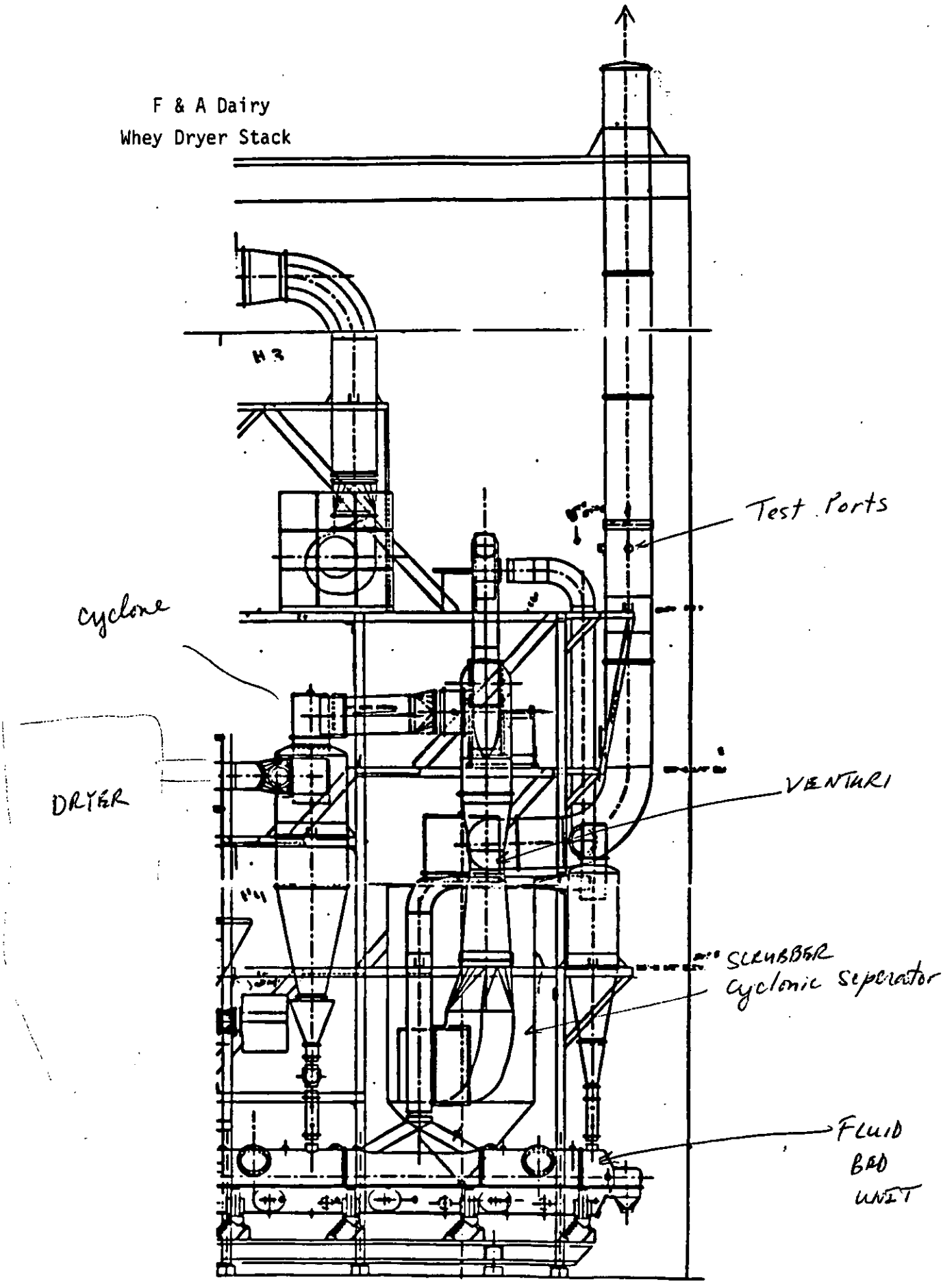
Results of Volumetric Flow Rate Determination-------Method 2

Date of Determination.....	03-29-88
Time of Determination.....(HRS)	900
Barometric pressure.....(IN.HG)	28.95
Pitot tube coefficient.....	.84
Number of sampling ports.....	2
Total number of points.....	20
Shape of duct.....	Round
Stack diameter.....(IN)	31
Duct area.....(SQ.FT)	5.24
Direction of flow.....	UP
Static pressure.....(IN.WC)	-.12
Avg. gas temp.....(DEG-F)	104
Moisture content.....(% V/V)	7.33
Avg. linear velocity.....(FT/SEC)	61.9
Gas density.....(LB/ACF)	.06624
Molecular weight.....(LB/LBMOLE)	28.95
Mass flow of gas.....(LB/HR)	77340
Volumetric flow rate.....	
actual.....(ACFM)	19459
dry standard.....(DSCFM)	16341

APPENDIX B

LOCATION OF TEST PORTS

F & A Dairy
Whey Dryer Stack



APPENDIX C

METHODS 2 - 5 FIELD DATA SHEETS

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job F+A Dairy / STERNER

Source Whey Dryer

Test 1 Run 1 Date 3-29-88

Stack dimen. 31 IN.

Dry bulb 104 deg-F

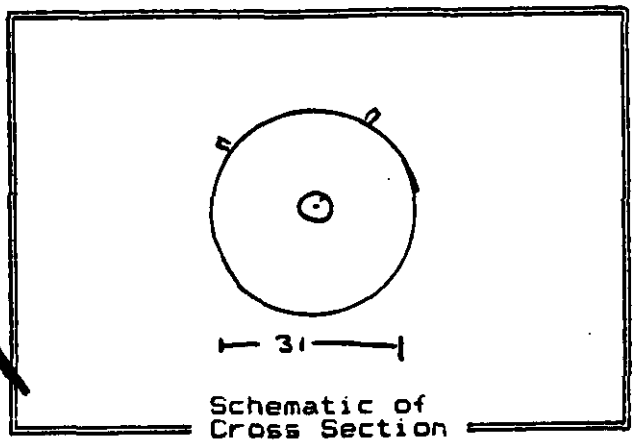
Wet bulb 104 deg-F

Barometric pressure 28.95 in Hg

Static pressure -.12 in WC

Operators John Burnett + Ted Hagen

Pitot No. U16-4 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 (deg-F)
		Port length:	in.	Time start: 0900	hrs
A - 1		1.00	5.25	.94	104
2		2.54	6.79	1.10	104
3		4.53	8.79	1.15	104
4		7.01	11.26	1.10	104
5		10.60	14.85	1.10	103
6		20.40	24.65	1.07	103
7		23.99	28.24	1.05	103
8		26.47	30.72	1.04	103
9		28.46	32.71	.97	103
10		30.00	34.25	.85	103
B 1				1.10	103
2				1.20	103
3				1.25	104
4				1.20	104
5				1.05	104
6				1.06	104
7				1.06	104
8				1.09	104
9				1.07	104
10				1.05	104
Temp. measure device:		Digital #1		Time end: 0914	hrs

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job PA DAIRY / STERNER Date 3-29-88 Test 1 Run 1
Source Whey Dryer No. of traverse points 20
Method 5 Filter holder: Glass Filter type: Glass Fiber

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☑
Postest: 0.00 cfm at 5.3 in. Hg. (vac) ☑

Particulate Catch Data:

No.s of filters used: 0100

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

No. of probe wash bottles:
Sample recovered by: J BURESH

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	544	494	50
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1350	1337	13
Total			63

Integrated Gas Sampling Data:

Bag Pump No. B-1 Box No. 7 Bag No. 1
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0.00 cc/min at 15 in. Hg.
Time start: 0932 (HRS) Time end: 1034 (HRS)
Sampling rate: 400 cc/min Operator: J BURESH
S/N of O_2 Analyzer used to monitor train outlet: 9

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job: FFA Dairy / STERNER
Source: Whey Dryer
Date: 3-29-88 Test 1 Run 1

Operators: JB+TH
Meter Box No.: 8
Coeaster coeff.: .9980

Pitot No.: V16-4 Cp: .840
Bar. Press.: 28.55 inHg H2O 8 %
Nozzle No.: 4-3 Nozzle Dia .191 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (v/v)
	0931	216.70											
A - 10	3	218.51	.94	1.18	8.51	2.8	104	260	260	55	76	66	19.4
9	6	220.41	1.00	1.25	0.41	2.9	104			55	78	67	20.4
8	9	222.25	1.05	1.32	2.26	3.2	104			55	80	67	20.4
7	12	224.17	1.05	1.32	4.17	3.3	104	265	260	55	80	67	20.4
6	15	226.10	1.07	1.34	6.10	3.5	104			56	82	67	20.4
5	18	228.00	1.04	1.31	8.00	3.4	103			56	83	68	20.4
4	21	229.96	1.10	1.39	9.96	3.7	103	247	260	57	84	68	20.4
3	24	231.96	1.15	1.46	1.97	3.7	102			57	84	69	20.4
2	27	233.94	1.10	1.39	3.94	3.8	102			58	85	70	20.4
1	30	235.82	1.00	1.27	5.82	3.5	102			57	85	70	20.4
B 10	33	237.71	1.05	1.33	7.74	3.6	103	245	260	58	84	71	20.4
9	36	239.68	1.07	1.36	9.68	3.7	103			58	85	71	20.4
8	39	241.65	1.09	1.39	1.65	3.7	103			58	86	71	20.4
7	42	243.58	1.06	1.35	3.58	3.6	103			58	87	72	20.4
6	45	245.52	1.06	1.35	5.52	3.6	103			58	87	72	20.4
5	48	247.45	1.05	1.34	7.45	3.6	103	245	260	58	88	73	20.4
4	51	249.52	1.20	1.53	9.52	4.2	103			58	88	73	20.4
3	54	251.63	1.25	1.59	1.63	4.4	103	248	250	58	88	73	20.1
2	57	253.69	1.20	1.53	3.70	4.3	103			58	89	73	20.4
1	60	255.68	1.10	1.40	5.68	4.1	103			58	90	74	20.4
	(1035)												
	θ = 60	Vs = 38.98		ΔH = 1.37							Avg. ~~103.1~~ 77.2		

0929 35700
1035 30000

C-3

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job FrA DAIRY / STERNER Date 3-29-88 Test 1 Run 2
Source Whey Dryer No. of traverse points 20
Method 5 Filter holder: Glass Filter type: Glass Fiber

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☑
Postest: 0.00 cfm at 59 in. Hg. (vac) ☐

Particulate Catch Data:

No.s of filters used: 0101

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

No. of probe wash bottles:
Sample recovered by:

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	552	494	58
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1488	1473	15
Total			73

Integrated Gas Sampling Data:

Bag Pump No. B1 Box No. 7 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0.00 cc/min at 15 in. Hg.
Time start: 1112 (HRS) Time end: 1214 (HRS)
Sampling rate: 400 cc/min Operator: JB
S/N of O_2 Analyzer used to monitor train outlet: 9

CF-023

S-0046RR

CF

[illegible] METHOD 5 FIELD DATA SHEET

Job FYA DAIRY / STERNER
Source WHEY Dryer
Date 3-29-88 Test 1 Run 2

Operators JB + TH
Meter Box No. 8
Counter coeff. .9980

Pitot No. U16-4 Cp .840
Bar. Press. 28.95 inHg H2O ___ %
Nozzle No. 4-3 Nozzle Dia .191 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dry. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas In	Gas Out	Oxygen (%v/v)
	(1111)	255.90											
B- 10	3	257.77	1.00	1.27	7.77	3.7	102	250	230	50	85	76	20.6
9	6	259.76	1.10	1.40	9.76	3.9	102			50	88	76	20.3
8	9	261.71	1.10	1.41	1.74	4.2	102			50	89	76	20.3
7	12	263.73	1.10	1.41	3.73	4.2	102	250	250	51	90	76	20.3
6	15	265.73	1.11	1.42	5.73	4.3	102			51	91	76	20.3
5	18	267.76	1.14	1.46	7.76	4.7	102			51	92	77	20.3
4	21	269.81	1.25	1.61	9.89	5.1	102			51	92	77	20.3
3	24	271.94	1.18	1.52	1.95	5.0	102	250	250	52	92	77	20.3
2	27	273.92	1.07	1.38	3.92	4.5	102			52	93	77	20.3
1	30	275.82	.99	1.27	5.82	4.0	102			52	93	78	20.3
A 10	33	277.74	1.00	1.30	7.74	4.0	95			52	91	78	20.3
9	36	279.71	1.06	1.38	9.71	4.3	97			53	91	78	20.3
8	39	281.64	1.05	1.36	1.66	4.4	99	239	250	54	93	78	20.3
7	42	283.71	1.15	1.49	3.71	4.7	99			54	93	79	20.3
6	45	285.78	1.18	1.53	5.79	4.9	99			54	93	79	20.4
5	48	287.84	1.19	1.54	7.88	5.0	99			54	94	79	20.4
4	51	289.88	1.10	1.43	9.88	4.6	99	295	250	54	94	79	20.4
3	54	291.87	1.07	1.39	1.87	4.7	99			54	94	79	20.4
2	57	293.87	1.10	1.43	3.87	4.7	99			54	94	79	20.3
1	60	295.58	.81	1.05	5.60	3.6	99			54	94	80	20.3
	(1215)												
	θ = 60	Vm = 39.68		ΔH = 1.40							Avg. = 84.7		

(1110) 27300
1219 21700

C-5

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job FY A DAIRY / STERNER Date 3-29 Test 1 Run 3
Source Whey Dryer No. of traverse points 20
Method 5 Filter holder: Glass Filter type: Glass Fiber

Sample Train Leak Check:

Pretest: 0.02 cfm at 15 in. Hg. (vac) ☑
Postest: 0.00 cfm at 6 in. Hg. (vac) ☑

Particulate Catch Data:

No.s of filters used: 0102

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

No. of probe wash bottles:
Sample recovered by: JBURESH

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	549	495	54
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1360	1350	10
Total			64

Integrated Gas Sampling Data:

Bag Pump No. B / Box No. 7 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0.00 cc/min at 15 in. Hg.
Time start: 1251 (HRS) Time end: 1363 (HRS)
Sampling rate: 400 cc/min Operator: JBURESH
S/N of O_2 Analyzer used to monitor train outlet: 9

CF-023

S-0046RR

CF

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job FRADAIRY / STERNER
Source Wet Dryer
Date 3-29-88 Test 1 Run 3

Operators JB + TH
Meter Box No. 9
Coeffic coeff. .9980

Pitot No. U16-4 Cp .840
Bar. Press. 28.95 inHg H2O 8 X
Nozzle No. #-3 Nozzle Dia .191 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F)						Oxygen
							Stack	Probe	Oven	Impg.	Gas In	Gas Out	(v/v)
	(1250)	295.80											
A - 10	3	297.60	.90	1.16	7.60	2.6	103	248	230	51	89	80	20.5
9	6	299.49	.99	1.27	9.49	3.5	103			51	92	80	20.3
8	9	301.48	1.09	1.40	1.48	3.7	103			51	93	80	20.3
7	12	303.43	1.04	1.31	3.43	3.7	103	248	240	51	94	80	20.1
6	15	305.39	1.05	1.35	5.39	3.7	103			51	94	80	20.3
5	18	307.29	.99	1.28	7.29	3.4	103			52	94	80	20.3
4	21	309.17	.95	1.24	9.17	3.5	95	247	250	52	94	80	20.3
3	24	311.23	1.15	1.50	1.23	4.0	95			53	94	80	20.3
2	27	313.25	1.10	1.44	3.25	4.0	95			53	94	80	20.3
1	30	315.20	1.03	1.35	5.20	4.0	95	247	250	53	94	80	20.3
B 10	33	317.21	1.10	1.43	7.21	4.0	100			53	92	80	20.3
9	36	319.19	1.07	1.38	9.19	4.0	100			53	94	80	20.3
8	39	321.19	1.07	1.39	1.17	4.0	100			53	94	80	20.3
7	42	323.13	1.05	1.36	3.13	4.0	100	248	255	53	94	80	20.3
6	45	325.10	1.05	1.36	5.09	4.0	100			54	94	80	20.3
5	48	327.19	1.20	1.56	7.19	4.3	100			54	95	81	20.3
4	51	329.29	1.20	1.56	9.29	4.3	100			54	95	81	20.3
3	54	331.41	1.25	1.62	1.44	4.5	100	253	255	54	95	81	20.3
2	57	333.54	1.20	1.56	3.54	4.3	100			54	95	81	20.3
1	60	335.71	.85	1.10	5.71	4.	100			54	95	81	20.3
	θ = 1354	Vm = 39.99		ΔH = 1.34							Avg. =	87.0	

(1254)
19200
(1403)
13100

C-7

APPENDIX D

LABORATORY DATA SHEETS

Interpoll Inc.
(612)786-6020

Pg 1 of 1

Chain of Custody
Sample Deposition Sheet

Job F+A DAIRY / STERNER
Site Whey Dryer
Team Leader John BURESH
Priority
Date Submitted 3-29-88
Received by
Test No(s). 1
Number of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Date Analyzed	Other Information or Special Instructions
3 + 1	Probe Wash Solvent(s):	☑ As per EPA 5 ☐ _____ _____		
3 + 1	Filter: ☑ 4" glass fiber ☐ Stainless steel ☐ ERC	☑ As per EPA 5 ☐ _____ _____		
3 + 1	Wet Catch	☑ Organic ☐ Inorganic ☐ Other	Wi	
3	Orsat	O_2 & CO_2		
—	SO_2			
—	SO_2 Audit Sample			EPA Control No(s).
—	NO_x (Open box tops after unloading)	☐ Colorimetric ☐ Ion Chromatographic		Date / / & Time of arrival at Interpoll
—	NO_x Audit Sample			EPA Control No(s).
—	Fuel Sample			

Source Information

1) Type of source: ☐ Boiler ☐ Asphalt Plant ☐ Incinerator ☑ Other DRYER
2) Fuel: ☐ Coal ☐ Wood ☑ Gas ☐ Oil ☐ Other _____
3) Is sample combustible? ☑ No ☐ Yes
4) Does sample need special desiccating? ☑ No ☐ Yes If yes, explain _____
5) Is particle size analysis required ☐ No ☐ Yes If yes, how many run(s)? _____
run preference _____

S-278RRRR

EPA METHOD 3

LABORATORY REPORT

SUMMARY OF ORSAT DATA

Job: F.A Dairy
Sampling Location: Whey Dryer/Stack
Sampling Date: 3-29-88
Analysis Date: 3-30-88
Technician: JR

Test # 1
Run # 123

TEST NO. AND DATE	RUN NO.	RESULTS						
		INTEGRATED (BAG)			GRAB (BULB)			O_2 ANALYZER
		% CO_2	% O_2	% CO	% CO_2	% O_2	% CO	% O_2
3-30-88 / 1	1	0.43	20.06					
/ 1	2	0.43	20.50					
1	3	0.50	20.48					

LSC-05

Interpoll Inc.
(612)786-6020

EPA Method 3 Data Sheet (Orsat Analysis)

Technician WK
Orsat Analyzer No. #1
Job EPA Dairy / Sterner
City/State WI Fuel Type

Date of Analysis 1-30-88
Leak Check Performed ☒ YES ☐ NO
Source Whey Dryer
Test Site Stack

Sample Identification		Test/Run	Analysis No.	Buret Readings (cc)			Concentration (% v/v,dry)		F_o
				Zero Point	After CO_2	After O_2	CO_2	O_2	
Ambient Air				0.00	0.00	20.90	0.00	20.90	
5984-07	F	1/1	1	0.00	0.93	20.99	0.93	20.06	0.903
	B		2	0.00	0.93	20.99	0.93	20.06	0.903
			3						
			AVG				0.93	20.06	
-11	F	1/2	1	0.00	0.43	20.93	0.43	20.50	0.930
	B		2	0.00	0.43	20.93	0.43	20.50	0.930
			3						
			AVG				0.43	20.50	
-10	F	1/3	1	0.00	0.50	20.98	0.50	20.48	0.840
	B		2	0.00	0.50	20.98	0.50	20.48	0.840
			3						
			AVG				0.50	20.48	

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

Note 1 Analyses performed as per CFR title 40, Part 60, Appendix A, Method 3; KOH for CO_2 and reduced methylene blue for O_2 absorption using a Burrell Orsat Analyzer with a 100 cc buret.

Note 2 Use PC-3 Program "ORSAT" Version 6-85.

(EPA Method 5) Impinger Wash (Wet Catch)
Gravimetric Analysis Lab: Organics/Inorganics

Date of Analysis 4-2-88 Data Sheet FR 42(160)

Technician MK Project No. _____

interpoll

Job F+A DAIRY/STERNER Date 3-29-88
City/State DRESSER, WI Log # 5959-03
Source Whey Dryer
Test Site STACK
Sample type Wet Catch Tech JB
Remarks: Blk Test/Run 1/D
_____ of _____

Special Handling _____

☐ Organics
Evap. Dish No. 5
Blk. (Solv) Wt. — g
E. Dish Tare Wt. 45.2270 g
E. Dish + Sample Wt. $\frac{2}{3}$ g 45.2272

☐ Inorganics
Evap. Dish No. 47
E. Dish Tare Wt. 50.0391 g
E. Dish + Sample Wt. $\frac{1}{2}$ g 50.0391

Comments _____

interpoll

Job _____ Date _____
City/State _____ J/N _____
Source _____
Test Site _____
Sample type _____ Tech _____
Remarks: Test/Run _____
_____ of _____

Special Handling _____

☐ Organics
Evap. Dish No. _____
Blk. (Solv) Wt. _____ g
E. Dish Tare Wt. $\frac{1}{2}$ _____ g
E. Dish + Sample Wt. $\frac{2}{3}$ _____ g

☐ Inorganics
Evap. Dish No. _____
E. Dish Tare Wt. _____ g
E. Dish + Sample Wt. $\frac{1}{2}$ _____ g

Comments _____

interpoll

Job _____ Date _____
City/State _____ J/N _____
Source _____
Test Site _____
Sample type _____ Tech _____
Remarks: Test/Run _____
_____ of _____

Special Handling _____

☐ Organics
Evap. Dish No. _____
Blk. (Solv) Wt. _____ g
E. Dish Tare Wt. $\frac{1}{2}$ _____ g
E. Dish + Sample Wt. $\frac{2}{3}$ _____ g

☐ Inorganics
Evap. Dish No. _____
E. Dish Tare Wt. _____ g
E. Dish + Sample Wt. $\frac{1}{2}$ _____ g

Comments _____

RESULTS:

	1	2	3
ORGANICS	0.0002		
INORGANICS			

LSC-03G

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Date of Analysis 3-31-89
Technician [signature]

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 0 µg/cc

(1)

interpoll

Job FYA DAIRY / STERNER Date 3-29-88
City/State DRESSER WI Log # 5909-01
Source ~~WHEY~~ WHEY DRYER
Test Site STACK
Sample type PW Tech JB
Remarks: Blank Test/Run 1/0
____ of ____

Special Handling Required ____
Evaporating Dish No. 36
Volume of acetone 100 cc (1)
E. Dish Tare Wt. 43.5639 g (2)
E. Dish + Sample Wt. 43.5639 g (3)
Comments ____

(2)

interpoll

Job ____ Date ____
City/State ____ Log# ____
Source ____
Test Site ____
Sample type ____ Tech ____
Remarks: Test/Run ____
____ of ____

Special Handling Required ____
Evaporating Dish No. ____
Volume of acetone ____ cc (1)
E. Dish Tare Wt. ____ g (2)
E. Dish + Sample Wt. ____ g (3)
Comments ____

(3)

interpoll

Job ____ Date ____
City/State ____ Log# ____
Source ____
Test Site ____
Sample type ____ Tech ____
Remarks: Test/Run ____
____ of ____

Special Handling Required ____
Evaporating Dish No. ____
Volume of acetone ____ cc (1)
E. Dish Tare Wt. ____ g (2)
E. Dish + Sample Wt. ____ g (3)
Comments ____

RESULTS:

1	2	3

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Date of Analysis 3-30-88

Technician MK

---

(1)

interpoll

Job FtA Dairy / Sterner Date 3-29-88
City/State WI Log# 5989-02
Source Whey Dryer
Test Site Stack
Sample type _____ Tech TB
Remarks: Test/Run 1/0
1 of 1

Special Handling Required _____

Filter No. 0105
Filter Type 4"
Filter Tare Wt. 0.9510 $_1$ g
Filter + Sample Wt. 0.9510 $_2$ g
Comments _____

---

(2)

interpoll

Job _____ Date _____
City/State _____ Log# _____
Source _____
Test Site _____
Sample type _____ Tech _____
Remarks: Test/Run _____
_____ of _____

Special Handling Required _____

Filter No. _____
Filter Type _____
Filter Tare Wt. _____ $_1$ g
Filter + Sample Wt. _____ $_2$ g
Comments _____

---

(3)

interpoll

Job _____ Date _____
City/State _____ Log# _____
Source _____
Test Site _____
Sample type _____ Tech _____
Remarks: Test/Run _____
_____ of _____

Special Handling Required _____

Filter No. _____
Filter Type _____
Filter Tare Wt. _____ $_1$ g
Filter + Sample Wt. _____ $_2$ g
Comments _____

RESULTS:

1	2	3

LSC-02P

(EPA Method 5) Impinger Wash (Wet Catch)
Gravimetric Analysis Lab: Organics/Inorganics
Date of Analysis 4-2-88 Data Sheet FR 42(160)
Technician [illegible] Project No. _____

interpoll

Job F+A DAIRY / STERNER Date 3-29-88
City/State DRESSER WI Log # 6999 -06
Source Whey Dryer
Test Site STACK
Sample type Wet Catch Tech JB
Remarks: Test/Run 1/1
_____ of _____

Special Handling _____

☑ Organics
Evap. Dish No. 6
Blk. (Solv) Wt. 0.0002 g
E. Dish Tare Wt. 49.1354 g
E. Dish + Sample Wt. 1 / 2 / 3 g 49.1424

☑ Inorganics
Evap. Dish No. 24
E. Dish Tare Wt. 49.5984 g
E. Dish + Sample Wt. 1 / 2 g 49.6178

Comments _____

interpoll

Job F+A DAIRY / STERNER Date 3-29-88
City/State DRESSER WI Log # -10
Source Whey Dryer
Test Site STACK
Sample type Wet Catch Tech JB
Remarks: Test/Run 1/2
_____ of _____

Special Handling _____

☐ Organics
Evap. Dish No. 38
Blk. (Solv) Wt. 0.0002 g
E. Dish Tare Wt. 49.6180 g
E. Dish + Sample Wt. 1 / 2 / 3 g 49.6217

☐ Inorganics
Evap. Dish No. 31
E. Dish Tare Wt. 45.8047 g
E. Dish + Sample Wt. 1 / 2 g 45.8153

Comments _____

interpoll

Job F+A Dairy / STERNER Date 3-29-88
City/State DRESSER / WI Log # -14
Source Whey Dryer
Test Site STACK
Sample type Wet Catch Tech JB
Remarks: Test/Run 1/3
_____ of _____

Special Handling _____

☐ Organics
Evap. Dish No. 70
Blk. (Solv) Wt. 0.0002 g
E. Dish Tare Wt. 49.1550 g
E. Dish + Sample Wt. 1 / 2 / 3 g 49.1587

☐ Inorganics
Evap. Dish No. 64
E. Dish Tare Wt. 42.4054 g
E. Dish + Sample Wt. 1 / 2 g 42.4114

Comments _____

RESULTS:

	1	2	3
ORGANICS	0.0068 ✓	0.0035 ✓	0.0035 ✓
INORGANICS	0.0194 D-7	0.0106 ✓	0.0060 ✓
	.0262	.0141	.0095

LSC-03G

INTERPOLL INC.
EPA Method 5 Probe (Cyclone) Wash
Gravimetric Analysis Laboratory Data Sheet
(CFR Title 40 Part 60 Appendix A)

Date of Analysis 3-31-88
Technician [signature]

EPA-M5 Acetone R.B SPEC ≤ 7.8 µg/cc
Actual acetone residue blank 0 µg/cc

(1)

interpoll

Job Fr A Dairy / STERNER Date 3-29-88
City/State DRESSER WI Log # 5289-04
Source Whey Dryer
Test Site STACK
Sample type PW Tech JB
Remarks: Test/Run 1/1
of

Special Handling Required
Evaporating Dish No. 7
Volume of acetone 110 cc
E. Dish Tare Wt. 48.1845 g
E. Dish + Sample Wt. 48.2116 g
Comments

(2)

interpoll

Job Fr A Dairy / STERNER Date 3-29-88
City/State DRESSER WI Log # -08
Source Whey Dryer
Test Site STACK
Sample type PW Tech JB
Remarks: Test/Run 1/2
of

Special Handling Required
Evaporating Dish No. 20
Volume of acetone 90 cc
E. Dish Tare Wt. 48.4154 g
E. Dish + Sample Wt. 48.4422 g
Comments

(3)

interpoll

Job Fr A Dairy / STERNER Date 3-29-88
City/State DRESSER WI Log # -12
Source Whey Dryer
Test Site STACK
Sample type PW Tech JB
Remarks: Test/Run 1/3
of

Special Handling Required
Evaporating Dish No. 25
Volume of acetone 115 cc
E. Dish Tare Wt. 44.3438 g
E. Dish + Sample Wt. 44.3682 g
Comments

RESULTS:

1 0.0272 D-8 2 0.0268 ✓ 3 0.0244 ✓

(EPA Method 5) Filter
Gravimetric Analysis Lab
Data Sheet
FR 42(160)

Date of Analysis 3-30-88
Technician MK

---

(1)

interpoll

Job F+A Dairy/Sterner Date 3-29-88
City/State WI Log# 5989-03
Source Whey Dryer
Test Site Stack
Sample type _____ Tech JB
Remarks: Test/Run 1/1
1 of 1

Special Handling Required _____
Filter No. 0100
Filter Type 4"
Filter Tare Wt. 0.9573 g
Filter + Sample Wt. 0.9477 g
Comments _____

---

(2)

interpoll

Job F+A Dairy/Sterner Date 3-29-88
City/State WI Log# -09
Source Whey Dryer
Test Site Stack
Sample type _____ Tech JB
Remarks: Test/Run 1/2
1 of 1

Special Handling Required _____
Filter No. 0101
Filter Type 4"
Filter Tare Wt. 0.9526 g
Filter + Sample Wt. 0.9444 g
Comments _____

---

(3)

interpoll

Job F+A Dairy/Sterner Date 3-29-88
City/State WI Log# -13
Source Whey Dryer
Test Site Stack
Sample type _____ Tech JB
Remarks: Test/Run 1/3
1 of 1

Special Handling Required _____
Filter No. 0102
Filter Type 4"
Filter Tare Wt. 0.9536 g
Filter + Sample Wt. 0.9462 g
Comments _____

RESULTS:

1	2	3
0	0	0
-0.0096	-0.0082	-0.0074
0.0438	0.0327	0.0265

D-9

LSC-02P

APPENDIX E

PROCESS DATA

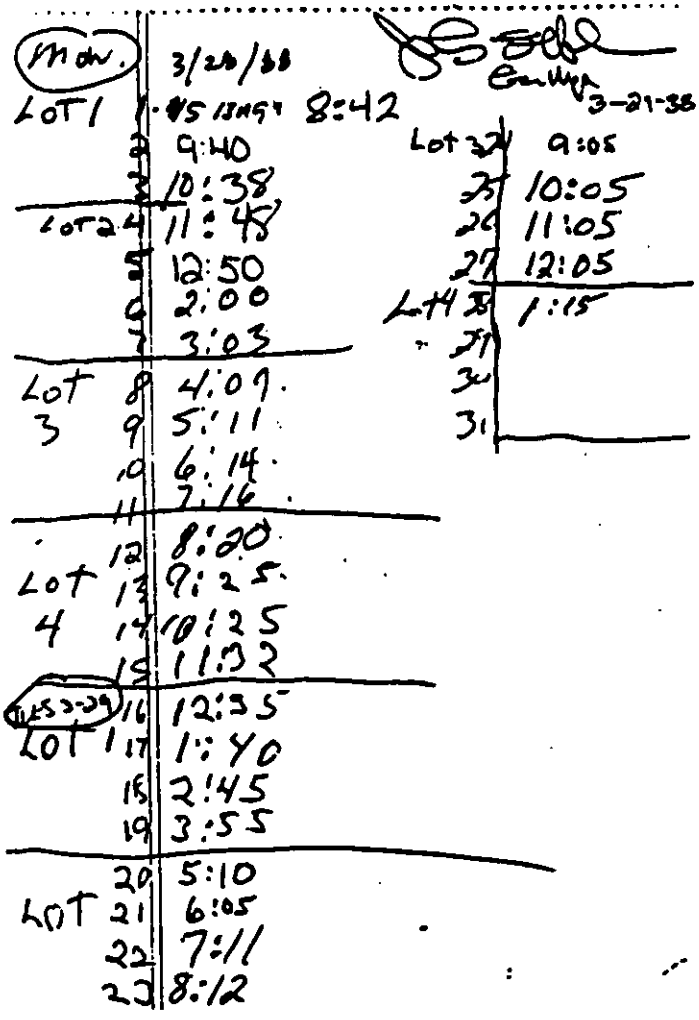
1:00 18,000 4,600 #/HR 2300 PSI. 3:28 1220 V.
5:00 13,200 4,800 " " 2300 "
1:01 8,601 4600 " " 2300 "
10
1
:50 → 41,500 170-175 AC — 165/HR — PSI.
10pm 31,500 — #/hr 2300 PSI
11pm 26800 — 4700 #/hr — 2300 "
12pm 22100 — 4700 #/hr — 2300 " — 3:28 8 TONS
1am 17500 — 4600 #/hr — 2300 PSI
2am 12900 — 4600 #/hr — 2300 PSI
3am 8300 — 4600 #/hr — 2300 PSI

Silo #2 → 54,600 170-175 AC DO
5:30

6:30 50,000 — 4600 #/HR — 2300+ P.S.I.
7:30 45,050 — 4950#/HR — 2400 P.S.I.
8:30 40,250 — 4800#/HR — 2400 P.S.I.
9:30 35,500 — 4750#/HR — 2500 P.S.I.
10:30 30,450 — 5050#/HR. — 2500 P.S.I.
11:30 25,650 — 4800#/HR. — 2500 P.S.I.
12:30 20,750 — 4900#/HR. — 2500 P.S.I.
1:30 15,600 — 5150#/Hr. 2500 P.S.I.

production info's
3-28-89-88
Ralph

DATE + TIME	BELT MOIST.	BAG MOIST.	INLET TEMP.	EXH. TEMP.	FLUID BED TEMP	HIGH PRESS. PUMP	POWD. AIR TEMP.	BAG TEMP.	VAC.	VAC.	CLONE DROP
3-28-88 5:00	11.5	3.2	357	137	232	2300	46	97	.3	-3	3.7
6:00	11.4	3.2	360	177	232	2300	46	96	.3	-2	3.8
7:00	10.8	3.3	357	137	233	2300	46	96	3	-2	3.8
9:30	11	2.8	362	136	233	2300	46	97	3	-3	3.8
10:30	11	2.8	362	136	233	2300	47	97	2½	-3	3.9
11:30	10.4	2.7	359	136	233	2300	47	97	3	-4	4
3-29-88 12:30	11	3.0	363	136	233	2300	47	97	3	-3	3.8
1:30	11	2.6	363	136	233	2300	47	97	3	-3	3.8
2:30	11.8	2.8	363	136	232	2300	50	98	3	-3	3.8
3:30	11	2.8	364	136	232	2300	50	97	3	-3	3.9
4:15	11.2	2.9	365	136	232	2300	49	95	3	-3	3.9
5:30	11.1	2.8	357	136	232	2350	48	98	.2½	-3	3.9
6:30	10.6	2.6	354	136	232	2300+	48	98	-3	2+	4+
7:30	10.4	2.7	357	136	232	2400	48	98	-3	3	-4
8:30	10.2	2.4	358	136	232	2400	48	97	-3	3	4
9:30	10.2	2.6	362	136	232	2500	48	97	-3	-4	3.8
10:30	10.2	2.5	361	136	232	2500	49	98	-3	4	3.8
11:30	10.1	2.5	358	136	232	2500	49	97	-3	3	3.8
12:30	10.1	2.5	31.5	136	232	2500	49	97	-3	4	3.8
1:30	10.8	3.6	364	136	232	2500	49	97	-3	3	3.5
					Product in dryer		3-28-29-88				
								Fail 3-29-88			


Mon.
3/28/88
LOT 1
8:42
9:40
10:38
LOT 2
11:45
12:50
2:00
3:03
LOT 3
4:09
5:11
6:14
7:16
8:20
LOT 4
9:25
10:25
11:32
12:35
LOT 1
1:40
2:45
3:55
5:10
LOT 21
6:05
7:11
8:12
Lot 24
9:05
10:05
11:05
12:05
LOT 28
1:15
3-21-88

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 al 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)

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 ^{o}F $\pm$ 10 ^{o}F. The analyst may take an aliquot of the sample, transferring it to a tared beaker and evaporate to dryness at 220 ^{o}F $\pm$ 10 ^{o}F. If an aliquot is used, the weight of the sample and aliquot will have to be taken to correct for the total sample weight.

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

   Calculation (if aliquot is taken):

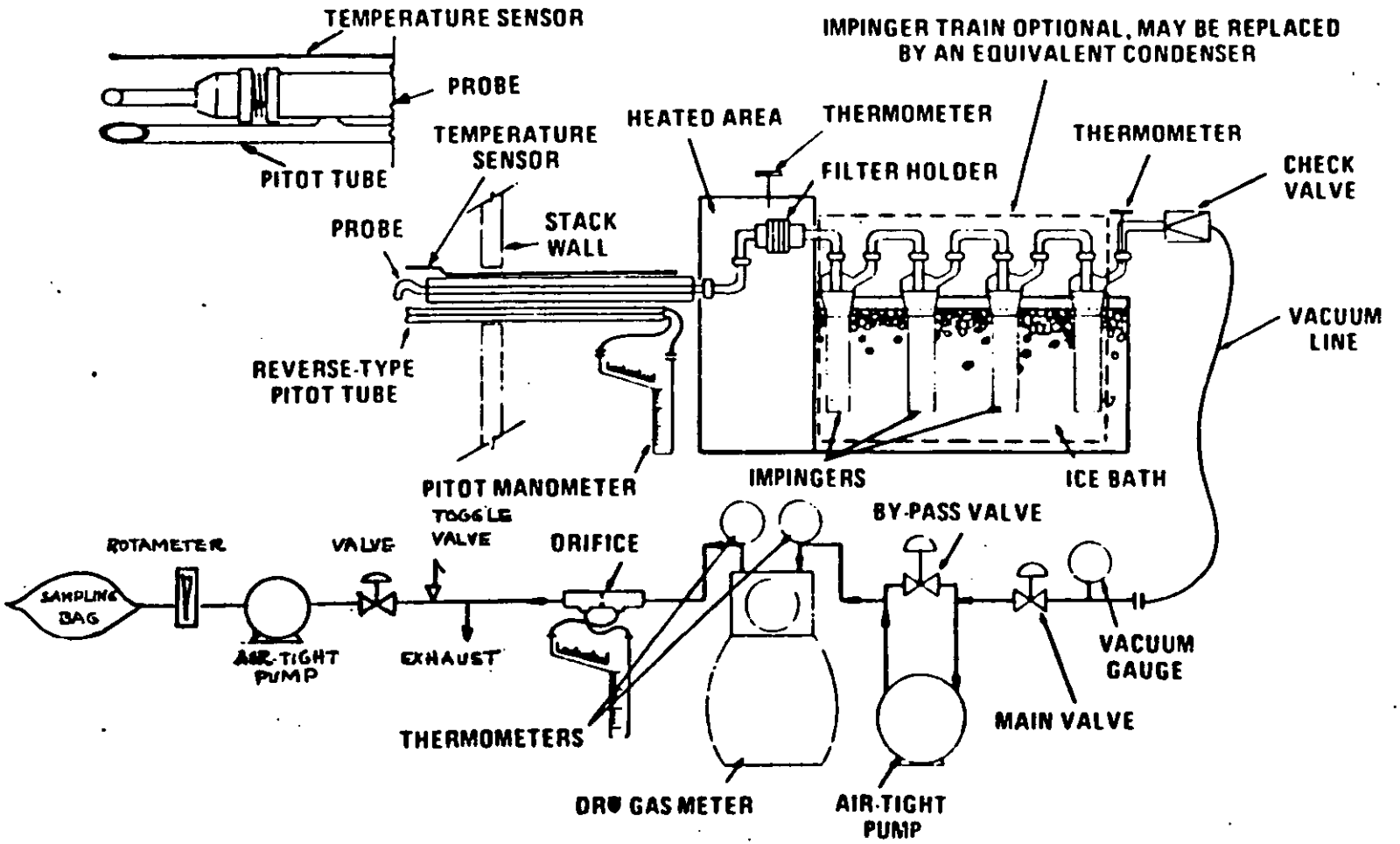
$$\text{grams} = \frac{(\text{grams recovered from aliquot}) \times (\text{total volume (ml) or grams of sample})}{(\text{aliquot volume (ml) or grams used})}$$

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

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

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

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



Particulate sampling train.

APPENDIX G

CALCULATION EQUATIONS

CALCULATION EQUATIONS

METHOD 2

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

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

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

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

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

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

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

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

CALCULATION EQUATIONS

METHOD 3

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

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

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

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

CALCULATION EQUATIONS

METHOD 5

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

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

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

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

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

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

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

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

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

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
(612) 786-6020

Meter Box Calibration
Data Sheet

Date of Calibration: March 4, 1988
Technician: E. Trowbridge
Barometric Pressure: 29.45

Meter Box No.: 8
Dry Test Meter Serial No.: 984552
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 Dry Test Meter Vdi (cf)	Gas Volume Dry Test Meter Vdf (cf)	Gas Temperature of Meters Wet Tw (deg-F)	Gas Temperature of Meters Dry Test Tdi (deg-F)	Gas Temperature of Meters Dry Test Tdo (deg-F)	Time (min/ sec)	Meter Coef.	Orifice Constant (in. WC)
.5	2	99.87	.04	77.000	79,000	75	86	70	5/09.77	1.0029	1.91
1.2	3	99.88	.06	73,500	76,502	75	84	68	4/53.10	.9968	1.83
2.0	3	99.89	.07	80.000	83,020	75	90	70	3/53.95	.9964	1.93
3.3	5	99.90	.085	83,500	88,533	75	94	72	5/08.31	.9988	1.98
4.7	5	99.95	.12	89.000	94,045	75	96	72	4/19.08	.9952	1.98
									Average:	.9980	1.92

Interpoll Laboratories
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: March 29, 1988

Meter Box No.: 8 (Rockwell Dry Test Meter Serial No. 964552)

Date of Last Calibration: March 4, 1988
Calibration Technician: E. Trowbridge
Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
March 21-26, 1988	8-2526	102.30	1216.57	1114.27	1114.27
March 29, 1988	8-2528	216.70	335.29	118.59	1232.86

* Total volume through meter since last calibration

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Nozzle Calibration
Data Sheet

Date of Calibration: March 29, 1988 Nozzle Number 4-3
Technician: J. Buresh

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

Position	Diameter (inches)
1	.191
2	.194
3	.189
Average:	.191

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S-Type Pitot Tube Inspection Sheet

Pitobe No. 4-16

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .460 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° 0
7. B_2 < 5° 1°

8. Z <.125" .02
9. W <.0625" .02

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .760 IN.
11. Pitot to probe sheath 3 IN.
12. Pitot to thermocouple (parallel to probe) _____ IN.
13. Pitot to thermocouple (perpendicular to probe) _____ IN.

Date of Inspection: January 3, 1986

Inspected by: E. Trowbridge

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