Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP42 Section: 11.1

Reference Number: 388

Title: Results Of The October 7-8 & 12, 1999 Air Emission Compliance Test On The Mathy Construction/Monarch Paving Asphalt Plant No. 46 Near Danbury, Wisconsin,

Interpoll Laboratories, Circle Pines, MN,

November 29, 1999.

Sec. H.1
Ref. 388

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RESULTS OF THE OCTOBER 7-8, 12,1999 AIR EMISSION COMPLIANCE TEST ON THE MATHY CONSTRUCTION / MONARCH PAVING ASPHALT PLANT NO. 46 NEAR DANBURY, WISCONSIN

Submitted to:

Mathy Construction Company
920 10th Ave. N.
Onalaska, Wisconsin 54650

Attention:

Tara Wetzel

Approved by:

Kathleen Eickstadt
Department Coordinator
Field Services Department

Report Number 9-13597WI
November 29, 1999
EJ/ehj

TABLE OF CONTENTS

ABBREVIATIONS iii

1 INTRODUCTION 1

2 SUMMARY AND DISCUSSION 3

3 RESULTS 6

3.1 Results of Orsat & Moisture Determinations 7

3.2 Results of Particulate Determinations 10

3.3 Results of Sulfur Dioxide Determinations 12

3.4 Results of Opacity Determinations 14

3.5 Results of Formaldehyde Determinations 18

4 RESULTS OF FUEL ANALYSIS 20

APPENDICES:

A - Results of Volumetric Flow Rate Determinations

B - Location of Test Ports

C - Field Data Sheets

D - Interpoll Laboratories Analytical Results

E - Computer Datalogger Printouts

F - Gas Analyzer Specifications

G - Measurement Systems Performance Specifications

H - Calibration Gas Certification Sheets

I - Process Rate Information

J - Procedures

K - Calculation Equations

L - Sampling Train Calibration Data

ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	dry standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (°F)	degrees Fahrenheit
DIA.	diameter
FP	finished product for plant
FT/SEC	feet per second
g	gram
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g/dscm	grams per dry standard cubic meter
HP	horsepower
HRS	hours
IN.	inches
IN.HG.	inches of mercury
IN.WC.	inches of water
LB	pound
LB/DSCF	pounds per dry standard cubic foot
LB/HR	pounds per hour
LB/10^6BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
LTPD	long tons per day
MW	megawatt
mg/Nm^3	milligrams per dry standard cubic meter
ug/Nm^3	micrograms per dry standard cubic meter
microns (um)	micrometer
MIN.	minutes
ng	nanograms
ohm-cm	ohm-centimeter
PM	particulate matter
PPH	pounds per hour
PPM	parts per million
ppmC	parts per million carbon
ppm,d	parts per million, dry
ppm,w	parts per million, wet
ppt	parts per trillion
PSI	pounds per square inch
SQ.FT.	square feet
TPD	tons per day
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.

g:\stack\wp\misc\abbrev.frm

INTRODUCTION

On October 7, 8 and 12 , 1999 Interpoll Laboratories personnel conducted an air emission compliance test on the Mathy Construction / Monarch Paving No. 46 Asphalt Plant located near Danbury, Wisconsin. The plant was tested while fired with waste oil. On-site testing was performed by Mark Kaehler, Jim Thoma, and Dave Hall. Coordination between testing activities and plant operation was provided by Dennis Goldberg of Mathy Construction. The tests were not witnessed by a representative of the Wisconsin Department of Natural Resources.

The No. 46 Asphalt Plant is a Standard Haven 7.5 x 40 AF60 Gencor AstroFlame drum mix asphalt plant which has a rated capacity of 350 TON/HR at 5% moisture. Particulate emissions are controlled by a Barber Greene CE 18 x 155 fabric filter baghouse which has a normal pressure drop of 4 IN.W.C. The plant is fired with waste oil.

Particulate determinations were performed in accordance with EPA Methods 1 - 5, CFR Title 40, Part 60, Appendix A (revised July 1, 1999). A preliminary determination of the gas linear velocity profile was made before the first particulate determination to select the appropriate nozzle diameter for isokinetic sample withdrawal. An Interpoll Labs sampling train which meet or exceed specifications in the above-cited reference was used to extract particulate samples by means of a heated glass-lined probe.

The O_2, CO_2, SO_2 determinations were performed in accordance with CFR Title 40, Part 60 Appendix B (revised July 1, 1998). Evaluations were performed in accordance with EPA Methods 3A and 6C . For oxygen, carbon dioxide, and sulfur dioxide analysis, a slip stream of sample gas was withdrawn from the exhaust gas stream using test ports (provided by the plant) on the stack using a heat-traced probe and filter assembly. After passing through the filter, the gas passed through two condenser-type moisture removal systems operating in series. The particulate-free dry gas was then transported to the oxygen analyzer with the excess exhausted to the atmosphere through a calibrated orifice which was used to ensure that the flow from the stack exceeds the requirements of the analyzer. The analog response of the analyzers was recorded using a computer data logger and backed up with a strip chart recorder.

The O_2, SO_2, and CO_2 analyzers were calibrated with National Specialty Gases and Air Products and Chemicals standard gases. The instruments were calibrated before and after each run as per EPA Method 3A and 6C. The sample probe was moved through a three-point traverse (1/6, 3/6, 5/6 of the stack diameter).

Formaldehyde samples were collected using EPA Method 0011 (SW 846 3rd Ed.). The samples were collected isokinetically using a Method 5 sampling train with an aqueous acidic 2,4-dinitrophenylhydrazine absorbing solution and analyzed by high performance liquid chromatography.

An integrated flue gas sample was extracted simultaneously with each of the formaldehyde samples 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 in-leakage are discarded.

Testing on the No.46 Asphalt Plant Stack was conducted from a set of five test ports situated horizontally on the vertical stack. These test ports are located 3.86 stack diameter equivalents downstream 1.03 stack diameter equivalents upstream of the nearest flow disturbances. A 25-point traverse was used to collect representative particulate samples. Each traverse point was sampled 2.5 minutes to give a total sampling time of 62.5 minutes per run. Three hours of visible emissions were read by Dave Hall, a certified reader.

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 air emission compliance tests are summarized in Tables 1 - 3. An overview of all results is presented below:

PARAMETER		LIMIT	MEASURED
NO.46 ASPHALT PLANT STACK			
PM			
DRY CATCH ONLY	(GR/DSCF)	0.04	0.0197
.....	(LB/HR)	N/A	4.17
Sulfur Dioxide			
.....	(ppm,w)	N/A	37.0
.....	(LB/HR)	N/A	13.2
Formaldehyde			
.....	(mg/dscm)	N/A	3.42
.....	(LB/HR)	N/A	0.33
Opacity			
.....	(%)	20%	11.25

No difficulties were encountered in the field by Interpoll Labs or in the laboratory evaluation of the samples which were conducted by Interpoll Labs. On the basis of these facts and a complete review of the data and results, it is our opinion that the results reported herein are accurate and closely reflect the actual values which existed at the time the test was performed.

SO2 EMISSIONS CALCULATIONS

Mathy Construction / Monarch Paving Asphalt Plant # 46

Sulfur in Burner Fuel

S = 0.36% by weight

Mass of Oil = 7.38 lb/gallon

Mass Flow of Sulfur Dioxide from the Burner

Burner fuel use = 506 gllons/hour.
506 gallons / hour x 7.38 lbs/gallon x .36/100 sulfur/oil x 2 SO2/S =
26.89 lbs SO2/hour generated in the plant drum by combustion.

Mass Flow of Sulfur Dioxide from the Plant Stack

13.2 lbs/hour

Sulfur Dioxide Capture Efficiency

EF = 100 x (Burner SO2 - Stack SO2) / Burner SO2

EF = **50.91** %

comp\plt\so2test

Table 1a Summary of the Results of the October 8, 1999 NSPS Particulate Emission Compliance Test on the Monarch Paving Plant No. 46 Located Near Danbury, Wisconsin.

ITEM	Run 1	Run 2	Run 3
Date of test	10-08-99	10-08-99	10-08-99
Time runs were done (HRS)	700/ 824	855/1001	1030/1134
Process rate (TON/HR)			
recycle	0.0	0.0	0.0
aggregate	255.4	256.4	259.0
asphalt	15.0	14.9	15.1
total	270.4	271.3	274.1
Volumetric flow			
actual (ACFM)	51161	50925	50191
standard (DSCFM)	24676	25365	24255
Gas temperature (DEG-F)	249	251	250
Moisture content (%V/V)	32.32	29.94	32.05
Gas composition (%V/V,dry)			
carbon dioxide	6.07	6.50	6.56
oxygen	12.36	12.14	11.95
nitrogen	81.57	81.36	81.49
Isokinetic variation (%)	103.4	96.6	101.9
Part. emission rate (LB/HR)	4.52	4.00	4.00
Particulate concentration			
actual (GR/ACF)	.0103	.009153	.009304
standard (GR/DSCF)	.0213	.0184	.0193

Note: Dry Catch Only

* Federal regulations restrict particulate emissions from portable asphalt plants to .04 GR/DSCF, CFR Title 40, Part 60, Subpart I.

Table 2. Summary of the Results of the **Sulfur Dioxide** Emission Test on the Mathy Construction No. 46 Asphalt Plant Stack Located Near Danbury, Wisconsin.

Date	Time (HRS)	Concentration (ppm,w)	Emission Rate (LB/HR)
No. 46 Asphalt Plant			
10-08-99	0700-0819	33.2	11.9
10-08-99	0855-0956	39.0	14.1
10-08-99	1030-1131	38.8	13.6
Avg		37.0	13.2

Table 3. Summary of the Results of the **Formaldehyde** Emission Test on the Mathy Construction No. 46 Asphalt Plant Stack Located Near Danbury, Wisconsin.

Date	Time (HRS)	Concentration (ppm,w)	Emission Rate (LB/HR)
No. 46 Asphalt Plant			
10-08-99	1225-1410	1.96	0.35
10-08-99	1440-1556	1.69	0.29
10-08-99*	1605-1709	1.89	0.34
Avg		1.85	0.33

* Note - Run 3 was shortened due to a halt in asphalt production

3 RESULTS

The results of all field and laboratory evaluations are presented in this section. Orsat (gas composition) and moisture is presented first followed by the computer printout of the particulate, sulfur dioxide, opacity and formaldehyde results. Preliminary measurements including test port locations are given in the appendices.

The results have been calculated on a personal 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 emission rates have been calculated using the product of the concentration times flow method.

3.1 Results of Orsat and Moisture Determinations

Test No. 2
Asphalt Plant No. 46

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

	Run 1	Run 2	Run 3
Date of run	10-08-99	10-08-99	10-08-99
Dry basis (orsat)			
carbon dioxide.....	6.07	6.50	6.56
oxygen.....	12.36	12.14	11.95
nitrogen.....	81.57	81.36	81.49
Wet basis (orsat)			
carbon dioxide.....	4.11	4.55	4.46
oxygen.....	8.37	8.51	8.12
nitrogen.....	55.21	57.00	55.37
water vapor.....	32.32	29.94	32.05
Dry molecular weight.....	29.47	29.53	29.53
Wet molecular weight.....	25.76	26.08	25.83
Specific gravity.....	0.890	0.901	0.892
Water mass flow.....(LB/HR)	33057	30401	32097
FO	1.407	1.348	1.364

Test No. 5
Asphalt Plant No. 46 Stack

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

	Run 1	Run 2	Run 3
Date of run	10-08-99	10-08-99	10-08-99
Dry basis (orsat)			
carbon dioxide.....	6.46	6.48	6.49
oxygen.....	12.11	12.11	12.11
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	81.43	81.41	81.40
Wet basis (orsat)			
carbon dioxide.....	4.50	4.50	4.14
oxygen.....	8.44	8.42	7.73
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	56.75	56.58	51.97
water vapor.....	30.31	30.50	36.15
Dry molecular weight.....	29.52	29.52	29.52
Wet molecular weight.....	26.03	26.01	25.36
Specific gravity.....	0.899	0.898	0.876
Water mass flow.....(LB/HR)	0.00	0.00	0.00
FO	1.361	1.356	1.354

3.2 Results of Particulate Determinations

Test No. 2
Asphalt Plant No. 46

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

	Run 1	Run 2	Run 3
Date of run	10-08-99	10-08-99	10-08-99
Time run start/end.....(HRS)	700/ 824	855/1001	1030/1134
Static pressure.....(IN.WC)	-0.77	-0.77	-0.77
Cross sectional area (SQ.FT)	13.38	13.38	13.38
Pitot tube coefficient.....	.84	.84	.84
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	395.0	349.0	387.0
desiccant.....(GRAMS)	23.0	10.0	13.0
total.....(GRAMS)	418.0	359.0	400.0
Total particulate material..			
.....collected(grams)	0.0571	0.0472	0.0499
Gas meter coefficient.....	1.0020	1.0020	1.0020
Barometric pressure..(IN.HG)	28.68	28.68	28.68
Avg. orif.pres.drop..(IN.WC)	1.55	1.44	1.48
Avg. gas meter temp..(DEF-F)	74.0	75.7	76.5
Volume through gas meter....			
at meter conditions...(CF)	43.30	41.71	42.15
standard conditions.(DSCF)	41.27	39.62	39.98
Total sampling time....(MIN)	62.50	62.50	62.50
Nozzle diameter.....(IN)	.252	.252	.252
Avg.stack gas temp ..(DEG-F)	249	251	250
Volumetric flow rate.....			
actual.....(ACFM)	51161	50925	50191
dry standard.....(DSCFM)	24676	25365	24255
Isokinetic variation.....(%)	103.4	96.6	101.9
Particulate concentration...			
actual.....(GR/ACF)	0.01029	0.00915	0.00930
dry standard.....(GR/DSCF)	0.02135	0.01838	0.01926
Particle mass rate...(LB/HR)	4.516	3.997	4.004

3.3 Results of Sulfur Dioxide Determinations

Interpoll Labs Report No. 9-13597
Mathy Construction / Monarch Paving
Danbury, WI

Test No. 4
No. 46 Asphalt Plant Stack

Results of Sulfur Dioxide Determinations——————————Method 6C

	Run 1	Run 2	Run 3
Date of run	10-08-99	10-08-99	10-08-99
Time run start/end (HRS)	0700-0819	0855-0956	1030-1131
Total sampling time (MIN)	60	60	60
Moisture content (%V/V)	32.28	29.9	32.01
Oxygen content (%V/V dry)	12.36	12.14	11.95
Volumetric flow rate (DSCFM)	24360	25390	24030
SO_2 concentration			
ppm wet	33.22	38.98	38.76
SO_2 emission rate (LB/HR)	11.9	14.06	13.64

3.4 Results of Opacity Determinations

Test No. 6A
No. 46 Asphalt Plant Stack

RESULTS OF OPACITY OBSERVATIONS ——————————EPA Method 9

MINUTE	SECONDS 0	15	30	45		SIX MINUTE AVERAGES
1	10	10	5	10		
2	10	10	10	10		
3	10	10	10	10		
4	15	10	20	10		
5	10	10	10	5		
6	10	5	5	10		9.79
7	10	10	5	5		9.58
8	5	5	10	10		9.17
9	5	10	10	10		8.96
10	10	5	5	5		7.71
11	10	10	10	10		7.92
12	5	10	15	10		8.33
13	15	10	10	10		8.96
14	10	15	15	10		9.79
15	15	10	10	15		10.42
16	15	10	10	10		11.25
17	10	10	10	5		11.04
18	10	10	10	5		10.83
19	15	10	10	5		10.63
20	5	5	5	10		9.58
21	10	5	5	10		8.75
22	10	5	5	5		7.92
23	5	5	5	5		7.29
24	5	5	5	5		6.67
25	5	5	5	5		5.83
26	5	5	5	5		5.63
27	5	5	10	5		5.42
28	5	10	5	10		5.63
29	10	5	10	10		6.25
30	*	*	*	*	Plant Stopped	5.42
31	*	*	*	*		4.58
32	*	*	*	*		3.75
33	*	*	*	*		2.71
34	*	*	*	*		1.46
35	*	*	*	*		0.00
36	*	*	*	*		0.00
37	*	*	*	*		0.00
38	*	*	*	*		0.00
39	*	*	*	*		0.00
40	*	*	*	*		0.00
41	*	*	*	*		0.00
42	*	*	*	*		0.00
43	*	*	*	*		0.00
44	*	*	*	*		0.00
45	*	*	*	*		0.00
46	*	*	*	*		0.00
47	*	*	*	*		0.00
48	*	*	*	*		0.00
49	*	*	*	*		0.00
50	*	*	*	*		0.00
51	*	*	*	*		0.00
52	*	*	*	*		0.00
53	*	*	*	*		0.00
54	*	*	*	*		0.00
55	*	*	*	*		0.00
56	*	*	*	*		0.00
57	*	*	*	*		0.00
58	*	*	*	*		0.00
59	*	*	*	*		0.00
60	*	*	*	*		0.00

Average Opacity **4.10**
Highest six-minute average **11.25**

Observer : David Hall
Cert Date : 10/6/99
Date of Observation : 10/12/99
Time of Observation : 1105-1133

Test No. 6B
No. 46 Asphalt Plant Stack

RESULTS OF OPACITY OBSERVATIONS ——————————EPA Method 9

MINUTE	SECONDS 0	15	30	45		SIX MINUTE AVERAGES
1	10	10	15	15		
2	10	10	10	10		
3	20	15	15	15		
4	10	10	15	10		
5	10	5	5	5		
6	5	5	10	10		10.63
7	5	5	5	5		9.38
8	10	10	5	10		9.17
9	10	10	5	5		7.71
10	5	10	5	5		6.88
11	10	10	10	10		7.50
12	5	10	10	5		7.50
13	5	10	10	10		8.13
14	10	10	10	5		8.13
15	5	5	10	5		7.92
16	5	5	5	10		7.92
17	5	5	10	5		7.29
18	10	10	5	10		7.50
19	5	5	5	10		7.08
20	10	10	5	5		6.88
21	5	10	10	15		7.50
22	15	10	10	5		8.13
23	5	10	5	5		8.13
24	5	10	5	5		7.71
25	5	5	5	5		7.50
26	5	5	5	5		7.08
27	5	10	5	10		6.67
28	10	10	5	5		6.25
29	10	5	5	5		6.25
30	5	5	5	5		6.04
31	5	5	5	5		6.04
32	5	5	5	5		6.04
33	5	5	5	5		5.63
34	5	5	5	5		5.21
35	5	5	5	5		5.00
36	5	5	5	5		5.00
37	5	5	5	5		5.00
38	5	5	5	5		5.00
39	5	5	5	5		5.00
40	5	5	5	5		5.00
41	5	5	5	5		5.00
42	5	5	5	5		5.00
43	5	10	5	10		5.42
44	5	5	5	5		5.42
45	5	10	5	5		5.63
46	5	5	5	5		5.63
47	5	10	5	5		5.83
48	5	5	5	5		5.83
49	5	10	5	5		5.63
50	5	5	5	5		5.63
51	0	0	0	0		4.58
52	0	0	0	0		3.75
53	0	0	0	0		2.71
54	0	0	0	0		1.88
55	0	0	0	0		0.83
56	0	0	-	-	Plant Stopped	0.00
57	-	-	-	-		0.00
58	-	-	-	-		0.00
59	-	-	-	-		0.00
60	-	-	-	-		0.00

Average Opacity **5.71**
Highest six-minute average **10.63**

Observer : David Hall
Cert Date : 10/6/99
Date of Observation : 10/12/99
Time of Observation : 1312-1407

Test No. 6C
No. 46 Asphalt Plant Stack

RESULTS OF OPACITY OBSERVATIONS ——————————EPA Method 9

MINUTE	SECONDS 0	15	30	45	SIX MINUTE AVERAGES
1	5	5	5	5	
2	10	5	5	5	
3	5	5	5	5	
4	5	5	5	5	
5	5	5	5	5	
6	5	5	10	10	5.63
7	10	10	5	5	6.04
8	5	5	5	5	5.83
9	5	5	5	5	5.83
10	5	5	5	5	5.83
11	5	0	5	5	5.63
12	5	5	5	5	5.21
13	5	5	5	5	4.79
14	5	5	5	0	4.58
15	5	5	5	5	4.58
16	5	5	5	0	4.38
17	0	0	0	0	3.75
18	5	0	5	5	3.54
19	5	0	0	0	2.92
20	0	0	0	0	2.29
21	0	0	0	0	1.46
22	0	0	0	0	0.83
23	0	0	0	0	0.83
24	0	0	0	0	0.21
25	0	0	0	0	0.00
26	0	0	5	5	0.42
27	5	5	5	0	1.04
28	0	5	5	0	1.46
29	5	5	5	5	2.29
30	5	0	5	5	2.92
31	5	5	5	5	3.75
32	5	5	5	5	4.17
33	5	5	5	5	4.38
34	5	5	5	5	4.79
35	5	5	5	5	4.79
36	5	5	5	5	5.00
37	5	0	0	0	4.38
38	5	5	5	5	4.38
39	5	5	5	5	4.38
40	5	5	5	5	4.38
41	5	5	5	5	4.38
42	5	5	5	5	4.38
43	5	10	5	5	5.21
44	5	10	5	10	5.63
45	5	5	5	5	5.63
46	5	5	5	5	5.63
47	5	5	5	5	5.63
48	5	5	5	5	5.63
49	5	5	5	5	5.42
50	5	5	5	0	4.79
51	5	5	5	5	4.79
52	5	5	5	5	4.79
53	5	5	5	5	4.79
54	5	5	5	5	4.79
55	5	5	5	5	4.79
56	0	5	5	5	4.79
57	0	0	0	0	3.96
58	5	5	5	5	3.96
59	5	5	5	5	3.96
60	5	5	5	5	3.96

Average Opacity **4.13**
Highest six-minute average **6.04**

Observer : David Hall
Cert Date : 10/6/99
Date of Observation : 10/12/99
Time of Observation : 1448-1547

3.5 Results of Formaldehyde Determinations

Test No. 5
Asphalt Plant No. 46 Stack

Results of Formaldehyde Tests ---------- EPA Method 0011

	Run 1	Run 2	Run 3
Date of run	10-08-99	10-08-99	10-08-99
Time run start/end.....(HRS)	1225/1410	1440/1556	1605/1709
Static pressure.....(IN.WC)	-0.81	-0.81	-0.81
Cross sectional area (SQ.FT)	13.38	13.38	13.38
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	445.0	452.0	376.0
desiccant.....(GRAMS)	20.0	15.0	15.0
total.....(GRAMS)	465.0	467.0	391.0
Formaldehyde in sample..(uG)	5000.00	4300.00	3400.00
Gas meter coefficient.....	1.0020	1.0020	1.0020
Barometric pressure..(IN.HG)	28.86	28.86	28.86
Avg. orif.pres.drop..(IN.WC)	1.60	1.59	1.63
Avg. gas meter temp..(DEF-F)	78.8	80.1	78.1
Volume through gas meter....			
at meter conditions...(CF)	53.03	52.90	34.20
standard conditions.(DSCF)	50.41	50.16	32.56
Total sampling time....(MIN)	75.00	75.00	48.00
Nozzle diameter.....(IN)	.253	.253	.253
Avg.stack gas temp ..(DEG-F)	252	256	249
Volumetric flow rate.....			
actual.....(ACFM)	53050	52177	53268
dry standard.....(DSCFM)	26404	25747	24388
Isokinetic variation.....(%)	97.6	99.6	106.7
CH2O concentration.....			
(GR/DSCF).....	0.0015	0.0013	0.0016
(MG/DSCM).....	3.52	3.04	3.70
(PPM-DRY).....	2.82	2.44	2.97
(PPM-WET).....	1.96	1.69	1.89
CH2O emission rate...(LB/HR)	0.35	0.29	0.34

4 RESULTS OF FUEL ANALYSIS

INTERPOLL LABORATORIES, INC.
(612)786-6020

Mathy Construction
Sample Log No. 13597-17

Results of Waste Oil Analysis

Source: Asphalt Plant Stack
Sample Description: Test 2, Runs 1-3
Sample Type: Waste Oil Composite

Parameter	Units	Method	As Received
Gross heating value	BTU/LB	ASTM D240	18636
Sulfur	%	ASTM D129	0.36[a]
Ash	%	ASTM D482	0.64
Flashpoint	°F	ASTM D93	> 200
Acidity	pH units	ASTM D1093	6.6
Specific gravity	60/60°F	ASTM D1298	0.8848
Total fluorine	% w/w	SW-846, 5050/9056	< 0.014
Total chlorine	% w/w	SW-846, 5050/9056	0.068
Total bromine	% w/w	SW-846, 5050/9056	< 0.027
Total lead	% w/w	EPA SW-846, 6010A	0.0030
Total PCB	mg/Kg	EPA SW-846, 8082	< 10

Respectfully submitted,

David J. Schneider, Manager
Chemistry Department

DJS/cg

[a]As requested by Mathy Construction, the sample was analyzed following the cited ASTM method. This method, however, is not applicable to the analysis of used oils.

Revised
12/8/99

APPENDIX A

PRELIMINARY VOLUMETRIC FLOW RATE DETERMINATIONS

Test No. 2
Asphalt Plant No. 46

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

Date of Determination.....	10-08-99
Time of Determination.....(HRS)	1700
Barometric pressure.....(IN.HG)	29.12
Pitot tube coefficient.....	.84
Number of sampling ports.....	5
Total number of points.....	25
Shape of duct.....	Rectangular
Duct width.....(IN)	47
Duct length.....(IN)	41
Duct area.....(SQ.FT)	13.38
Direction of flow.....	UP
Static pressure.....(IN.WC)	-.77
Avg. gas temp.....(DEG-F)	252
Moisture content.....(% V/V)	32.32
Avg. linear velocity.....(FT/SEC)	61.8
Gas density.....(LB/ACF)	.04819
Molecular weight.....(LB/LBMOLE)	29.47
Mass flow of gas.....(LB/HR)	143506
Volumetric flow rate.....	
actual.....(ACFM)	49635
dry standard.....(DSCFM)	24198

APPENDIX B

LOCATION OF TEST PORTS

Figure 1 Site Description Form

Plant #46

Hot Mix Asphalt Plant Exhaust Stack

SAMPLING LOCATION DATA

Duct Cross-Sectional Dimension;
- Traverse Depth, inches 48.0
- Rectangular Width, inches 42.0
- Equivalent Diameter, inches 44.8

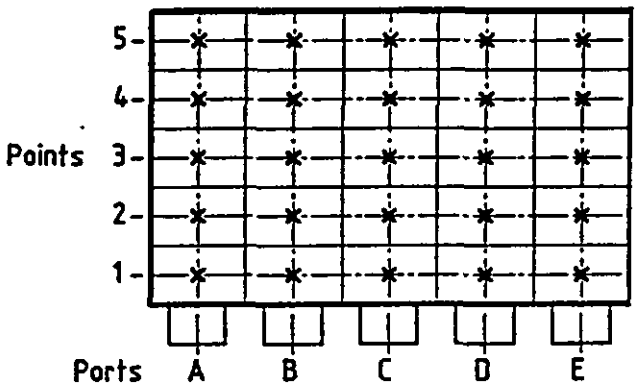
Length of straight, undisturbed flow;
- Before ports, inches..... 204
- After ports, inches..... 45
- Before ports, stack diameters 4.6
- After ports, stack diameters..... 1.0

Number of sampling points;
- Required by EPA Method 1 25
- Actually used 25
  - Number of ports 5
  - Number of points per port 5

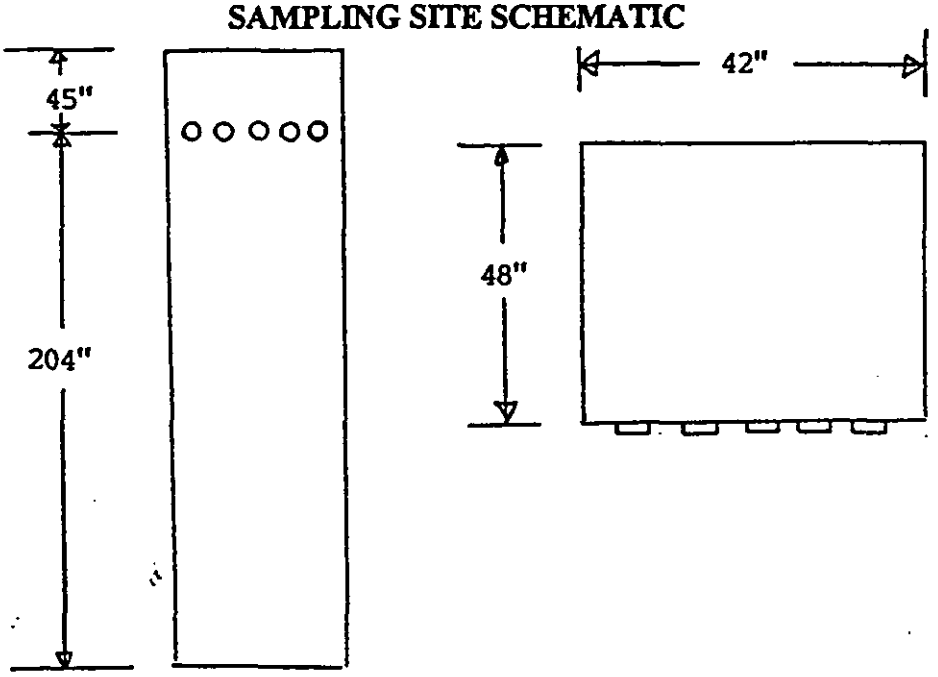
Particulate test sampling time;
- Minutes per point.....2.5
- Minutes per test run 62.5

SAMPLING POINT LOCATION WITHIN STACK CROSS-SECTION

Point Number	Percent of Traverse	Inches from Wall
1	10.0	4.8
2	30.0	14.4
3	50.0	24.0
4	70.0	33.6
5	90.0	43.2



SAMPLING SITE SCHEMATIC



APPENDIX C

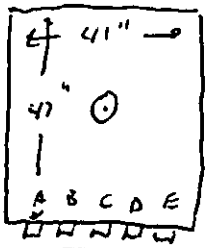
FIELD DATA SHEETS

INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

Job: Mathy Plant 46 / Danbury, WI
Source: Asphalt Plant / Stack
Test: 1 Run: 0 Date: 10-6-99
Stack Dimen.: 42 X 41 IN.
Dry Bulb: 252 °F Wet bulb: 140 °F
Manometer: ☒ Reg. ☐ Exp ☐ Elec.
Barometric Pressure: 29.12 IN.HG
Static Pressure: -.77 IN.WC
Operators: M. Kuehler + T. Thoma
Pitot No.: 31V-4 C_p: .84

Drawing of Test Site

Cross-section View	Elevation View
	

Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas
		Port Length:	2.0 IN.	Time Start:	1700 HRS
A-1		4.70	6.70	1.27	
2		14.10	16.10	1.10	
3		23.50	25.50	.59	
4		32.90	34.90	.49	
5		42.30	44.30	.43	
B-1				1.39	
2				1.18	
3				.83	
4				.62	
5				.60	↑
C-1				1.39	
2				.96	252
3				.80	
4				.66	↓
5				.55	
D-1				1.31	
2				.96	
3				.74	
4				.58	
5				.59	
E-1				1.05	
2				.80	
3				.54	
4				.46	
5				.34	

Temp. Meas. Device & S/N: PDT-67 / TC
Time End: 1721 HRS

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

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INTERPOLL LABORATORIES, INC.
(612) 786-6020
Interpoll Laboratories EPA Method 5/202 Sample Log Sheet

Job Mathy 46 / Danbury, WI
Source Asphalt Plant / Steel
Method 5/202

Date 10-8-99 Test 2 Run 1
No. of traverse points 25
Filter holder Glass Filter Type 4" G.F.

Sample train Leak Check:
Pretest: ≤ 0.02 cfm @ 15 In. Hg (vac)
Post test <0.02 cfm @ 15 Hg (vac)

Particulate Catch Data
No. of filters used 1202

Recovery Solvents
Acetone MeCl2
Others HPLC

No. of probe wash bottles: 1
Sample recovered by: Mikaelian & T. Thoma

Condensate Data:

Item	Weight (g) Final	Tare	Difference
Impinger No. 1	612	594	18
Impinger No. 2	673	296	377
Impinger No. 3			
Condenser			
Desiccant	1487	1464	23
Total			418

EPA Method 202 Data:
pH of Impinger Catch: ≥ 3
Purge: Y Time: 60 Date: 10-9-99
Tare weight of imp catch jar: 307 g

Integrated Bag Sample:
Bag Pump No.
Box No. Bag No.
Bag Material 5-layer aluminized Tedlar
Size: 44L
Pretest Leak Check:
cc/min @ In.Hg
Time Start:
Time End

S/N of O2 Analyzer 5NL

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INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 5 Field Data Sheet

Job: Mathy 46 / Danbury, WI
Source: Asphalt Plant / Stack
Date: 10-8-94 Test: 2 Run: 1

Operators: M. Kuehl / T. Thoma
Meter Box No.: 5 ΔH@: 1.78 in.WC
Gasmeter Coeff.: 1.0020

Nozzle No.: 1-4
Nozzle Dia.: .252 in.
Bar. Press.: 28.68 in.Hg

Pitot No.: 31V-9
C_p: .84
H_2O: 29 %

Traverse Point No.	Sampling Time (min)	Sample Vol. (cf)	Velocity Head (in.WC)	Orifice Meter (in.WC)	Des. Vol. (cf)	VAC. (in.Hg)	Temperatures (°F) Stack	Probe	Oven	Imp.	Gas/In	Gas/Out	Oxygen (% v/v)
	0700	295.30											
A-5	2.5	296.23	.57	.06	6.74	5	251	238	244	38	74	74	13.0
4	5	298.18	.63	1.16	8.26	6	258				73	73	12.4
3	7.5	299.75	.72	1.32	9.07	8	257	243	242	38	73	73	12.3
2	10	301.20	1.10	2.03	1.07	13	254				72	74	12.5
1	12.5	303.65	1.03	1.91	3.80	13	253	247	251	39	73	74	12.2
B-5	15	305.10	.51	.94	5.17	7.5	253				73	74	12.6
4	17.5	306.55	.55	1.02	6.59	7	252	242	254	39	73	74	12.8
3	20	308.15	.08	1.62	0.37	10.5	257				73	74	12.5
2	22.5	310.23	1.07	1.97	0.34	13	256	238	255	39	73	74	12.4
1	25	312.25	1.02	1.88	2.27	13	256				74	74	12.3
C-5	27.5	313.85	.72	1.33	3.89	9.5	255	246	253	41	74	74	12.6
4	30	315.48	.73	1.36	5.52	9.5	252				74	74	12.2
3	32.5	316.97	.54	1.00	6.93	7.5	252	241	250	41	74	74	12.5
2	35	318.86	1.15	2.13	8.98	14	253				74	74	12.6
1	37.5	320.83	1.07	1.98	0.95	13	253	238	252	40	74	74	12.4
D-5	40	322.50	.63	1.17	2.47	9	253				75	74	12.5
4	42.5	324.07	.61	1.13	3.97	8.5	252	243	250	40	74	74	12.2
3	45	325.97	.91	1.69	5.79	10	251				75	74	12.2
2	47.5	327.97	1.06	2.02	7.79	12	234	239	250	43	74	75	12.2
1	50	329.86	1.01	1.92	9.73	12	235				74	75	12.2
E-5	52.5	331.54	.62	1.18	1.26	8.5	235	245	248	43	74	75	11.9
4	55	332.97	.63	1.21	2.80	8	231				74	75	11.9
3	57.5	334.20	.91	1.73	4.65	10	235	241	253	43	75	75	12.3
2	60	336.62	1.10	2.08	6.68	14	239				75	75	11.7
1	62.5	338.60	1.07	2.02	8.67	14	242	244	251	44	75	75	
	0 - 62.5	V_m - 43.30		1.55 ΔH -							Avg. - 74.0		

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INTERPOLL LABORATORIES, INC.
(612) 786-6020
Interpoll Laboratories EPA Method 5/202 Sample Log Sheet

Job Marks 46 / Danbury, WI
Source Asphalt Plant / Stack
Method 5/202

Date 10-6-99 Test 2 Run 2
No. of traverse points 25
Filter holder Glass Filter Type 9" GF

Sample train Leak Check:
Pretest: ≤ 0.02 cfm @ 15 In. Hg (vac)
Post test <0.01 cfm @ 16 Hg (vac)

Particulate Catch Data
No. of filters used 1283

Recovery Solvents
Acetone MeCl
Others HPLC

No. of probe wash bottles: 1
Sample recovered by: M. Kuehlert + J. Thoma

Condensate Data:

Item	Weight (g) Final	Tare	Difference
Impinger No. 1	718	600	118
Impinger No. 2	430	199	231
Impinger No. 3			
Condenser			
Desiccant	1494	1484	10
Total			359

EPA Method 202 Data:
pH of Impinger Catch: ≈ 3
Tare weight of imp catch jar: 296 g

Purge: Y Time: 60 Date: 10-9-99

Integrated Bag Sample:
Bag Pump No. _____
Bag Material 5-layer aluminized Tedlar
Pretest Leak Check: _____
Time Start: _____

Box No. ____ Bag No. ____
Size: 44L
cc/min @ _____ In.Hg
Time End _____

S/N of O2 Analyzer TR2

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INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 5 Field Data Sheet

Job: Mathy 46 / Danbury, WI
Source: Asphalt Plant / Stack
Date: 10-8-94 Test: 2 Run: 2

Operators: M. Kuehler + J. Thoma
Meter Box No.: 5 ΔH@: 1.87 in.WC
Gasmeter Coeff.: 1.0020

Nozzle No.: 1-4
Nozzle Dia.: .252 in.
Bar. Press.: 28.68 in.Hg

Pitot No.: 31V-4
C_p: .84
H_2O: 32.3 %

Traverse Point No.	Sampling Time (min)	Sample Vol. (cf)	Velocity Head (in.WC)	Orifice Meter (in.WC)	Des. Vol. (cf)	VAC. (in.Hg)	Temperatures (°F) Stack	Probe	Oven	Imp.	Gas/In	Gas/Out	Oxygen (% v/v)
	0055	339.00											
E-5	2.5	340.40	.56	.97	0.38	6	242	243	256	43	75	75	11.9
4	5	341.86	.62	1.08	1.04	6.5	243				74	75	12.3
3	7.5	343.62	.87	1.50	3.57	9	246	248	253	43	74	75	12.3
2	10	345.30	1.10	1.89	5.50	12.5	250				74	75	12.3
1	12.5	347.16	1.07	1.83	7.40	12.5	253	252	249	42	74	75	11.9
D-5	15	348.85	.73	1.25	8.97	9	253				75	75	12.1
4	17.5	350.45	.75	1.29	0.57	9	248	246	255	42	74	75	12.2
3	20	352.08	.78	1.34	2.19	9	250				75	76	12.0
2	22.5	354.07	1.12	1.92	4.14	13	255	243	249	42	76	76	12.2
1	25	355 ~~356~~ .95	1.05	1.80	6.03	12	254				76	76	12.2
C-5	27.5	357.62	.72	1.24	7.59	9	253	239	252	43	76	75	12.3
4	30	359.22	.67	1.16	9.11	8.5	246				76	76	12.1
3	32.5	360.92	.91	1.58	0.87	10	247	243	250	43	75	75	12.3
2	35	362.85	1.10	1.90	2.81	12.5	249				76	75	12.4
1	37.5	364.72	1.02	1.76	4.67	12.5	250	247	248	42	76	76	12.1
B-5	40	366.55	.65	1.12	6.16	8	250				75	75	11.9
4	42.5	367.68	.53	.91	7.50	7	250	241	253	42	76	76	12.1
3	45	369.30	.87	1.50	9.23	9	251				77	76	12.2
2	47.5	371.12	1.09	1.87	1.15	11.5	253	237	249	44	77	76	12.5
1	50	372.98	1.00	1.71	2.99	11.5	256				77	76	12.4
A-5	52.5	374.32	.44	.75	4.22	5.5	254	240	245	44	77	76	11.8
4	55	375.55	.39	.67	5.37	5	251				77	76	11.9
3	57.5	377.04	.80	1.38	7.02	7.5	253	245	244	44	78	76	11.9
2	60	378.87	1.07	1.84	8.43	12	253				78	76	12.0
1	62.5	380.71	.47	1.67	0.25	11	253	243	241	45	78	77	12.1
	0-62.5	V_m = 41.71		1.44 ΔH =							Avg. =	75.7	

(1001)

INTERPOLL LABORATORIES, INC.
(612) 786-6020
Interpoll Laboratories EPA Method 5/202 Sample Log Sheet

Job Mathy 46 / Danbury, WI
Source Asphalt Plant / Stack
Method 5/202

Date 10-8-99 Test 2 Run 3
No. of traverse points 25
Filter holder Glass Filter Type 4" G.F.

Sample train Leak Check:
Pretest: ≤ 0.02 cfm @ 15 In. Hg (vac)
Post test <0.02 cfm @ 16 Hg (vac)

Particulate Catch Data
No. of filters used 1204

Recovery Solvents
Acetone MeCl
Others HPLC

No. of probe wash bottles: 1
Sample recovered by: McKaebliert T. Thoma

Condensate Data:

Item	Weight (g) Final	Tare	Difference
Impinger No. 1	633	603	30
Impinger No. 2	657	300	357
Impinger No. 3			
Condenser			
Desiccant	1500	1487	13
Total			400

EPA Method 202 Data:
pH of Impinger Catch: ≃ 3
Tare weight of imp catch jar: 298 g

Purge: Y Time: 60 Date: 10-9-99

Integrated Bag Sample:
Bag Pump No. _____
Bag Material 5-layer aluminized Tedlar
Pretest Leak Check: _____
Time Start: _____

Box No. ____ Bag No. ____
Size: 44L
cc/min @ _____ In.Hg
Time End _____

S/N of O2 Analyzer TL2

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INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 5 Field Data Sheet

Job: Mathy 46 / Danbury, WI
Source: Asphalt Plant / Stack
Date: 10-8-99 Test: 2 Run: 3
Operators: M. Kuehler + S. Thomas
Meter Box No.: 5 ΔH@: 1.87 in.WC
Gasmeter Coeff.: 1.0020
Nozzle No.: 1-4
Nozzle Dia.: .252 in.
Bar. Press.: 28.86 in.Hg
Pitot No.: 310-9
C_p: .84
H_2O: 29.9 %

Traverse Point No.	Sampling Time (min)	Sample Vol. (cf)	Velocity Head (in.WC)	Orifice Meter (in.WC)	Des. Vol. (cf)	VAC. (in.Hg)	Temperatures (°F) Stack	Probe	Oven	Imp.	Gas/In	Gas/Out	Oxygen (% v/v)
	1030	381.10											
A-5	1:5	382.10	.33	.60	2.19	3.5	247	238	241	47	75	76	12.3
4	5	383.44	.47	.85	3.49	5	254				77	76	12.0
3	7.5	385.25	.93	1.68	5.32	11.5	258	243	240	48	76	76	11.8
2	10	387.10	1.07	1.94	7.27	13.5	257				76	76	12.3
1	12.5	388.57	.80	1.45	8.97	12	256	246	248	46	76	76	12.2
B-5	15	390.31	.56	1.02	0.39	8	256				76	76	11.5
4	17.5	391.70	.52	.95	1.76	7	249	243	247	46	77	76	12.1
3	20	393.35	.84	1.54	3.51	10.5	247				77	77	11.7
2	22.5	395.32	1.08	1.98	5.49	14	251	248	253	46	77	76	11.6
1	25	397.17	.99	1.81	7.38	14	252				77	76	12.1
C-5	27.5	398.69	.58	1.06	8.83	9	250	241	258	47	77	76	12.2
4	30	400.20	.57	1.05	0.27	8	247				76	76	12.2
3	32.5	402.00	.89	1.63	2.07	10	247	236	261	46	76	77	12.1
2	35	403.80	1.00	1.84	3.98	12	248				76	76	11.9
1	32.5	405.71	1.02	1.88	5.90	13	245	240	263	46	76	77	12.1
D-5	40	407.36	.69	1.27	7.49	10	245				76	80	11.8
4	41.5	409.13	.64	1.18	9.02	10	248	243	257	47	77	77	12.0
3	45	410.75	.90	1.65	0.83	11	249				76	77	12.1
2	47.5	412.79	1.10	2.02	2.83	15	248	246	251	47	77	77	12.1
1	50	414.74	1.07	1.97	4.80	15	246				77	77	12.1
E-5	52.5	ML 416.23	.53	.98	6.20	7	246	245	253	46	77	77	12.0
4	55	417 ~~42~~.67	.56	1.05	7.64	7.5	236				77	77	12.2
3	57.5	419.43	.92	1.67	9.46	11.5	256	239	258	46	77	77	12.1
2	60	421.39	1.08	1.95	1.42	14.5	260				75	77	12.3
1	62.5	423.25	1.05	1.90	3.36	14	257	238	256	47	77	75	12.2
	0-62.5	V_m = 42.15		ΔH = 1.48							Avg. =	76.5	

(1134)

C-7

INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 2 Field Data Sheet

Job: Allentown, WI / Danbury, WI
Source: Asphalt Plant / Stack
Test: 5 Run: 0 Date: 10-8-99
Stack Dimen.: 47/41 IN.
Dry Bulb: 252 °F Wet bulb: 148 °F
Manometer: ☒ Reg. ☐ Exp ☐ Elec.
Barometric Pressure: 28.86 IN.HG
Static Pressure: -.01 IN.WC
Operators: M. Kuehler + S. Thiesse
Pitot No.: 31V-4 C_p: .84

Drawing of Test Site

Cross-section View	Elevation View

Traverse Point No.	Fraction of Diameter	Distance From Stack Wall (IN.)	Distance From End of Port (IN.)	Velocity	Temp. of Gas
		Port Length:	IN.	Time Start:	HRS
		Refer to	Test No. 2		
		for Pts.	and Flows		

Temp. Meas. Device & S/N: | Time End: HRS

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

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INTERPOLL LABORATORIES, INC.
(612) 786-6020
Interpoll Laboratories EPA Method 5/202 Sample Log Sheet

Job Marty 46 / Danbury, WI
Source Asphalt Plant / Stack
Method 0011

Date 10-8-99 Test 5 Run 1
No. of traverse points 25
Filter holder NA Filter Type NA

Sample train Leak Check:
Pretest: ≤ 0.02 cfm @ 15 In. Hg (vac)
Post test <0.02 cfm @ 0 Hg (vac)

Particulate Catch Data
No. of filters used NA

Recovery Solvents
~~Acetone~~ MeCl2
Others

No. of probe wash bottles: Added to Imp.
Sample recovered by: Mikuehlout S. Thorne

Condensate Data:

Item	Weight (g) Final	Tare	Difference
Impinger No. 1	634	472	162
Impinger No. 2	565	282	283
Impinger No. 3			
Condenser			
Desiccant	1514	1494	20
Total			465

EPA Method 202 Data: NA
pH of Impinger Catch: _____ Purge: _____ Time: _____ Date: _____
Tare weight of imp catch jar: _____ g

Integrated Bag Sample:
Bag Pump No. NA
Box No. 14 Bag No. 1
Bag Material 5-layer aluminized Tedlar
Size: 44L
Pretest Leak Check: 0 cc/min @ 15 In.Hg
Time Start: 1225
Time End 1410

S/N of O2 Analyzer 31A

G:\Stack\WP\Forms\S-0046

INTERTOX LABORATORIES, INC.
(612) [illegible]-6020

EPA Method 5 Field Data Sheet

Job Marshfield / Danbury, WI
Source Asphalt Plant / Stack
Date 10-8-99 Test 5 Run 1

Operators M. Kuehl and S. Thoma
Meter Box No. 5 ΔH@ 1.87 in.WC
Gasmeter Coeff. 1.0020

Nozzle No. Glass
Nozzle Dia. .253 in.
Bar. Press. 28.86 in.Hg

Pitot No. S1V-4
C_p .84
H_2O 32.0 %

Traverse Point No.	Sampling Time (min)	Sample Vol. (cf)	Velocity Head (in.WC)	Orifice Meter (in.WC)	Des. Vol. (cf)	VAC. (in.Hg)	Temperatures (°F) Stack	Probe	Oven	Imp.	Gas/In	Gas/Out	Oxygen (% v/v)
	1224	424.90											
E-5	3	426.94	.77	1.35	6.86	3.5	254	243	257	45	76	77	12.3
4	6	428.86	.79	1.39	8.85	3.5	255				77	77	12.0
3	9	431.10	1.03	1.81	1.12	4	254	241	253	47	78	77	12.6
2	12	433.49	1.17	2.06	3.55	4.5	253				79	77	12.0
1	15	435.77	1.06	1.87	5.86	4.5	252	243	252	47	80	77	12.3
D-5	18	437.85	.82	1.45	7.90	4	252				80	77	12.1
4	21	439.85	.80	1.41	9.90	4	255	246	250	47	81	77	12.2
3	24	442.07	.99	1.74	2.14	4	256				82	77	12.3
2	27	444.40	1.02	1.79	4.40	4	260	243	255	46	82	78	12.0
1	30	446.82	1.18	2.07	6.83	5	259				83	78	12.0
C-5	33	448.75	.75	1.32	8.78	5.5	259	239	257	46	82	78	12.1
4	36	450.67	.73	1.28	0.70	3.5	261				83	78	12.0
3	39	452.75	.88	1.56	2.81	4	255	242	251	46	78	78	12.2
2	42	455.35	1.25	2.26	5.35	5	236				77	78	12.3
1	45	457.63	1.09	1.97	7.72	5	237	245	250	48	77	78	12.5
B-5	48	459.50	.58	1.04	9.44	3.5	240				78	78	12.4
4	51	461.26	.64	1.15	1.26	3.5	238	248	247	48	79	78	12.3
3	54	463.36	.90	1.61	3.41	4.5	245				80	78	12.2
2	57	465.86	1.28	2.27	5.95	5.5	251	253	246	47	80	78	12.2
1	60	468.19	1.05	1.85	8.25	4.5	254				81	78	12.3
A-5	63	469.96	.52	.92	9.88	3.5	254	249	250	47	80	78	12.2
4	66	471.36	.48	.85	1.44	3.5	254				80	78	12.1
3	69	473.35	.78	1.38	3.43	4	252	246	253	48	81	78	12.3
2	72	475.64	1.08	1.91	5.77	5.5	252				82	78	12.3
1	75	477.93	1.00	1.77	8.02	5	253	243	250	48	82	78	12.1
	θ - 75.00	V_m - 53.03		1.60 ΔH -							Avg. -	78.8	

(1410)

08/19/99 G:\STACK\WIAFORMS\S-5.HB

INTERPOLL LABORATORIES, INC.
(612) 786-6020
Interpoll Laboratories EPA Method 5/202 Sample Log Sheet

Job Mathy 46 / Danbury, WI
Source Asphalt Plant / Stack
Method 0011

Date 10-8-99 Test 5 Run 2
No. of traverse points 25
Filter holder NA Filter Type NA

Sample train Leak Check:
Pretest: ≤ 0.02 cfm @ 15 In. Hg (vac)
Post test 0.02 cfm @ 8 Hg (vac)

Particulate Catch Data
No. of filters used
NA

Recovery Solvents
~~Acetone~~ MeCl2
Others

No. of probe wash bottles: Added to Imp.
Sample recovered by: M. Kaehler J. Thome

Condensate Data:

Item	Weight (g) Final	Tare	Difference
Impinger No. 1	606	475	131
Impinger No. 2	584	263	321
Impinger No. 3			
Condenser			
Desiccant	1515	1500	15
Total			467

EPA Method 202 Data:
pH of Impinger Catch: NA
Purge: Time: Date:
Tare weight of imp catch jar: g

Integrated Bag Sample:
Bag Pump No. NA
Box No. 14 Bag No. 2
Bag Material 5-layer aluminized Tedlar
Size: 44L
Pretest Leak Check: 0
cc/min @ 15 In.Hg
Time Start: 1440
Time End 1556

S/N of O2 Analyzer 31A

G:\Stack\WP\Forms\S-0046

INTERPOLL LABORATORIES, INC.
(612) [illegible]6-6020

EPA Method 5 Field Data Sheet

Job: Matly 46 / Danbury, WI
Source: Asphalt Plant / Stack
Date: 10-8-99 Test: 5 Run: 2

Operators: M. Knehler + T. Thoma
Meter Box No.: 5 ΔH@: 1.87 in.WC
Gasmeter Coeff.: 1.0020

Nozzle No.: Glass
Nozzle Dia.: .253 in.
Bar. Press.: 28.86 in.Hg

Pitot No.: 31014
C_p: .84
H_2O: 30.4 %

Traverse Point No.	Sampling Time (min)	Sample Vol. (cf)	Velocity Head (in.WC)	Orifice Meter (in.WC)	Des. Vol. (cf)	VAC. (in.Hg)	Temperatures (°F) Stack	Probe	Oven	Imp.	Gas/In	Gas/Out	Oxygen (% v/v)
	1440	480.70											
A-5	3	482.55	.59	1.10	2.47	3	245	237	240	43	77	77	12.5
4	6	484.35	.63	1.15	4.28	3	257				77	77	12.1
3	9	486.48	.94	1.71	6.49	4	259	243	245	43	79	77	12.1
2	10	488.80	1.06	1.93	8.84	4.5	257				80	77	12.2
1	15	491.12	1.01	1.84	1.13	4.5	258	240	252	42	80	76	12.2
B-5	18	492.82	.56	1.02	2.84	3	258				80	77	12.0
4	21	494.50	.53	.97	4.51	3	253	246	250	42	80	77	12.1
3	24	496.55	.84	1.54	6.62	4	252				81	76	12.3
2	27	498.95	1.08	1.98	8.99	4.5	255	243	250	43	82	76	12.2
1	30	501.23	.97	1.77	1.24	4	258				82	76	12.3
C-5	33	503.22	.76	1.39	3.24	3.5	255	241	263	43	82	80	12.3
4	36	505.06	.60	1.09	5.02	3.5	261				82	77	12.0
3	39	507.18	.87	1.59	7.16	4	256	236	265	42	83	77	12.2
2	42	509.49	1.08	1.97	9.53	4.5	259				84	78	12.3
1	45	511.78	.99	1.81	1.81	4.5	259	240	260	42	84	77	12.3
D-5	48	513.78	.74	1.35	3.79	4	258				84	78	12.3
4	51	515.72	.73	1.34	5.25	4	258	237	262	44	85	78	12.2
3	54	517.90	.91	1.67	7.94	4	258				86	79	12.0
2	57	520.24	1.10	2.02	0.35	4.5	257	236	257	44	86	78	12.2
1	60	522.61	1.08	1.98	2.74	5	257				86	79	12.3
E-5	63	524.64	.75	1.38	4.74	4	257	241	255	45	86	80	12.2
4	66	526.61	.74	1.37	6.73	4	253				85	79	12.1
3	69	528.85	.96	1.78	8.99	4.5	252	240	250	45	85	79	12.3
2	72	531.22	1.09	2.02	1.40	5	250				85	78	12.0
1	75	533.60	1.08	1.99	3.79	5	253	245	251	45	84	79	12.3
	0-75	V_m = 52.90		1.59 ΔH =							Avg. =	80.1	

(1556)

INTERPOLL LABORATORIES, INC.
(612) 786-6020
Interpoll Laboratories EPA Method 5/202 Sample Log Sheet

Job Murphy 46 / Danburg, WI
Source Asphalt Plant / Stack
Method 0011

Date 10-0-99 Test 5 Run 3
No. of traverse points 6.5
Filter holder NA Filter Type NA

Sample train Leak Check:
Pretest: ≤ 0.02 cfm @ 15 In. Hg (vac)
Post test <0.02 cfm @ 7 Hg (vac)

Particulate Catch Data
No. of filters used NA

Recovery Solvents
~~Acetone~~ MeCl2
Others

No. of probe wash bottles: Added to Imp.
Sample recovered by: Michael S. Thoma

Condensate Data:

Item	Weight (g) Final	Tare	Difference
Impinger No. 1	563	477	86
Impinger No. 2	553	263	290
Impinger No. 3			
Condenser			
Desiccant	1530 ~~1515~~ ML	1515 ~~1500~~ ML	15
Total			391

EPA Method 202 Data:
pH of Impinger Catch: NA
Purge: _____ Time: _____ Date: _____
Tare weight of imp catch jar: _____ g

Integrated Bag Sample:
Bag Pump No. NA
Box No. M Bag No. 3
Bag Material 5-layer aluminized Tedlar
Size: 44L
Pretest Leak Check: 0
cc/min @ 15 In.Hg
Time Start: 1605
Time End 1709

S/N of O2 Analyzer ~~THE~~ 31A

G:\Stack\WP\Forms\S-0046

INTERTEK LABORATORIES, INC.
(612) [illegible]-6020

EPA Method 5 Field Data Sheet

Job Hwy 46 / Danbury WI
Source Asphalt Plant / Stack
Date 10-8-99 Test 5 Run 3

Operators M. Kuehl & J. Thone
Meter Box No. 5 ΔH@ 1.07 in.WC
Gasmeter Coeff. 1.0020

Nozzle No. Glass
Nozzle Dia. .253 in.
Bar. Press. 28.86 in.Hg

Pitot No. S1U-4
C_p .84
H_2O 30.6 %

Traverse Point No.	Sampling Time (min)	Sample Vol. (cf)	Velocity Head (in.WC)	Orifice Meter (in.WC)	Des. Vol. (cf)	VAC. (in.Hg)	Temperatures (°F) Stack	Probe	Oven	Imp.	Gas/In	Gas/Out	Oxygen (% v/v)
	1605	533.00											
E-5	3	535.03	.76	1.39	5.79	3	254	243	256	43	79	78	12.4
4	6	537.80	.83	1.51	7.88	4	255				79	78	12.3
3	9	540.02	.97	1.77	0.13	4	253	240	261	43	80	78	12.3
2	12	542.38	1.11	2.05	2.53	4.5	254				80	78	12.3
1	15	544.66	1.05	1.92	4.88	4.5	252	246	255	44	80	77	12.0
D-5	18	546.75	.71	1.30	6.81	3.5	253				80	77	12.1
4	21	548.63	.69	1.29	8.73	3.5	237	247	253	44	77	77	12.3
3	24	550.82	.93	1.73	0.95	4.5	240				77	77	12.0
2	27	553.20	1.07	1.98	3.32	5	242	241	256	43	78	76	12.1
1	30	555.25	1.13	2.08	5.26	5	245				78	77	11.9
C-5	33	557.49	.59	1.09	7.53	3.5	245	243	255	43	79	77	11.9
4	36	559.30	.63	1.16	9.35	3.5	248				79	76	12.0
3	39	561.48	.89	1.64	1.51	4	248	239	258	45	81	76	11.8
2	42	563.70	1.09	2.00	3.90	5	249				80	76	11.8
1	45	566.01	1.04	1.90	6.23	4.5	252	244	254	45	81	77	12.0
B-5	48	568.00	.73	1.34	8.19	4	253				81	76	12.0
4	51												
3	54												
2	57												
1	60												
A-5	63												
4	66												
3	69												
2	72												
1	75												
	0-48	V_m - 34.20		1.63 ΔH -							Avg. -	79.1	

(1709)

1621

081194-G:\STACK\WIAFORMS\S-5.1B

1.1

Plant #46

EPA

VISIBLE EMISSION OBSERVATION FORM 1

Form Number: | Page 1 of 1

Continued on VEO Form Number:

Method Used (Circle One): Method 9 | 203A | 203B | Other: _____

Company Name: MATHY

Facility Name: Monarch Paving #46

Street Address: Old Hwy 35

City: Danbury | State: WI | Zip:

Process: | Unit #: | Operating Mode:

Control Equipment: | Operating Mode:

Describe Emission Point: ONLY Stack on site

Height of Emis. Pt.: Start ~35 ft. End Same | Height of Emis. Pt. Rel. to Observer: Start ~10 ft. End Same

Distance to Emis. Pt.: Start ~100 ft. End Same | Direction to Emis. Pt. (Degrees): Start 10° End Same

Vertical Angle to Obs. Pt.: Start ∠180° End Same | Direction to Obs. Pt. (Degrees): Start 10° End Same

Distance and Direction to Observation Point from Emission Point: Start 6" above End

Describe Emissions: Start CONDG End

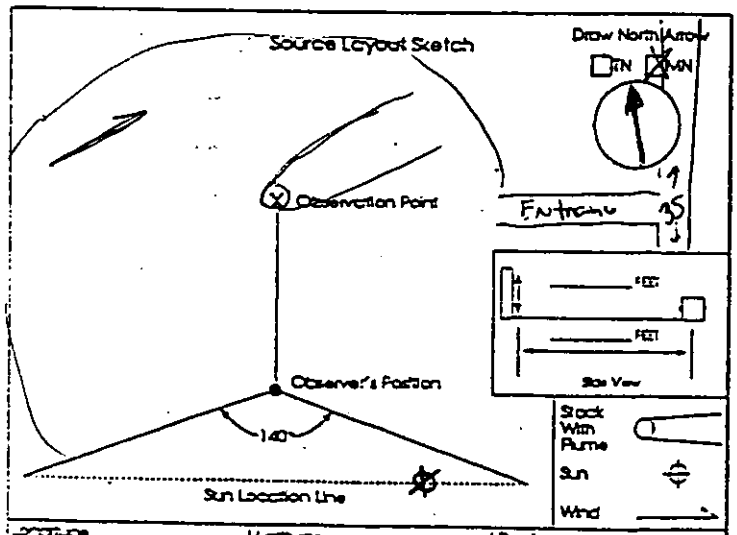
Emission Color: Start White End | Water Droplet Plume: Attached ☐ Detached ☐ None ☒

Describe Plume Background: Start Sky End

Background Color: Start Blue/white End | Sky Conditions: Start Overcast End

Wind Speed: Start 3-5mph End | Wind Direction: Start NE End

Ambient Temp.: Start 75.1° End | Wet Bulb Temp.: NA | RH Percent: 35%



Longitude | Latitude | Declination

Additional Information

Observation Date	Time Zone	Start Time	End Time
10/12/99	CST	11:05	11:33

Min \ Sec	0	15	30	45	Comments
1	10	10	5	10	
2	10	10	10	10	
3	10	10	10	10	
4	15	10	20	10	
5	10	10	10	5	
6	10	5	5	10	
7	10	10	5	5	
8	5	5	10	10	
9	5	10	10	10	
10	10	5	5	5	
11	10	10	10	10	
12	5	10	15	10	
13	15	10	10	10	
14	10	15	15	10	
15	15	10	10	15	
16	15	10	10	10	
17	10	10	10	5	
18	10	10	10	15	
19	15	10	10	5	
20	5	5	5	10	
21	10	5	5	10	
22	10	5	5	5	
23	5	5	5	5	
24	5	5	5	5	
25	5	5	5	5	
26	5	5	5	5	
27	5	5	10	5	
28	5	10	5	10	
29	10	5	10	0	* PLANT STOPPED
30					

Observer's Name (Print): David M. Hall

Observer's Signature: David M Hall | Date: 10/12/99

Organization: Intergal Labs

Certified by: ETA | Date: 10/6/99

VEOF1.1

EPA

VISIBLE EMISSION OBSERVATION FORM 1

Form Number	Page 2 of 6
Continued on VEO Form Number	

Method/Field (Circle One): Method 9 (circled) 203A 203B Other: _____

Company Name: MATHY

Facility Name: Monarch Paving #46

Street Address: Old Hwy 85

City: Danburg | State: WI | Zip:

Process: | Unit #: | Operating Mode:

Control Equipment: | Operating Mode:

Describe Emission Point:

Height of Emiss. Pt. Start: End: | Height of Emiss. Pt. Rel. to Observer Start: End:

Distance to Emiss. Pt. Start: End: | Direction to Emiss. Pt. (Degrees) Start: End:

Vertical Angle to Obs. Pt. Start: End: | Direction to Obs. Pt. (Degrees) Start: End:

Distance and Direction to Observation Point from Emission Point Start: End:

Describe Emissions Start: End:

Emission Color Start: End: | Water Droplet Plume Attached ☐ Detached ☐ None ☐

Describe Plume Background Start: End:

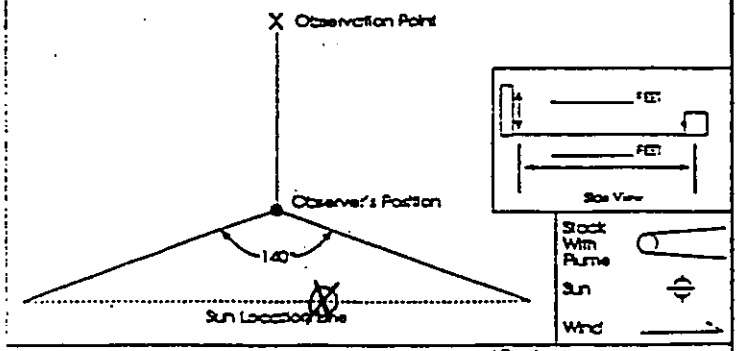
Background Color Start: End: | Sky Conditions Start: End:

Wind Speed Start: End: | Wind Direction Start: End:

Ambient Temp. Start: End: | Wet Bulb Temp. | RH Percent

Source Layout Sketch

Draw North Arrow ☐TN ☐MN



Longitude | Latitude | Declination

Additional Information

Observation Date	Time Zone (CST)	Start Time	End Time
10/13/99	13:12	13:12	

Min \ Sec	0	15	30	45	Comments
1	10	10	15	15	*Re Start
2	10	10	10	10	
3	20	15	15	15	
4	10	10	15	10	
5	10	5	5	5	
6	5	5	10	10	
7	5	5	5	5	
8	10	10	5	10	
9	10	10	5	5	
10	5	10	5	5	
11	10	10	10	10	
12	5	10	10	5	
13	5	10	10	10	
14	10	10	10	5	
15	5	5	10	5	
16	5	5	5	10	
17	5	5	10	5	
18	10	10	5	10	
19	5	5	5	10	
20	10	10	5	5	
21	5	10	10	15	
22	15	10	10	5	
23	5	10	5	5	
24	5	10	5	5	
25	5	5	5	5	
26	5	5	5	5	
27	5	10	5	10	
28	10	10	5	5	
29	10	5	5	5	
30	5	5	5	5	

Observer's Name (Print): David M. Hall

Observer's Signature: David M. Hall | Date: 10/12/99

Organization: Interpoll Labs

Certified by: ETA | Date: 10/6/99

VEOF1.1

2.2

EPA

VISIBLE EMISSION OBSERVATION FORM 1

Form Number	Page 3 of 6
Continued on VEO Form Number	

Method Used (Circle One): Method 9 | 203A | 203B | Other: _____

Company Name	MATHY
Facility Name	MONARCH #46
Street Address	
City	DANBURY
State	WI
Zip	

Process	Unit #	Operating Mode
Control Equipment		Operating Mode

Describe Emission Point:

Height of Emiss. Pt. Start ~35 ft. End Same	Height of Emiss. Pt. Rel. to Observer Start ~ End
Distance to Emiss. Pt. Start ~100 ft. End	Direction to Emiss. Pt. (Degrees) Start End
Vertical Angle to Obs. Pt. Start <18° End	Direction to Obs. Pt. (Degrees) Start End
Distance and Direction to Observation Point from Emission Point Start 6' above End	

Describe Emissions: Start Coming End

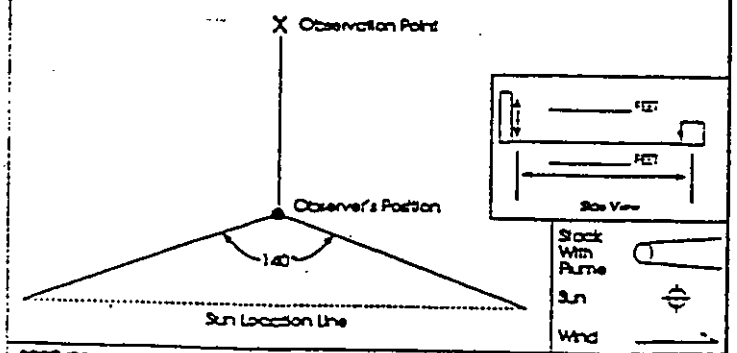
Emission Color Start White End	Water Droplet Plume Attached ☐ Detached ☐ None ☒

Describe Plume Background: Start End

Background Color Start End	Sky Conditions Start End
Wind Speed Start End	Wind Direction Start End
Ambient Temp. Start 71.0° End	Wet Bulb Temp. / Rel Percent 34%

Source Layout Sketch

Draw North Arrow ☐ TN ☐ MN



Longitude	Latitude	Declination

Additional Information:

Observation Date 10/13/99	Time Zone CST	Start Time 1342	End Time

Min \ Sec	0	15	30	45	Comments
1	5	5	5	5	
2	5	5	5	5	
3	5	5	5	5	
4	5	5	5	5	
5	5	5	5	5	
6	5	5	5	5	
7	5	5	5	5	
8	5	5	5	5	
9	5	5	5	5	
10	5	5	5	5	
11	5	5	5	5	
12	5	5	5	5	
13	5	10	5	10	
14	5	5	5	5	
15	5	10	5	5	
16	5	5	5	5	
17	5	10	5	5	
18	5	5	5	5	
19	5	10	5	5	
20	5	5	5	5	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	—	—	* SHUT 14:07
27	—	—	—	—	DOWN
28	—	—	—	—	PLANT
29	—	—	—	—	(2ND Time)
30	—	—	—	—	

Observer's Name (Print)	
Observer's Signature	Date
Organization	
Certified by	Date

VEOF1.1

EPA

VISIBLE EMISSION OBSERVATION FORM 1

Form Number	Page of
Continued on VEO Form Number	

Method Used (Circle One): Method 9 | 203A | 203B | Other: _____

Company Name	MATHY
Facility Name	MONARCH PAVING #46
Street Address	Old Hwy 35
City	DANBURY
State	WI
Zip	
Process	
Unit #	
Operating Mode	
Control Equipment	
Operating Mode	
Describe Emission Point	ONLY Stack on site
Height of Emiss. Pt.	Start ~35 ft. End Same
Height of Emiss. Pt. Rel. to Observer	Start ~15 ft End
Distance to Emiss. Pt.	Start ~100 ft. End Same
Direction to Emiss. Pt. (Degrees)	Start 10° End
Vertical Angle to Obs. Pt.	Start <18° End Same
Direction to Obs. Pt. (Degrees)	Start 10° End Same
Distance and Direction to Observation Point from Emission Point	Start 6" above End Same
Describe Emissions	Start CURING End Same
Emission Color	Start White End Same
Water Droplet Plume	Attached ☐ Detached ☐ None ☑
Describe Plume Background	Start Sky End Sky
Background Color	Start Blue grey End Same
Sky Conditions	Start Overcast End
Wind Speed	Start 3-5 End Same
Wind Direction	Start NE End
Ambient Temp.	Start 70 End 70
Wet Bulb Temp.	NA
RH Percent	34

Source Layout Sketch

Draw North Arrow ☐TN ☐MN

Observation Point

35

FEET

FEET

Side View

Observer's Position

140°

Sun Location Line

Stack With Plume

Sun

Wind

Longitude	Latitude	Declination

Additional Information

Observation Date	Time Zone	Start Time	End Time
10/12/99	CST	1448	1517

Min \ Sec	0	15	30	45	Comments
1	5	5	5	5	
2	10	5	5	5	
3	5	5	5	5	
4	5	5	5	5	
5	5	5	5	5	
6	5	5	10	10	
7	10	10	5	5	
8	5	5	5	5	
9	5	5	5	5	
10	5	5	5	5	
11	5	0	5	5	
12	5	5	5	5	
13	5	5	5	5	
14	5	5	5	0	
15	5	5	5	5	
16	5	5	5	0	
17	0	0	0	—	truck exhaust
18	5	0	5	5	
19	5	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	5	5	
27	5	5	5	0	
28	0	5	5	0	
29	5	5	5	5	
30	5	0	5	5	

Observer's Name (Print)	David M Hall
Observer's Signature	David M. Hall
Date	10/12/99
Organization	Intersoil Labs
Certified by	ETA
Date	10/6/99

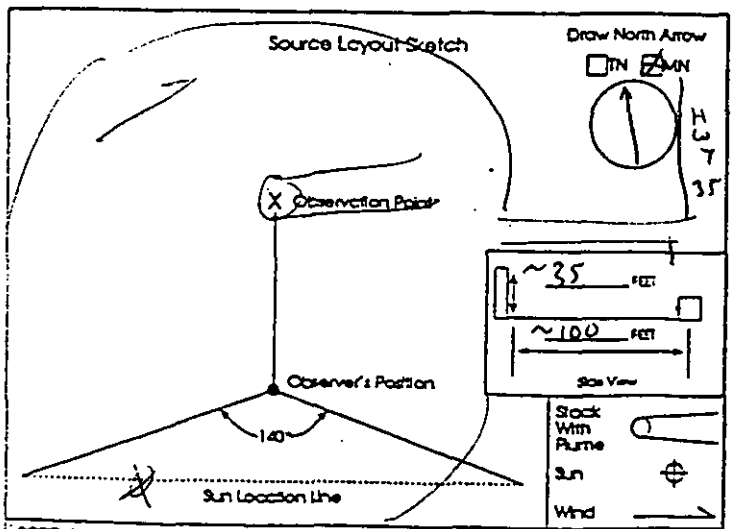
VEOF1.1

3.2

EPA

VISIBLE EMISSION OBSERVATION FORM 1

Method Described (Circle One)	Method 9 (circled) 203A 203B Other:
Company Name	MATHY
Facility Name	MONARCH PAVING #46
Street Address	Old Hwy 35
City	DANBURY
State	WI
Zip	
Process	Asphalt Plant Libra Systems
Unit #	6528
Operating Mode	AUTO
Control Equipment	BAGHOUSE
Operating Mode	AUTO/270TPH
Describe Emission Point	ONLY Stack @ site
Height of Emiss. Pt.	Start ~35 ft End Same
Height of Emiss. Pt. Rel. to Observer	Start ~10 ft. End Same
Distance to Emiss. Pt.	Start ~100 ft. End Same
Direction to Emiss. Pt. (Degrees)	Start 10 End Same
Vertical Angle to Obs. Pt.	Start <18° End Same
Direction to Obs. Pt. (Degrees)	Start 10 End
Distance and Direction to Observation Point from Emission Point	Start 6" above End Same
Describe Emissions	Start Coming End Same
Emission Color	Start White End Same
Water Droplet Plume	Attached ☐ Detached ☐ None ☒
Describe Plume Background	Start Sky (Grey) End Same
Background Color	Start Grey End Same
Sky Conditions	Start Overcast End Same
Wind Speed	Start 3-5 End
Wind Direction	Start NE End
Ambient Temp.	Start End
Wet Bulb Temp.	
RH Percent	



Longitude	Latitude	Declination

Additional Information

Form Number	Page of
Continued on VEO Form Number	

Observation Date	Time Zone	Start Time	End Time
10/12/99	CST	15:18	15:49

Min \ Sec	0	15	30	45	Comments
1	5	5	5	5	
2	5	5	5	5	
3	5	5	5	5	
4	5	5	5	5	
5	5	5	5	5	
6	5	5	5	5	
7	5	0	0	0	
8	5	5	5	5	
9	5	5	5	5	
10	5	5	5	5	
11	5	5	5	5	
12	5	5	5	5	
13	5	10	5	5	
14	5	10	5	10	
15	5	5	5	5	
16	5	5	5	5	
17	5	5	5	5	
18	5	5	5	5	
19	5	5	5	5	
20	5	5	5	0	
21	5	5	5	5	
22	5	5	5	5	
23	5	5	5	5	
24	5	5	5	5	
25	5	5	5	5	
26	0	5	5	5	
27	0	0	0	0	
28	5	5	5	5	
29	5	5	5	5	
30	5	5	5	5	

Observer's Name (Print)	David M Hall
Observer's Signature	David M. Hall
Date	10/12/99
Organization	Interpoll Labs
Certified by	ETA
Date	10/6/99

VEOF1.1

VISIBLE EMISSIONS EVALUATOR

This is to certify that

David Hall

met the specifications of Federal Reference Method 9 and qualified as a visible emissions evaluator. Maximum deviation on white and black smoke did not exceed 7.5% opacity and no single error exceeding 15% opacity was incurred during the certification test conducted by Eastern Technical Associates of Raleigh, North Carolina. This certificate is valid for six months from date of issue.

273413	*Minneapolis, Minnesota*	*October 6, 1999*
Certificate Number	Location	Date of Issue

President

Director of Training

APPENDIX D

INTERPOLL LABORATORIES ANALYTICAL DATA

INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 3A Data Reporting Sheet

Waste 0.1

Job Name: Marty 46 / Danbury, WI
Source: Asphalt Plant / Stack
Date of Analysis: 10-8-99
Analyst: Mark Kaehler
Team Leader: M. Kaehler Date of Test: 10-8-99

Fuel Type: ~~NO.2~~ MC
Analyzer: Servomex Model 1400
Range: 0-25% O2
Range: 0-20% CO2
Flow rate: 1000 cc/min

Calibration Values (%)							
	Cylinder Value		Pre-test Reading		Post-test		Cyl. No.
	O2	CO2	O2	CO2	O2	CO2	
Zero Gas (N2)	0.0	0.0	.14	.33	.09	.16	
Upscale (40-60%)	10.9	11.0	11.00	10.98	10.97	10.89	CC 117719
Upscale (80-100%)	20.9	16.8	21.01	16.89			CC 38918

Sample Test/Run	Sample Log No.	O2(%)					CO2(%)					Fo
		$\bar{C}$	C_0	C_{ma}	C_m	C_{gas}	$\bar{C}$	C_0	C_{ma}	C_m	C_{gas}	
5/1		12.21	.12	10.9	10.99	12.11	6.53	.25	11.0	10.94	6.46	1.361
5/2		12.2	.12	10.9	10.99	12.11	6.55	.25	11.0	10.94	6.48	1.356
5/3		12.10	.12	10.9	10.99	12.11	6.56	.25	11.0	10.94	6.49	1.354

EPA Method 3 Guidelines

Fuel Type	Fo Range	Fuel Type	Fo Range
Coal:		Gas:	
Anthracite/Lignite	1.016-1.130	Natural	1.600-1.836
Bituminous	1.083-1.230	Propane	1.434-1.586
Oil:		Butane	1.405-1.553
Distillate	1.260-1.413	Wood/Wood Bark:	1.000-1.130
Residual	1.210-1.37		

Note 1: The analyzer must be zeroed and spanned immediately before and after sample analysis. Additional checks may be performed between sample analyses if required.

Note 2: $C_{gas} = (\bar{C}-C_0)\, C_{ma}/(C_m-C_0)$ where: C_{gas} = Effluent gas concentration; $\bar{C}$ = Average gas concentration indicated by gas analyzer; C_0 = Average of zero calibration values; C_{ma} = Actual concentration of calibration gas; C_m = Average of initial and final upscale readings.

Note 3: $F_0 = 20.9/O2/CO2$ (use C_{gas} values)

Note 4: All calibration values should be within 2% of the analyzer span.

Coments:

022897-G:\STACK\WP\FORMS\S-585

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Impinger Catch Data Reporting Sheet

Protocol: ☐Minnesota ☐Wisconsin ☐Iowa ☒EPA Method 202 ☐Other

Job: Hathy 46
Date Submitted: 10/11/99
Date of Analysis: 10/16/99
Source/Site: Asphalt plant / Stack
Test No.: 2
Technician: AK 6

	Solvent Phase	Aqueous Phase
Test: 2 Run: 0	Dish No: 979	Dish No: 966
Log No: 13597 · 09,13	Dish + Sample Wt: 39.3738 g	Dish + Sample Wt: 39.8300 g
Color & Appearance:	Dish Tare Wt: 39.3738 g	Dish Tare Wt: 39.8300 g
	Fraction Wt: 0.0000 g	Fraction Wt: 0.0000 g
Comments:	Smpl Vol: 300 ml, Alqt: 250 ml, Factor: 1.200	Smpl Vol: 300 ml, Alqt: 250 ml, Factor: 1.200
	Sample Wt: 0.0000 g	Sample Wt: 0.0000 g
Test: 2 Run: 1	Dish No: 328	Dish No: 109
Log No: 10,14	Dish + Sample Wt: 41.9757 g	Dish + Sample Wt: 51.8521 g
Color & Appearance:	Dish Tare Wt: 41.9639 g	Dish Tare Wt: 51.7658 g
	Fraction Wt: 0.0118 g	Fraction Wt: 0.0863 g
Comments:	Smpl Vol: 700 ml, Alqt: 650 ml, Factor 1.077	Smpl Vol: 700 ml, Alqt: 650 ml, Factor 1.077
	Sample Wt: 0.0127 g	Sample Wt: 0.0929 g
Test: 2 Run: 2	Dish No: 421	Dish No: 001
Log No:	Dish + Sample Wt: 44.6472 g	Dish + Sample Wt: 54.7329 g
Color & Appearance: 11,15	Dish Tare Wt: 44.6389 g	Dish Tare Wt: 54.6740 g
	Fraction Wt: 0.0083 g	Fraction Wt: 0.0589 g
Comments:	Smpl Vol: 700 ml, Alqt: 650 ml, Factor 1.077	Smpl Vol: 700 ml, Alqt: 650 ml, Factor 1.077
	Sample Wt: 0.0089 g	Sample Wt: 0.0634 g
Test: 2 Run: 3	Dish No: 771	Dish No: 134
Log No: 12,16	Dish + Sample Wt: 43.8297 g	Dish + Sample Wt: 44.8249 g
Color & Appearance:	Dish Tare Wt: 43.8223 g	Dish Tare Wt: 44.7690 g
	Fraction Wt: 0.0074 g	Fraction Wt: 0.0559 g
Comments:	Smpl Vol: 700 ml, Alqt: 650 ml, Factor 1.077	Smpl Vol: 700 ml, Alqt: 650 ml, Factor 1.077
	Sample Wt: 0.0080 g	Sample Wt: 0.0602 g

Note: Factor = Sample Volume/Aliquot Volume

Blank Solvent Wt. _____ g

	RUN 0	RUN 1	RUN 2	RUN 3
Results of Solvent Phase g	0.0000	0.0127	0.0089	0.0080
Results of Aqueous Phase g	0.0000	0.0929	0.0634	0.0602

D-2 .1056 .0723 .0682

INTERPOLL LABORATORIES, INC.
(612) 786-6020

GRAVIMETRICS DATA SHEET

Job Mathy
Date Collected 10/8/99
Date of Analysis 10/28/99

Source Plant #46 Asphalt Plant Stack
Test No. 2
Technician D. Van Hoever

Solvent Used: Acetone

Filter Type: 4" glass fiber

Probe Wash Data		Filter Data	
Run 0			
Log # 13597-01	Dish # 209	Log # 13597-05	Filter # 1325
Volume 55 ml	Leakage X no, __ yes	Color	
Tare + Sample (g)	42.9482	Tare + Sample (g)	.9337
Tare (g)	42.9481	Tare (g)	.9336
Sample (g)	.0001	Sample (g)	.0001
Run 1			
Log # -02	Dish # 55	Log # -06	Filter # 1282
Volume 105 ml	Leakage X no, __ yes	Color	
Tare + Sample (g)	52.4188	Tare + Sample (g)	.9690
Tare (g)	52.3828	Tare (g)	.9477
Sample (g)	.0360	Sample (g)	~~.0223~~ .0213
Run 2			
Log # -03	Dish # 119	Log # -07	Filter # 1283
Volume 100 ml	Leakage X no, __ yes	Color	
Tare + Sample (g)	47.7912	Tare + Sample (g)	.9623
Tare (g)	47.7627	Tare (g)	.9434
Sample (g)	.0285	Sample (g)	.0189
Run 3			
Log # -04	Dish # 14	Log # -08	Filter # 1284
Volume 105 ml	Leakage X no, __ yes	Color	
Tare + Sample (g)	37.7870	Tare + Sample (g)	.9706
Tare (g)	37.7595	Tare (g)	.9480
Sample (g)	.0275	Sample (g)	.0226

Note: Solvent residue must be less than 0.0000078 g/ml

	Run 1 (.0358)	Run 2 (.0283)	Run 3 (.0273)	Run
Results of Filter + Probe Wash (g)	.0571	.0472	.0499	
Total Mass (g)				

010397-G:\STACK\WP\FORMS\S-491

INTERPOLL LABORATORIES INC.

Formaldehyde Results Using EPA Method 0011
For Dept. 20, Mathy Construction
Collected 10/8/99

	Field Spike			Test: 5				Source: Asphalt Plant Stack
	Actual	Found	% Recovery	Train Blank	Trip Blank	Run 1	Run 2	Run 3
Log #		13597-20		13597-18	13597-19	13597-21	13597-22	13597-23
Formaldehyde (ug)*	760	570	75.0	9.0	2.9	5000	4300	3400

* = Total mass in the sample in ug.

Reviewed by:

David J. Schneider, Manager
Chemistry Department

DJS/cg

Interpoll Laboratories, Inc.

(612)786-6020

Impinger Catch Preparation Work

Order Form

Project Name: MATHY

Order Date: 9/10/99

Date Required: 10/4/99

Delivery Date: 10/4/99

Nature of Spiking Material	Spike Concentration	Spike Volume	Total Mass of Spike
FORMALDEHYDE 95204-184-A	3.80 µg/ml	200 ml	760 µg

SPECIAL REQUIREMENTS

Prepared (1) one field spike SKJ 10/4/99

95147-05-71

**Please return this form with the samples.

LOA-34

g:/chem/excel forms/loa-34.xls

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Sample Chain of Custody

Job: Metty 40 / Danbury, WI Source: Asphalt Plant Site: Stack Log No.: 15597
Field Engineer: M. Kaehler Date of Test: 10-8-99 Test No.: 2 No. of Runs: 3

No. Items	Sample Type		Analysis		Sequence No.	Comments
3+1	**Probe Wash:** ☒ Acetone ☐ $MeCl_2$	☐ DI Water ☐ _____	☒ EPA M-5 ☐ EPA M-29	☐ EPA M-201A ☐ _____	01 - 04	
3+1	**Filter:** ☒ 4" Glass ☐ SS Thimble	☐ Pallflex ☐ 2.5" Glass	☒ EPA M-5 ☐ EPA M-29 ☐ EPA M-201A	☐ EPA M-17	05 - 08	
8+1 (17 impingers received OOS 10/11/99) 3+1	**Impingers:** ☒ DI Water APLC ☐ 3% H_2O_2 ☐ 1N NaOH ☐ 2,4-DNPH	☐ H_2SO_4 ☐ HNO_3/H_2O_2 ☐ $KMnO_4/H_2SO_4$ ☑ $MeCl_2$ Rinse	☐ MN Protocol ☐ WI Protocol ☒ EPA M-202 ☐ EPA M6,8 ☐ Acid Gases	☐ IA Protocol ☐ Formaldehyde ☐ EPA M-29 ☐ EPA M-26 ☐ _____	09 - 12 / 13-16	
—	**Integrated Gas:** ☐ Tedlar Bag	☐ _____	☐ EPA M-3 ☐ _____	☐ EPA M-10		TR 2
—	**Oxides of Nitrogen:**		☐ EPA M-7A ☐ _____			
1	**Fuel Lab:** ☒ Fuel Sample	☐ Aggregate	☐ Per S-0163		17	
—	**Particle Sizing:**		☐ X-Ray Sdgraph ☐ _____	☐ Cascade Imp		
—	**Miscellaneous:**	☐ _____	☐ _____			

Fuel Type: Coal: ☐ Bituminous ☐ Anthracite ☐ Lignite Wood: ☐ Wood Waste ☐ Dust ☐ Bark Oil: ☒ Waste Oil AK ~~☐ No. 2~~ ☐ No. 6 Misc: ☐ Natural Gas ☐ RDF ☐ _____

Relinquished by/Affiliation	Accepted by/Affiliation	Date
Mark Kaehler / Interpoll Labs	[illegible]	10/11/99

D-6

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Sample Chain of Custody

Job: Hatty 46 Source: Asphalt Plant Site: Stack Log No.: 13597
Field Engineer: M. Kaehler Date of Test: 10-8-99 Test No.: 5 No. of Runs: 3

No. Items	Sample Type		Analysis		Sequence No.	Comments
—	**Probe Wash:** ☐ Acetone ☐ $MeCl_2$	☐DI Water ☐_____	☐EPA M-5 ☐EPA M-29	☐EPA M-201A ☐_____		Added to Imp.
—	**Filter:** ☐ 4" Glass ☐ SS Thimble	☐Pallflex ☐2.5" Glass	☐EPA M-5 ☐EPA M-29 ☐EPA M-201A	☐EPA M-17		
6+1+1+1	**Impingers:** ☐DI Water ☐3%H_2O_2 ☐1N NaOH ☒2,4-DNPH	☐H_2SO_4 ☐HNO_3/H_2O_2 ☐$KMnO_4/H_2SO_4$ ☐_____	☐MN Protocol ☐WI Protocol ☐EPA M-202 ☐EPA M6,8 ☐Acid Gases	☐IA Protocol ☒Formaldehyde ☐EPA M-29 ☐EPA M-26 ☐_____	18- 23 n/s	
—	**Integrated Gas:** ☐Tedlar Bag	☐_____	☐EPA M-3 ☐_____	☐EPA M-10		Analyzed in Field
—	**Oxides of Nitrogen:**		☐EPA M-7A ☐_____			
—	**Fuel Lab:** ☐Fuel Sample	☐Aggregate	☐Per S-0163			
—	**Particle Sizing:**		☐X-Ray Sdgraph ☐_____	☐Cascade Imp		
—	**Miscellaneous:**	☐_____	☐_____			

Fuel Type: Coal: ☐Bituminous ☐Anthracite ☐Lignite Wood: ☐Wood Waste ☐Dust ☐Bark Oil: ☒Waste Oil ☐No. 2 ☐No. 6 Misc: ☐Natural Gas ☐RDF ☐_____

Relinquished by/Affiliation	Accepted by/Affiliation	Date
Mark Kaehler / Interpoll Labs	David Richards	10/11/99

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APPENDIX E

COMPUTER DATALOGGER PRINTOUTS

FIELD CALCULATION
MATHY 46
DANBURY, WI
ASPHALT PLANT
STACK
TEST 4 / RUN 1
10/8/99

RAW DATA TABLE

Fo	1.406	MOISTURE	32.28
		DSCFM	24360

INSTRUMENT

			RAW	ZERO	SPAN	GAS	C GAS
SO2	PPM	(DRY)	49.09	-0.38	78.18	77.90	49.05
O2	%	(DRY)	12.44	0.00	10.97	10.90	12.36
CO2	%	(DRY)	6.04	-0.01	10.95	11.00	6.07

RESULTS

SO2	PPM	(WET)	33.22	SO2	LBS/HR	11.90
O2	%	(WET)	8.37			
CO2	%	(WET)	4.11			

MATHY 46
DANBURY, WI
ASPHALT PLANT
STACK
TEST 4 / RUN 1
10/8/99

TIME		SO2 PPM		O2 %		CO2 %
700.14		43.711		12.709		5.864
701.14		44.606		12.522		5.897
702.14		40.13		12.423		5.97
703.14		42.368		12.522		5.937
704.14		37.445		12.5		5.97
705.14		37.892		12.61		5.929
706.14		38.787		12.709		5.831
707.14		38.34		12.522		6.019
708.14		39.235		12.533		5.864
709.14		42.368		12.511		5.978
710.14		43.711		12.467		6.1
711.14		42.816		12.302		6.149
712.14		40.13		12.346		6.076
713.14		31.626		12.621		6.01
714.14		41.921		12.489		6.076
715.14		46.844		12.478		6.059
716.14		46.396		12.379		5.929
717.14		49.082		12.588		5.986
718.14		49.53		12.555		6.059
719.14		50.872		12.478		6.019
720.14		49.082		12.522		6.092
721.14		48.187		12.204		6.157
722.14		49.53		12.39		6.19
723.14		51.32		12.489		6.084
724.14		49.53		12.368		6.124
725.14		48.187		12.39		6.124
726.14		48.187		12.533		6.043
727.14		50.425		12.511		6.076
728.14		52.215		12.522		6.124
729.14		54.901		12.39		6.059
730.14		53.558		12.5		6.124
731.14		54.453		12.522		6.1
732.14		53.558		12.423		6.116
733.14		50.872		12.5		6.084
734.14		53.11		12.28		6.255
735.14		50.872		12.258		6.271
736.14		52.663		12.423		6.133
737.14		53.11		12.39		6.157
738.14		53.11		12.478		6.165
739.14		53.558		12.478		6.092
740.14		53.11		12.621		6.076
741.14		41.921		14.544		4.529
742.14		56.691		12.248		6.401
743.14		55.348		12.094		6.287
744.14		53.558		12.258		6.295
745.14		52.215		12.127		6.238
746.14		53.558		12.346		6.238
807.14		50.872		12.302		5.75
808.14		52.215		12.193		5.888
809.14		53.558		12.237		5.954
810.14		54.901		12.204		5.994
811.14		52.663		12.28		5.88
812.14		53.558		12.094		6.084
813.14		56.691		12.138		6.165
814.14		55.348		12.237		6.059
815.14		54.901		12.291		6.092
816.14		54.006		12.237		6.141
817.14		53.558		12.324		6.076
818.14		54.006		12.401		6.076
819.14		54.453		12.28		6.1
		AVERAGE		AVERAGE		AVERAGE
		49.09		12.44		6.04

FIELD CALCULATION
MATHY 46
DANBURY, WI
ASPHALT PLANT
STACK
TEST 4 / RUN 2
10/8/99

RAW DATA TABLE

Fo	1.349	MOISTURE	29.90
		DSCFM	25390

INSTRUMENT

			RAW	ZERO	SPAN	GAS	C GAS
SO2	PPM	(DRY)	55.76	-0.15	78.18	77.90	55.60
O2	%	(DRY)	12.25	0.02	11.01	10.90	12.14
CO2	%	(DRY)	6.49	0.01	10.99	11.00	6.50

RESULTS

SO2	PPM	(WET)	38.98	SO2	LBS/HR	14.06
O2	%	(WET)	8.51			
CO2	%	(WET)	4.55			

MATHY 46
DANBURY, WI
ASPHALT PLANT
STACK
TEST 4 / RUN 2
10/8/99

TIME		SO2 PPM		O2 %		CO2 %
855.14		56.243		12.302		6.19
856.14		54.453		12.368		6.149
857.14		54.901		12.237		6.214
858.14		57.586		12.335		6.336
859.14		58.034		12.061		6.295
900.14		56.691		11.94		6.336
901.14		57.586		12.237		6.328
902.14		57.586		12.215		6.369
903.14		57.139		12.379		6.303
904.14		60.272		12.127		6.531
905.14		59.377		12.094		6.491
906.14		56.691		12.269		6.417
907.14		57.139		12.269		6.466
908.14		55.796		12.16		6.507
909.14		53.558		12.324		6.393
910.14		54.901		12.061		6.548
911.14		54.006		12.105		6.621
912.14		53.11		12.237		6.409
913.14		54.006		12.291		6.491
914.14		54.901		12.226		6.458
915.14		53.558		12.313		6.458
916.14		54.901		12.204		6.507
917.14		58.034		12.16		6.678
918.14		58.481		12.083		6.474
919.14		54.901		12.215		6.596
920.14		57.139		12.204		6.539
921.14		56.691		12.171		6.58
922.14		55.796		12.237		6.523
923.14		47.292		13.643		5.368
924.14		54.901		12.105		6.596
925.14		54.901		12.324		6.474
926.14		55.348		12.182		6.499
927.14		55.348		12.269		6.596
928.15		56.243		12.39		6.401
929.14		54.901		12.291		6.572
930.14		58.034		12.138		6.613
931.14		58.034		12.302		6.482
932.14		58.929		12.258		6.515
933.14		51.32		12.237		6.653
934.14		56.243		12.105		6.556
935.14		55.348		12.237		6.629
938.15		53.11		12.215		6.596
939.14		52.663		12.193		6.613
940.14		54.006		12.258		6.531
941.14		55.348		12.489		6.442
942.14		55.796		12.291		6.556
943.14		57.139		12.226		6.629
944.14		58.481		12.324		6.434
945.14		59.824		12.39		6.556
946.15		60.719		12.204		6.539
947.14		59.377		12.401		6.523
948.15		60.272		12.269		6.531
949.14		53.11		12.28		6.694
950.14		58.787		12.039		6.645
951.14		52.816		12.248		6.662
952.14		50.13		12.105		6.678
953.14		56.102		12.116		6.686
954.14		50.731		12.258		6.702
955.14		53.569		12.017		6.751
956.15		53.569		12.094		6.718
		AVERAGE		AVERAGE		AVERAGE
		55.76		12.25		6.49

FIELD CALCULATION
MATHY 46
DANBURY, WI
ASPHALT PLANT
STACK
TEST 4 / RUN 3
10/8/99

RAW DATA TABLE

Fo	1.364	MOISTURE	32.01
		DSCFM	24030

INSTRUMENT

			RAW	ZERO	SPAN	GAS	C GAS
SO2	PPM	(DRY)	57.41	0.75	78.18	77.90	57.01
O2	%	(DRY)	12.05	0.08	11.00	10.90	11.95
CO2	%	(DRY)	6.73	0.23	11.13	11.00	6.56

RESULTS

SO2	PPM	(WET)	38.76	SO2	LBS/HR	13.64
O2	%	(WET)	8.12			
CO2	%	(WET)	4.46			

MATHY 46
DANBURY, WI
ASPHALT PLANT
STACK
TEST 4 / RUN 3
10/8/99

TIME		SO2 PPM		O2 %		CO2 %
1030.14		56.691		12.039		6.426
1031.15		58.929		12.215		6.36
1032.15		61.167		12.017		6.548
1033.15		62.51		12.237		6.409
1034.15		60.272		12.083		6.572
1035.14		61.167		12.127		6.58
1036.14		62.51		12.017		6.58
1037.14		59.377		12.094		6.596
1038.14		60.719		11.984		6.637
1039.14		60.272		11.951		6.71
1040.15		60.272		12.05		6.67
1041.15		60.272		12.006		6.71
1042.15		57.586		11.94		6.767
1043.15		58.929		12.083		6.735
1044.14		42.816		12.094		6.637
1045.14		43.711		12.116		6.653
1046.14		53.11		11.951		6.718
1047.14		55.348		11.94		6.832
1048.14		55.796		12.127		6.678
1049.14		56.691		11.951		6.792
1050.15		54.006		11.94		6.824
1051.15		48.187		11.94		6.832
1052.15		51.32		12.05		6.743
1053.14		51.768		11.951		6.832
1054.14		53.11		12.017		6.832
1055.14		54.901		11.863		6.898
1056.14		53.11		12.039		6.751
1059.15		51.32		12.116		6.678
1100.15		49.977		12.248		6.613
1101.15		52.663		12.138		6.686
1102.14		54.901		12.072		6.694
1103.14		56.691		12.127		6.637
1104.14		53.558		12.072		6.8
1105.14		56.691		12.083		6.816
1106.14		58.929		11.951		6.784
1107.14		56.243		12.094		6.727
1108.15		55.348		12.138		6.735
1109.15		58.034		11.94		6.873
1110.15		58.034		11.962		6.881
1111.15		60.272		12.127		6.727
1112.14		60.719		11.962		6.808
1113.14		56.243		11.973		6.824
1114.14		57.139		11.929		6.881
1115.14		55.796		12.138		6.735
1116.15		54.453		12.16		6.808
1117.15		57.139		12.116		6.694
1118.15		61.167		12.061		6.784
1119.15		59.377		12.16		6.686
1120.15		62.957		11.951		6.938
1121.15		61.615		12.039		6.816
1122.14		61.615		12.017		6.775
1123.14		61.615		12.149		6.67
1124.14		62.957		12.116		6.832
1125.14		60.272		12.105		6.743
1126.15		64.3		12.006		6.857
1127.15		64.3		12.149		6.727
1128.15		62.51		12.006		6.914
1129.15		62.062		12.083		6.751
1130.14		60.719		12.05		6.71
1131.15		60.272		12.094		6.767
		AVERAGE		AVERAGE		AVERAGE
		57.41		12.05		6.73

5.1.1 **Sample Probe.** Glass, stainless steel, or equivalent, of sufficient length to traverse the sample points. The sampling probe shall be heated to prevent condensation.

5.1.2 **Sample Line.** Heated (sufficient to prevent condensation) stainless steel or Teflon tubing, to transport the sample gas to the moisture removal system.

5.1.3 **Sample Transport Lines.** Stainless steel or Teflon tubing, to transport the sample from the moisture removal system to the sample pump, sample flow rate control, and sample gas manifold.

5.1.4 **Calibration Valve Assembly.** A three—way valve assembly, or equivalent, for blocking the sample gas flow and introducing calibration gases to the measurement system at the outlet of the sampling probe when in the calibration mode.

5.1.5 **Moisture Removal System.** A refrigerator-type condenser or similar device (e.g., permeation dryer), to remove condensate continuously from the sample gas while maintaining minimal contact between the condensate and the sample gas. The moisture removal system is not necessary for analyzers that can measure gas concentrations on a wet basis; for these analyzers, (1) heat the sample line and all interface components up to the inlet of the analyzer sufficiently to prevent condensation, and (2) determine the moisture content and correct the measured gas concentrations to a dry basis using appropriate methods, subject to the approval of the Administrator. The determination of sample moisture content is not necessary for pollutant analyzers that measure concentrations on a wet basis when (1) a wet basis CO_2 analyzer operated according to Method 3A is used to obtain simultaneous measurements, and (2) the pollutant/CO_2 measurements are used to determine emissions in units of the standard.

5.1.6 **Particulate Filter.** An in-stack or heated (sufficient to prevent water condensation) out—of—stack filter. The filter shall be borosilicate or quartz glass wool, or glass fiber mat. Additional filters at the inlet or outlet of the moisture removal system and inlet of the analyzer may be used to prevent accumulation of particulate material in the measurement system and extend the useful life of the components. All filters shall be fabricated of materials that are nonreactive to the gas being sampled.

5.1.7 **Sample Pump.** A leak-free pump, to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. The pump may be constructed of any material that is nonreactive to the gas being sampled.

5.1.8 **Sample Flow Rate Control.** A sample flow rate control valve and rotameter, or equivalent, to maintain a constant sampling rate within 10 percent.

(Note: The tester may elect to install a back-pressure regulator to maintain the sample gas manifold at a constant pressure in order to protect the analyzer(s) from over pressurization, and to minimize the need for flow rate adjustments.)

5.1.9 **Sample Gas Manifold.** A sample gas manifold, to divert a portion of the sample gas stream to the analyzer, and the remainder to the by-pass discharge vent. The sample gas manifold should also include provisions for introducing calibration gases directly to the analyzer. The manifold may be constructed of any material that is nonreactive to the gas being sampled.

5.1.10 **Gas Analyzer.** A UV or NDIR absorption or fluorescence analyzer, to determine continuously the SO_2 concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

(Note: Housing the analyzer(s) in a clean, thermally-stable, vibration-free environment will minimize drift in the analyzer calibration.)

5.1.11 **Data Recorder.** A strip chart recorder, analog computer, or digital recorder, for recording measurement data. The data recorder resolution (i.e., readability) shall be 0.5 percent of span. Alternatively, a digital or analog meter having a resolution of 0.5 percent of span may be used to obtain the analyzer responses and the readings may be recorded manually. If this alternative is used, the readings shall be obtained at equally spaced intervals over the duration of the sampling run. For sampling run durations of less than 1 hour, measurements at 1—minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be obtained. For sampling run durations greater than 1 hour, measurements at 2—minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be obtained.

5.2 **Method 6 Apparatus and Reagents.** The apparatus and reagents described in Method 6, and shown by the schematic of the sampling train in Figure 6C-2, to conduct the interference check.

5.3 **SO2 Calibration Gases.** The calibration gases for the gas analyzer shall be SO_2 in N_2 or SO_2 in air. Alternatively, SO_2/CO_2, SO_2/O_2, or $SO_2/CO_2/O_2$ gas mixtures in N_2 may be used. For fluorescence-based analyzers, the O_2 and CO_2 concentrations of the calibration gases as introduced to the analyzer shall be within 1 percent (absolute) O_2 and 1 percent (absolute) CO_2 of the O_2 and Co_2 concentrations of the effluent samples as introduced to the analyzer. Alternatively, for fluorescence-based analyzers, use calibration blends of SO_2 in air and the nomographs provided by the vendor to determine the quenching correction factor (the effluent O_2 and CO_2 concentrations must be known). Use three calibration gases as specified below:

5.3.1 **High-Range Gas.** Concentration equivalent to 80 to 100 percent of the span.

5.3.2 **Mid-Range Gas.** Concentration equivalent to 40 to 60 percent of the span.

5.3.3 **Zero Gas.** Concentration of less than 0.25 percent of the span. Purified ambient air may be used for the zero gas by passing air through a charcoal filter, or through one or more impingers containing a solution of 3 percent H_2O_2.

Method 6C—Determination of Sulfur Dioxide Emissions From Stationary Sources (Instrumental Analyzer Procedure)

1. Applicability and Principle

1.1 **Applicability.** This method is applicable to the determination of sulfur dioxide (SO_2) concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations.

1.2 **Principle.** A gas sample is continuously extracted from a stack, and a portion of the sample is conveyed to an instrumental analyzer for determination of SO_2 gas concentration using an ultraviolet (UV), nondispersive infrared (NDIR), or fluorescence analyzer. Performance specifications and test procedures are provided to ensure reliable data.

2. Range and Sensitivity

2.1 **Analytical Range.** The analytical range is determined by the instrumental design. For this method, a portion of the analytical range is selected by choosing the span of the monitoring system. The span of the monitoring system shall be selected such that the pollutant gas concentration equivalent to the emission standard is not less than 30 percent of the span. If at any time during a run the measured gas concentration exceeds the span, the run shall be considered invalid.

2.2 **Sensitivity.** The minimum detectable limit depends on the analytical range, span, and signal—to—noise ratio of the measurement system. For a well designed system, the minimum detectable limit should be less than 2 percent of the span.

3. Definitions

3.1 **Measurement System.** The total equipment required for the determination of gas concentration. The measurement system consists of the following major subsystems:

3.1.1 **Sample Interface.** That portion of a system used for one or more of the following: sample acquisition, sample transport, sample conditioning, or protection of the analyzers from the effects of the stack effluent.

3.1.2 **Gas Analyzer.** That portion of the system that senses the gas to be measured and generates an output proportional to its concentration.

3.1.3 **Data Recorder.** A strip chart recorder, analog computer, or digital recorder for recording measurement data from the analyzer output.

3.2 **Span.** The upper limit of the gas concentration measurement range displayed on the data recorder.

3.3 **Calibration Gas.** A known concentration of a gas in an appropriate diluent gas.

3.4 **Analyzer Calibration Error**. The difference between the gas concentration exhibited by the gas analyzer and the known concentration of the calibration gas when the calibration gas is introduced directly to the analyzer.

3.5 **Sampling System Bias**. The difference between the gas concentrations exhibited by the measurement system when a known concentration gas is introduced at the outlet of the sampling probe and when the same gas is introduced directly to the analyzer.

3.6 **Zero Drift**. The difference in the measurement system output reading from the initial calibration response at the zero concentration level after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.7 **Calibration Drift**. The difference in the measurement system output reading from the initial calibration response at a mid-range calibration value after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.8 **Response Time**. The amount of time required for the measurement system to display 95 percent of a step change in gas concentration on the data recorder.

3.9 **Interference Check**. A method for detecting analytical interferences and excessive biases through direct comparison of gas concentrations provided by the measurement system and by a modified Method 6 procedure. For this check, the modified Method 6 samples are acquired at the sample by-pass discharge vent.

3.10 **Calibration Curve**. A graph or other systematic method of establishing the relationship between the analyzer response and the actual gas concentration introduced to the analyzer.

4. Measurement System Performance Specifications

4.1 **Analyzer Calibration Error**. Less than ± 2 percent of the span for the zero, mid-range, and high-range calibration gases.

4.2 **Sampling System Bias**. Less than ± 5 percent of the span for the zero, and mid— or high-range calibration gases.

4.3 **Zero Drift**. Less than ± 3 percent of the span over the period of each run.

4.4 **Calibration Drift**. Less than ± 3 percent of the span over the period of each run.

4.5 **Interference Check**. Less than ± 7 percent of the modified Method 6 result for each run.

5. Apparatus and Reagents

5.1 **Measurement System**. Any measurement system for SO_2 that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1. The essential components of the measurement system are described below:

APPENDIX F

GAS ANALYZER SPECIFICATIONS

INTERPOLL LABORATORIES
4500 BALL ROAD N.E.
CIRCLE PINES, MN 55014-1819
(612) 786-6020

Servomex

1420
Oxygen Analyser
Instruction Manual

Ref : 01420/001A/0

Order as part No. 01420001A

was (7982-2842)

INTERPOLL LABORATORIES
4500 BALL ROAD N.E.
CIRCLE PINES, MN 55014-1819
(612) 786-6020

1.3 Sampling System

The sampling system of the analyser includes a combination filter/automatic flow control device, designed to keep a constant flow of sample gas through the measuring cell for varying input pressures and to prevent the entrance of particulate matter into the measuring cell. Excess flow is vented to the by-pass.

1.4 Specification

Performance Specification (typical)

Repeatability:	Better than +/-0.2% O2 under constant conditions.
Drift:	Less than 0.2% O2 per week under constant conditions. (Excluding variation due to barometric pressure changes; reading is proportional to barometric pressure.)

Outputs

Display:	3 1/2 digit LCD reading 0.0 to 100.0% oxygen with overrange capability.
Output:	0 to 1V (non-isolated) for 0 to 100% oxygen available on 'D' type connector located on the back panel of the instrument. Output impedance is less than 10 ohms.
Option:	4 - 20mA isolated, Max impedance 500 ohms.
Flow alarm output:	Change over relay contact rated at 3A/115V ac, 1A/240V ac or 1A/28V dc. 4 sets of single pole changeover contacts. Alarm becomes active when sample gas flow through the analyser fails.

Sample requirements

Condition:	Clean, dry gas with dew point 5 deg C below ambient temperature.
Inlet pressure:	0.5 to 3psig (3.5 to 21kPa). Inlet pressure changes within this range will change the reading by less than 0.1% O2. May be operated up to 10psig (70kPa) with degraded stability.
Flowrate:	1.5 to 6 litres/minute approximately depending on sample pressure.
Filtering:	0.6 micron replaceable filter integral to the automatic flow control device.

Response time:	Less than 15 secs. to 90% at an inlet pressure of 3psig (21kPa).
Inlet/vent connections:	1/4 inch OD tube (stainless steel) suitable for 6mm ID flexible tubing or 1/4 inch OD compression fittings.
Materials exposed to the sample:	Stainless steel, Pyrex glass, brass, platinum, epoxy resin, Viton, polypropylene and glass fibre filter.

Physical Characteristics

Case:	Steel and aluminium finished in epoxy powder paint.
Case classification:	IP 20 (IEC 529) when fitted into the Servomex 1400 series 19 inch case.
Dimensions:	See Figure 2.1.
Weight:	10Kg (22lb) approximately.

Electrical

AC Supply:	110 to 120V AC or 220 to 240V AC, +/-10%, 48 to 62Hz. Voltage selected by a voltage selector integral to the IEC supply plug.
Power required:	15VA maximum.

Environmental Limits

Operating ambient temperature:	0 to +40 deg C (32 to 104 deg F)
Storage temp. range:	-20 to +70 deg C (-4 to 158 deg F)
Relative humidity:	0-85%, non-condensing.

SPECIFICATIONS FOR ACS MODEL 3300 CO_2 NDIR

Measuring principle	NDIR single beam method
Measurable gas components and measuring range	0 - 20%
Reproducibility	±0.5% of full scale
Stability	Zero drift; ±% of full scale/24H Span drift; ±% of full scale/24H
Noise	0.5% of full scale
Ambient temperature	-5 to 45°C
Ambient humidity	Less than 90% RH
Response time (90% of final reading)	Electrical system; 2 sec, 3 sec, 5 sec (selectable with connector) Response of actual gas; Within 15 sec (depending on cell length)
Indicator	100 linear division
Output signal	OUTPUT 1; DC 0 - 1 V OUTPUT 2; DC 0 - 10 mV or DC 0 - 100 mV or DC 0 - 1 V or DC 4 - 20 mA (Allowable load resistance 500Ω max.)
Linearity	Better than ±2% of full scale (when linearizer is used)
Power supply	AC 115 V ± 10%, 60 Hz

Power consumption	Approx. 30 VA
Materials of gas-contacting parts	Measuring cell; SUS304 Window; CaF_2 Piping; Polyethylene
Sample gas flow rate	1ℓ/min ± 0.5ℓ/min
Sample gas temperature	0 to 55°C
Purging gas flow rate	1ℓ/min (to be flowed as occasion demands)
Warmup time	Approx. 2 hours
External dimensions	200 x 250 x 541 (H x W x D) mm
Weight	Approx. 11 kg
Finish Color	MUNSELL N1.5

Remarks: For combinations of measuring ranges for the dualcomponent analyzer, inquiry should be made to the manufacturer.

SPECIFICATIONS FOR SO_2 ANALYZER
WESTERN RESEARCH MODEL 721ATZ

Measuring principle	NDUV double beam method which uses 285 nm UV light for SO_2 measurement and 585 nm visible light to compensate for contamination of all windows, detector drift or changes in the intensity of the radiation source
Range	SO_2: 0 - 500 ppm and 0 - 1000 ppm; but low range may be reduced to 0 - 100 ppm with full scale analog output; total dynamic range of 0 - 5000 ppm with 1 ppm readability
Accuracy	±2% f.s., worst case. Typically better than ±1% f.s.
Temperature drift	≤0.5% f.s./°C
Noise	0.5% of full scale, worst case
Ambient temperature	0 to 40 °C
Ambient humidity	Less than 100% RH
Response time (90% of final reading)	<5 seconds
Optical cell length	35 cm
Output signal	Panel display is digital - direct reading in ppm,w; output signal: 7 field-selectable potentiometric outputs of 1V, 2V, 5V, 10V DC and 100, 200, 500 mV DC. Two outputs per range are provided at the rear of the

	instrument, standard. Unit equipped also with 4 - 20 mA
Interferences	No known interferences from O_2, CO_2, CO or hydrocarbons; internally compensated for NO interference
Linearity	±1.5% of full scale
Power supply	AC 115 V ± 10%, 60 Hz
Power consumption	Less than 575 watts
Electronic span value	Nominal 766 @ 77 ^{0}F and 29.92 in Hg
Sample gas flow	1.0 - 5.0 LPM to give desired response time
Sample gas temperature	0 to 40 ^{0}C
Warmup time	Approximately 30 minutes
External dimensions	7 x 19 x 22 (H x W x D) inch
Weight	40 LB

APPENDIX G

MEASUREMENT SYSTEMS PERFORMANCE SPECIFICATIONS

INTERPOLL LABORATORIES, INC.
(612) 786-6020

ANALYZER LINEARITY CHECK

MATHY 46
DANBURY, WI
10/8/99
CONDUCTED BY:
MARK KAEHLER

O2 Calibration — Time (HRS) 630

	Cylinder Value %	Analyzer Resp. %	Difference %	Span Value %	Percent of Span
Zero Gas	0.0	0.1	0.09	25.00	0.36
Mid Level	10.9	11.1	0.16	25.00	0.64
High Level	20.9	21.0	0.11	25.00	0.44

CO2 Calibration — Time (HRS) 630

	Cylinder Value %	Analyzer Resp. %	Difference %	Span Value %	Percent of Span
Zero Gas	0.0	0.0	0.02	20.00	0.10
Mid Level	11.0	10.8	0.19	20.00	0.95
High Level	16.8	16.9	0.09	20.00	0.45

SO2 Calibration — Time (HRS) 630

	Cylinder Value (ppm)	Analyzer Resp. (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero Gas	0.0	0.6	0.58	150.00	0.39
Mid Level	77.9	76.7	1.23	150.00	0.82
High Level	140.0	138.9	1.07	150.00	0.71

Must be within 2% of the span for each calibration gas.

INTERPOLL LABORATORIES, INC.
(612) 786-6020

SYSTEM BIAS CHECK

MATHY 46
DANBURY, WI
10/8/99
CONDUCTED BY:
MARK KAEHLER

Instrument		Cyl Val (% / ppm)	Response (% / ppm) Analyzer	Response (% / ppm) System	Diff. (Anal - Sys)	Span Val. (% / ppm)	% of Span
SO2	Zero Gas	0.0	0.6	3.4	-2.9	150.00	1.90
	Upscale	77.9	76.7	73.8	2.9	150.00	1.90
O2	Zero Gas	0.0	0.1	0.1	0.0	25.00	0.08
	Upscale	10.9	11.1	11.1	0.0	25.00	0.00
CO2	Zero Gas	0.0	0.0	-0.1	0.0	20.00	0.20
	Upscale	11.0	10.8	10.9	-0.1	20.00	0.45

Must be within 5% of the span for the zero and upscale calibration gases.

INTERPOLL LABORATORIES, INC.
(612) 786-6020

O2 CAL DRIFT CHECK

MATHY 46
DANBURY, WI
ASPHALT PLANT
STACK
TEST 1 / RUNS 1-3
10/8/99

RUN	$\bar{C}$		Cyl Val (% / ppm)	System Response Initial	System Response Final	Co	Cm	Cgas
1	12.44	Zero Gas	0.0	0.0	0.0	0.00		12.36
		Upscale	10.9	10.9	11.0		10.97	
2	12.25	Zero Gas	0.0	0.0	0.0	0.02		12.14
		Upscale	10.9	11.0	11.0		11.01	
3	12.05	Zero Gas	0.0	0.0	0.1	0.08		11.95
		Upscale	10.9	11.0	11.0		11.00	

Must be within 3% of the span for the zero and upscale cal. gases

INTERPOLL LABORATORIES, INC.
(612) 786-6020

CO2 CAL DRIFT CHECK

MATHY 46
DANBURY, WI
ASPHALT PLANT
STACK
TEST 1 / RUNS 1-3
10/8/99

RUN	$\bar{C}$		Cyl Val (% / ppm)	System Response Initial	System Response Final	Co	Cm	Cgas
1	6.04	Zero Gas	0.0	0.1	-0.1	-0.01		6.07
		Upscale	11.0	11.2	10.7		10.95	
2	6.49	Zero Gas	0.0	-0.1	0.1	0.01		6.50
		Upscale	11.0	10.7	11.3		10.99	
3	6.73	Zero Gas	0.0	0.1	0.3	0.23		6.56
		Upscale	11.0	11.3	11.0		11.13	

Must be within 3% of the span for the zero and upscale cal. gases

INTERPOLL LABORATORIES, INC.
(612) 786-6020

SO2 CAL DRIFT CHECK

MATHY 46
DANBURY, WI
ASPHALT PLANT
STACK
TEST 1 / RUNS 1-3
10/8/99

RUN	$\bar{C}$		Cyl Val (% / ppm)	System Response Initial	System Response Final	Co	Cm	Cgas
1	49.09	Zero Gas	0.0	-0.6	-0.2	-0.38		49.05
		Upscale	77.9	78.2	78.2		78.18	
2	55.76	Zero Gas	0.0	-0.2	-0.2	-0.15		55.60
		Upscale	77.9	78.2	78.2		78.18	
3	57.41	Zero Gas	0.0	-0.2	1.6	0.75		57.01
		Upscale	77.9	78.2	78.2		78.18	

Must be within 3% of the span for the zero and upscale cal. gases

APPENDIX H

CALIBRATION GAS CERTIFICATION SHEETS

NATIONAL SPECIALTY GASES
630 UNITED DRIVE
DURHAM, NC
27713
(919)544-3772

CERTIFICATE OF ANALYSIS * EPA PROTOCOL MIXTURES

REFERENCE #:	88-62598	CYLINDER #:	CC 117719	CYL. PRESSURE:	2000 PSIG	P.O. #:	30367
EXP. DATE:	5/4/02	LAST ANALYSIS DATE:	5/4/99	CUSTOMER:	TWIN CITY OXYGEN		

METHOD: ANALYZED ACCORDING TO EPA TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION OF GASEOUS CALIBRATION STANDARDS-SEPTEMBER 1997:G-1 THIS STANDARD SHOULD NOT BE USED WHEN ITS GAS PRESSURE IS BELOW 1.0 MEGAPASCALS (150 PSIG).

COMPONENT:	OXYGEN	COMPONENT:	CARBON DIOXIDE
STANDARD		STANDARD	
SRM #:	2659A	SRM #:	1675B
CYL. #:	CAL 014488	CYL. #	CAL 014623
CONC:	20.92 %	CONC:	13.96%
INSTRUMENT:	BECKMAN PARAMAGNETIC	INSTRUMENT:	ROSEMOUNT NDIR
MODEL #:	755	MODEL #:	880A
SERIAL #:	1001419	SERIAL #:	2000418
LAST CAL.:	4/7/99	LAST CAL.:	4/14/99

MEAN CONC.:	10.9 %	+/-	0.09 %	MEAN CONC.:	11.0 %	+/-	0.09 %
REPLICATE CONC.				REPLICATE CONC.			
DATE:	5/4/99			DATE:	5/4/99		
10.9	%			11.0	%		
11.0	%			11.0	%		
10.9	%			11.0	%		

BALANCE GAS: NITROGEN

REPLICATE DATA						REPLICATE DATA						REPLICATE DATA					
DATE:	5/4/99					DATE:	5/4/99										
Z	0	R	20.9	C	10.9	Z	0	R	14.0	C	11.0						
R	20.9	Z	0	C	11.0	R	14.0	Z	0	C	11.0						
Z	0	C	10.9	R	20.9	Z	0	C	11.0	R	14.0						

Z= ZERO C=CANDIDATE R=REFERENCE

ANALYST: APPROVED BY:

THIS REPORT STATED ACCURATELY THE RESULTS OF THE INVESTIGATION MADE UPON THE MATERIAL SUBMITTED TO THE ANALYTICAL LABORATORY. EVERY EFFORT HAS BEEN MADE TO DETERMINE OBJECTIVELY THE INFORMATION REQUESTED; HOWEVER, IN CONNECTION WITH THIS REPORT, NATIONAL SPECIALTY GASES SHALL HAVE NO LIABILITY IN EXCESS OF ITS ESTABLISHED CHARGE FOR THE SERVICE. ASSAYED AT: NATIONAL SPECIALTY GASES, 630 UNITED DRIVE, DURHAM, NC 27713. (919)544-3772

H-1

NATIONAL SPECIALTY GASES
630 UNITED DRIVE
DURHAM, NC
27713
(919)544-3772

CERTIFICATE OF ANALYSIS * EPA PROTOCOL MIXTURES

REFERENCE #:	88-62964	CYLINDER #:	CC 38918	CYL. PRESSURE:	2000 PSIG	P.O. #:	30522
EXP. DATE:	6/4/02	LAST ANALYSIS DATE:	6/4/99	CUSTOMER:	TWIN CITY OXYGEN		

METHOD: ANALYZED ACCORDING TO EPA TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION OF GASEOUS CALIBRATION STANDARDS-SEPTEMBER 1997:G-1 THIS STANDARD SHOULD NOT BE USED WHEN ITS GAS PRESSURE IS BELOW 1.0 MEGAPASCALS (150 PSIG).

COMPONENT:	CARBON DIOXIDE	COMPONENT:	OXYGEN
STANDARD		STANDARD	
SRM #:	1675B	SRM #:	2659A
CYL. #:	CAL 014623	CYL. #	CAL 014488
CONC:	13.96%	CONC:	20.92 %
INSTRUMENT:	ROSEMOUNT NDIR	INSTRUMENT:	BECKMAN PARAMAGNETIC
MODEL #:	880A	MODEL #:	755
SERIAL #:	2000418	SERIAL #:	1001419
LAST CAL.:	5/18/99	LAST CAL.:	5/11/99

MEAN CONC.:	16.8 %	+/-	0.13 %	MEAN CONC.:	20.9 %	+/-	0.17 %
REPLICATE CONC.				REPLICATE CONC.			
DATE:	6/4/99			DATE:	6/4/99		
16.8	%			20.9	%		
16.8	%			20.9	%		
16.9	%			20.9	%		

BALANCE GAS: NITROGEN

REPLICATE DATA						REPLICATE DATA						REPLICATE DATA
DATE:	6/4/99					DATE:	6/4/99					
Z	0	R	14.0	C	16.8	Z	0	R	20.9	C	20.9	
R	14.0	Z	0	C	16.8	R	20.9	Z	0	C	20.9	
Z	0	C	16.9	R	14.0	Z	0	C	20.9	R	20.9	

Z= ZERO C=CANDIDATE R=REFERENCE

ANALYST: APPROVED BY:

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CERTIFICATE OF ANALYSIS * EPA PROTOCOL MIXTURES

REFERENCE #:	88-63170	CYLINDER #:	CC 47591	CYL. PRESSURE:	2000 PSIG	P.O. #:	30617
EXP. DATE:	6/22/01	LAST ANALYSIS DATE:	6/22/99	CUSTOMER:	TWIN CITY OXYGEN		

METHOD: ANALYZED ACCORDING TO EPA TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION OF GASEOUS CALIBRATION STANDARDS-SEPTEMBER 1997:G-1 THIS STANDARD SHOULD NOT BE USED WHEN ITS GAS PRESSURE IS BELOW 1.0 MEGAPASCALS (150 PSIG).

COMPONENT:	NITRIC OXIDE	COMPONENT:	SULFUR DIOXIDE
STANDARD		STANDARD	
SRM #:	1685B	SRM #:	R1661A
CYL. #:	CLM 10143	CYL. #	CAL 010522
CONC:	242.4 PPM	CONC:	504.4 PPM
INSTRUMENT:	KVB ANALECT FTIR	INSTRUMENT:	KVB ANALECT FTIR
MODEL #:	KVM 6400	MODEL #:	KVM 6400
SERIAL #:	FN 844A	SERIAL #:	FN 844A
LAST CAL.:	6/1/99	LAST CAL.:	6/1/99

MEAN CONC.:	145 PPM	+/-	1.16 PPM	MEAN CONC.:	140 PPM	+/-	1.12 PPM
REPLICATE CONC.				REPLICATE CONC.			
DATE:	6/11/99	DATE:	6/22/99	DATE:	6/11/99	DATE:	6/22/99
145	PPM	145	PPM	140	PPM	140	PPM
145	PPM	144	PPM	140	PPM	140	PPM
144	PPM	145	PPM	139	PPM	140	PPM

BALANCE GAS: NITROGEN TRACE GASES: 1.53 PPM NITROGEN DIOXIDE

REPLICATE DATA						REPLICATE DATA						REPLICATE DATA					
DATE:	6/11/99					DATE:	6/11/99										
Z	0	R	242	C	145	Z	0	R	504	C	140						
R	242	Z	0	C	145	R	504	Z	0	C	140						
Z	0	C	144	R	242	Z	0	C	139	R	504						
DATE	6/22/99					DATE:	6/22/99										
Z	0	R	242	C	145	Z	0	R	504	C	140						
R	242	Z	0	C	144	R	504	Z	0	C	140						
Z	0	C	145	R	242	Z	0	C	140	R	504						

Z= ZERO C=CANDIDATE R=REFERENCE

ANALYST: Teresa Jensen APPROVED BY: Richard Sykes

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27713
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CERTIFICATE OF ANALYSIS * EPA PROTOCOL MIXTURES

REFERENCE #:	88-63450	CYLINDER #:	CC 52167	CYL. PRESSURE:	2000 PSIG	P.O. #:	30771
EXP. DATE:	7/15/01	LAST ANALYSIS DATE:	7/15/99	CUSTOMER:	TWIN CITY OXYGEN		

METHOD: ANALYZED ACCORDING TO EPA TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION OF GASEOUS CALIBRATION STANDARDS-SEPTEMBER 1997:G-1 THIS STANDARD SHOULD NOT BE USED WHEN ITS GAS PRESSURE IS BELOW 1.0 MEGAPASCALS (150 PSIG).

COMPONENT:	SULFUR DIOXIDE	COMPONENT:	NITRIC OXIDE
STANDARD		STANDARD	
SRM #:	R1694A	SRM #:	1684B
CYL. #:	CLM 8659	CYL. #	CAL 013583
CONC:	97.2 PPM	CONC:	97.8 PPM
INSTRUMENT:	KVB ANALECT FTIR	INSTRUMENT:	KVB ANALECT FTIR
MODEL #:	KVM 6400	MODEL #:	KVM 6400
SERIAL #:	FN 844A	SERIAL #:	FN 844A
LAST CAL.:	7/1/99	LAST CAL.:	7/1/99
MEAN CONC.:	77.9 PPM +/- 0.62 PPM	MEAN CONC.:	73.1 PPM +/- 0.59 PPM

REPLICATE CONC.				REPLICATE CONC.			
DATE:	7/8/99	DATE:	7/15/99	DATE:	7/8/99	DATE:	7/15/99
77.6	PPM	78.2	PPM	72.9	PPM	73.4	PPM
77.7	PPM	78.3	PPM	72.9	PPM	73.3	PPM
77.6	PPM	78.3	PPM	73.0	PPM	73.4	PPM

BALANCE GAS: NITROGEN TRACE GASES: 0.30 PPM NITROGEN DIOXIDE

REPLICATE DATA						REPLICATE DATA						REPLICATE DATA
DATE:	7/8/99					DATE:	7/8/99					
Z	0	R	97.2	C	77.6	Z	0	R	97.8	C	72.9	
R	97.2	Z	0	C	77.7	R	97.8	Z	0	C	72.9	
Z	0	C	77.6	R	97.2	Z	0	C	73.0	R	97.8	
DATE	7/15/99					DATE:	7/15/99					
Z	0	R	97.2	C	78.2	Z	0	R	97.8	C	73.4	
R	97.2	Z	0	C	78.3	R	97.8	Z	0	C	73.3	
Z	0	C	78.3	R	97.2	Z	0	C	73.4	R	97.8	

Z= ZERO C=CANDIDATE R=REFERENCE

ANALYST: Lara Jensen APPROVED BY:

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APPENDIX I

PROCESS RATE INFORMATION

OPERATING DATA SUMMARY FOR ASPHALT SOURCES

Form OAS
June 15

Test Date(s): 10-8-99

General Information: ***All blanks must be filled in, use N/A where appropriate, circle all that apply***

This plant is: Portable [moved around for majority of year] Stationary [in one place for a majority of year]

Plant Type: Batch Mix Parallel Flow Drum Counterflow Drum Continuous Mix
Other _____

Pollution Control Equipment: Fabric Filter Multiclone Cyclone
Venturi Scrubber Wet Scrubber If wet scrubber: ____% scrubber water recycled

Fuel, Material Processed, and Control Equipment Information:
Itemize all fuels and materials added to the combustion process during the test period. List fuel type used during testing (if oil, specify typ
Oil / waste oil. If other units of measure are used, specify and calculate appropriate heat input.
What other types of fuel can be burned? N/A

Test No.	Fuel Input (gal/hr)	Heat Content (Btu/gal-as received)	Heat Input (Btu/hr)	% - 200 fines	% Moisture of Virgin Aggregate Material
Run 1	505	140,000	70,700,000	4.9	6.3
Run 2	509	140,000	71,260,000	4.9	6.3
Run 3	518	140,000	72520,000	4.9	6.3

Other Control Equipment Parameters	Design	During Testing
Cleaning Cycles *(fabric filter)*	24 sec	
Air to Cloth Ratios *(fabric filter)*	6.3	
No. of spray bars and psi *(scrubber)*		
No. of nozzles per spray bar *(scrubber)*		
Water flow rate in gpm *(scrubber)*		

Describe the location of the thermocouples reading exiting dryer and mix temperature: Inlet of Bag House
Discharge Chute

Note:

- *All information required must be completed and submitted as part of the performance test report. Failure to submit the required information will result in an incomplete performance test report.*
- ***This form provides only a summary of the operating conditions during the performance test. Additional and more detailed records are required to meet the requirements of Minn. R. 7017.2035. This form is to be submitted as part of the performance test report to North, Metro, or South District, Performance Test Coordinator, Minnesota Pollution Control Agency, 520 Lafayette Rd., St. Paul, MN 55155-4194.***

Environmental Programs Daily Tracking Form

Plant #: 46 Date: 10-8-99
Location: Danbury, Wis.
Plant Foreman: Jay Schott

AIR QUALITY MONITORING

Production:

Total Asphalt Mix Tonnage: 2734.12
Diesel Fuel Gallons for Generator: 610.1
RAP % in mix: _____ RAP tons: _____
Mix Temperature (degrees F): _____
Hours of Operation: 12

Process fuel:

Fuel Type: Used Oil Amt: 5088
Burner Pressure: 106" Fuel Temp: 140°
Fuel Type: _____ Amt: _____
Burner Pressure: _____ Fuel Temp: _____
Spec. Sheet Delivered: ✓ yes ____ no

Baghouse:

Magnehelic dP: .68 & .9 inches of water
Photohelic dP: .34 - .36 inches of water
Optimum photohelic range from burner tune-up: .33 - .45 inches of water
Photohelic malfunction: ____ yes ✓ no
(If yes, next day DNR notification required)
Weekly Inspection of drum and door seals, ducts, photohelic, damper, & other system parts: ✓ yes ____ no
Maintenance Performed: _____

50,000 ton Blacklight Baghouse Inspection:
✓ yes ____ no
Number of Bags Replaced: 0

Fugitive Dust Control:

Control Measures: ✓ yes ____ no
Water Amt. Applied: _____
Chemical Amt. Applied: _____
Speed Limit Control (mph): 10

Soil Remediation:

Soil Remediation Performed: ____ yes ✓ no
Type: ____ commercial ____ own spill
Documented: ____ yes
(If yes, Complete Contaminated Soil Tracking form and Monthly Soil Remediation Summary form)

SPILL PREVENTION PLAN (SPCC)

Plant Inspection Conducted per SPCC Inspection Outline (Attachment # 9)
✓ yes ____ no
Systems Locked out: ✓ yes ____ no
Petroleum Equipment Maintenance: _____

Weekly SPCC Meeting: ✓ yes ____ no
Containment Water Released: ____ yes ✓ no
(If yes, complete Water Drainage Form)

STORMWATER RUNOFF QUALITY

Best Mgmt. Practices (BMP) Applied: ✓ yes ____ no
Petroleum Products Secure: ✓ yes ____ no
Site Runoff Naturally Contained on Site:
✓ yes ____ no
If no, has containment been constructed:
____ yes ____ no
Erosion Control Practices used (i.e. silt fence, site seeding, slopes): _____

Rain Amount in last 24 hrs: ½" inches
Any known Petro. Contamination: ____ yes ✓ no
Sediment Content:
✓ Low ____ Medium ____ High
(Water Containment Drainage documentation is covered by SPCC)

To the best of my ability and to the extent that I am able to observe under the conditions of this site, I have due diligently completed this daily form. Signature means that the inspections have been completed and any observed deficiencies have been noted and communicated to the supervisors.

Plant Foreman's Signature: _____

Time in 15 minute intervals	Virgin (V) Material tph	Asphalt (A) Material tph	Total Throughput (V+A) tph	Temp. of Gases Exiting Dryer °F	Hot Mix Temp. °F	Dust Collector ΔP inches w. c.	Water Flow Rate gpm	Water Supply Pressure psig
7:00	253	14.8	267.8	272	288	.35		6.2
7:15	254	14.9	268.9	282	299	.36		6.8
7:30	256	15.0	271	273	287	.37		6.9
7:45	257	15.1	272.1	270	282	.34		7.0
Stop PL.								
8:15	257 (256.4)	15.0 (15.0)	272	269	281	.34		6.9
9:00	256	14.9	270.9	275	287	.34		6.9
9:15	256	14.9	270.9	268	280	.35		6.9
9:30	255	14.8	269.8	277	289	.34		7.0
9:45	256	14.8	270.8	276	289	.34		6.9
10:00	259 (256.4)	15.1 (14.9)	274.1	269	285	.35		6.9
10:30	256	14.8	270.8	274	288	3.3		6.8
10:45	263	15.6	278.6	271	285	3.5		6.9
11:00	257	15.1	272.1	268	280	3.4		7.0
11:15	259	15.0	274.0	272	288	3.4		7.0
11:30	260 (259)	15.0 (15.1)	275	278	292	3.5		6.9

tph - tons per hour °F-degrees Fahrenheit ΔP - pressure drop Temp.-Temperature gpm-gallons per minute
inches w. c.- inches of water column psig-pressure per square inch gauge

OPERATING DATA SUMMARY FOR ASPHALT SOURCES

Form OAS01
June 1999

Test Date(s): 10-8-99

General Information: *All blanks must be filled in, use N/A where appropriate, circle all that apply*

This plant is: (Portable) [moved around for majority of year] Stationary [in one place for a majority of year]

Plant Type: Batch Mix (Parallel Flow Drum) Counterflow Drum Continuous Mix
Other_____

Pollution Control Equipment: (Fabric Filter) Multiclone Cyclone
Venturi Scrubber Wet Scrubber If wet scrubber:_____% scrubber water recycled

Fuel, Material Processed, and Control Equipment Information:
Itemize all fuels and materials added to the combustion process during the test period. List fuel type used during testing (if oil, specify type) oil - waste oil. If other units of measure are used, specify and calculate appropriate heat input.
What other types of fuel can be burned? none

Test No.	Fuel Input (gal/hr)	Heat Content (Btu/gal-as received)	Heat Input (Btu/hr)	% - 200 fines	% Moisture of Virgin Aggregate Material
Run 1	503	140,000	70,420,000	4.9%	6.3%
Run 2	510	140,000	71,400,000	4.9%	6.3%
Run 3	505	140,000	70,700,000	4.9%	6.3%

Other Control Equipment Parameters	Design	During Testing
Cleaning Cycles *(fabric filter)*	24 sec.	
Air to Cloth Ratios *(fabric filter)*	6.3	
No. of spray bars and psi *(scrubber)*		
No. of nozzles per spray bar *(scrubber)*		
Water flow rate in gpm *(scrubber)*		

Describe the location of the thermocouples reading exiting dryer and mix temperature: Baghouse Inlet / discharge chute

Note:

- *All information required must be completed and submitted as part of the performance test report. Failure to submit the required information will result in an incomplete performance test report.*
- ***This form provides only a summary of the operating conditions during the performance test. Additional and more detailed records are required to meet the requirements of Minn. R. 7017.2035. This form is to be submitted as part of the performance test report to: North, Metro, or South District, Performance Test Coordinator, Minnesota Pollution Control Agency, 520 Lafayette Rd., St. Paul, MN 55155-4194.***

Time in 15 minute intervals	Virgin (V) Material tph	Asphalt (A) Material tph	Total Throughput (V+A) tph	Temp. of Gases Exiting Dryer °F	Hot Mix Temp. °F	Dust Collector ΔP inches w. c.	Water Flow Rate gpm	Water Supply Pressure psig
12:29	258	15.0	273	268	279	.34		6.8
12:44	254	14.9	268.9	272	281	.36		6.7
12:59	253	14.9	267.9	276	295	.38		6.9
Stop								
1:30	265	15.3	280.3	270	273	.38		6.2
1:45	257 (251.4)	14.8 (15.0)	271.8	272	287	.37		6.9
2:00	254	15.0	269	270	282	.36		6.9
2:40	262	15.1	277.1	274	290	.35		6.6
2:55	261	15.2	276.2	272	286	.35		6.9
3:10	258	15.0	273	275	287	.36		6.9
3:25	260	15.1	275.1	275	290	.34		7.0
3:40	263	15.3	278.3	273	288	.37		7.0
3:55	259 (251.6)	14.8 (15.1)	273.8	275	291	.38		7.0
4:05	258	14.9	272.9	276	290	.35		6.9
4:20	259	15.0	274	277	289	.36		6.9
4:45	260	15.1	275.1	277	286	.36		6.8
5:00	260 (259.3)	15.0 (15.0)	275	276	287	.35		6.8

tph - tons per hour °F-degrees Fahrenheit ΔP - pressure drop Temp.-Temperature gpm-gallons per minute
inches w. c.- inches of water column psig-pressure per square inch gauge

APPENDIX J

PROCEDURES

Particulate Loading and Emission Rates

The particulate emission rates were determined per EPA Methods 1 - 5, CFR Title 40, Part 60, Appendix A (revised July 1, 1992). 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. The sampling module also houses the impinger case and a Drierite filled column. The sampling module is connected by means of an umbilical cord to the control module. The control module houses the dry test gas meter, the calibrated orifice, a leakless pump, two inclined manometers, and all controls required for operating the sampling train.

Particulate samples are collected as follows: The sample gas is drawn through the sampling probe isokinetically and passed through a 4-inch diameter Gelman Type A/E glass fiber filter where particulates are removed. The sample gas is then passed through an ice-cooled impinger train and a desiccant-packed column which absorbs remaining moisture. The sample gas then passes through a vacuum pump followed by a dry test gas meter. The gas meter integrates the sample gas flow throughout the course of the test. A calibrated orifice attached to the outlet of the gasmeter provides real time flow rate data.

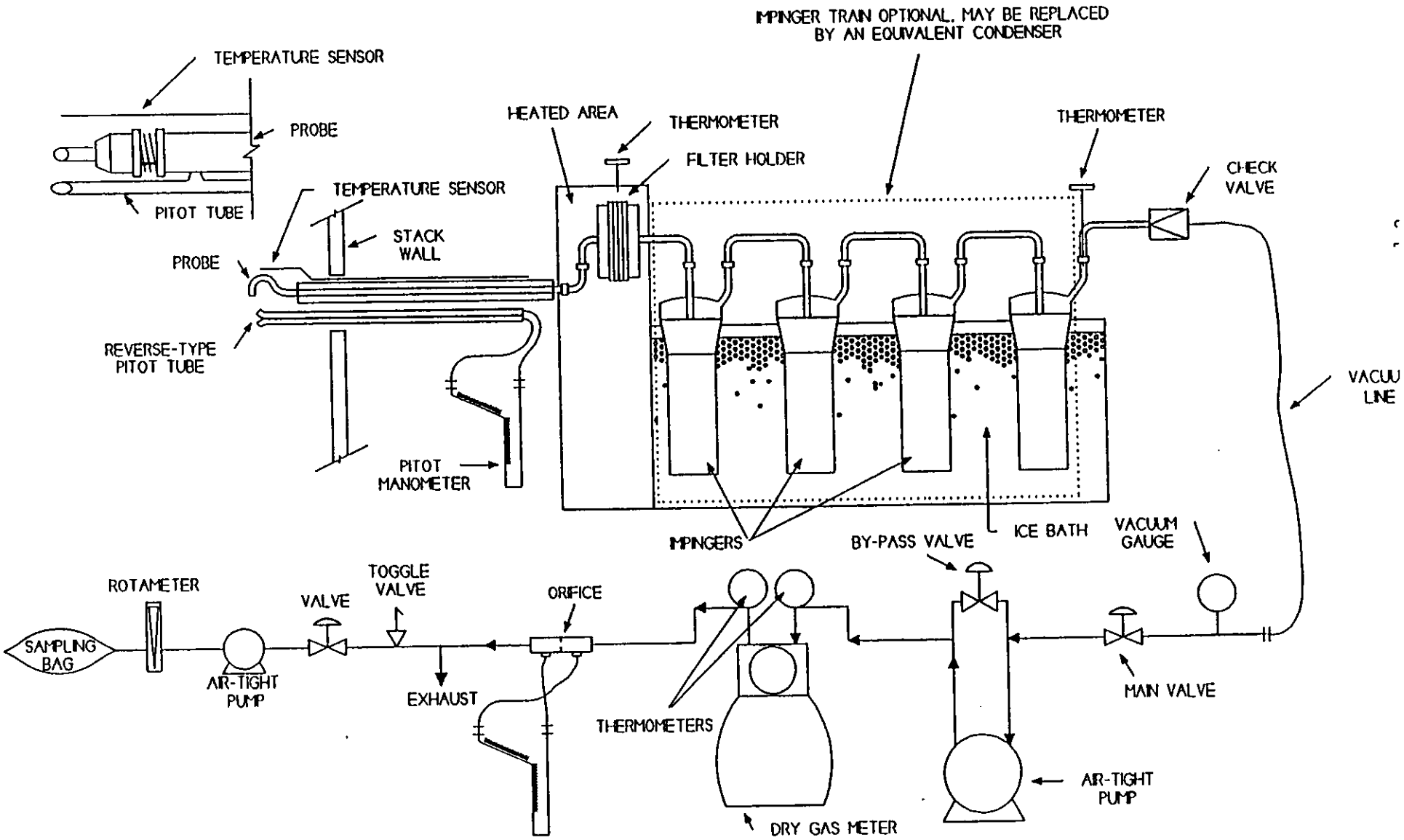
A representative particulate sample was acquired by sampling for equal periods of time at the centroid of a number of equal area regions in the duct. The sampling rate is adjusted at each test point maintaining isokinetic sampling conditions. Nomographs are used for rapid determination of the sampling rate.

Particulate Loading and Emission Rates

When sampling is complete the filter is removed with tweezers and placed in a clean container. The nozzle, pitot tube 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 the rinse is transferred to a tared 120 cc porcelain evaporating dish. The acetone is then evaporated off at 97 - 105 °F. At this elevated temperature condensation of atmospheric moisture is prevented. The acetone-free sample is then dried at 105 °C for 30 minutes, cooled in a desiccator over Drierite, and weighed to the nearest 0.01 mg. The filter sample is transferred to a 6 inch watch glass and dried at 105 °C for two hours. The filter and watch glass are then cooled in a desiccator and the filter weighed to the nearest 0.01 mg. All weighings are performed in a balance room where the relative humidity is maintained at less than 50%. Microscopic examination of the samples is performed if any unusual characteristics are observed. The weight of the acetone rinse blank is subtracted from the samples. The Drierite column is weighed on-site and the water absorbed by the Drierite is added to the condensate to give the total amount of absorbed water.

Interpoll Laboratories
(612) 786-6020

PARTICULATE SAMPLING TRAIN



Method 3A——Determination of Oxygen and Carbon Dioxide Concentrations in Emissions From Stationary Sources (Instrumental Analyzer Procedure)

1. Applicability and Principle

1.1 **Applicability.** This method is applicable to the determination of oxygen (O_2) and carbon dioxide (CO_2) concentrations in emissions from stationary sources only when specified within the regulations.

1.2 **Principle.** A sample is continuously extracted from the effluent stream: a portion of the sample stream is conveyed to an instrumental analyzer(s) for determination of O_2 and CO_2 concentration(s). Performance specifications and test procedures are provided to ensure reliable data.

2. Range and Sensitivity

Same as Method 6C, Sections 2.1 and 2.2, except that the span of the monitoring system shall be selected such that the average O_2 or CO_2 concentration is not less than 20 percent of the span.

3. Definitions

3.1 **Measurement System.** The total equipment required for the determination of the O_2 or CO_2 concentration. The measurement system consists of the same major subsystems as defined in Method 6C, Sections 3.1.1, 3.1.2, and 3.1.3.

3.2 Span, Calibration Gas, Analyzer Calibration Error, Sampling System Bias, Zero Drift, Calibration Drift, Response Time, and Calibration Curve. Same as Method 6C, Sections 3.2 through 3.8, and 3.10.

3.3 **Interference Response.** The output response of the measurement system to a component in the sample gas, other than the gas component being measured.

4. Measurement System Performance Specifications

Same as Method 6C, Sections 4.1 through 4.4.

5. Apparatus and Reagents

5.1 **Measurement System.** Any measurement system for O_2 or CO_2 that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1 of Method 6C. The essential components of the measurement system are described below:

5.1.1 **Sample Probe.** A leak-free probe, of sufficient length to traverse the sample points.

5.1.2 **Sample Line.** Tubing, to transport the sample gas from the probe to the moisture removal system. A heated sample line is not required for systems that measure the O_2 or CO_2 concentration on a dry basis, or transport dry gases.

5.1.3 Sample Transport Line, Calibration Value Assembly, Moisture Removal System, Particulate Filter, Sample Pump, Sample Flow Rate Control, Sample Gas Manifold, and Data Recorder. Same as Method 6C, Sections 5.1.3 through 5.1.9, and 5.1.11, except that the requirements to use stainless steel, Teflon, and nonreactive glass filters do not apply.

5.1.4 **Gas Analyzer**. An analyzer to determine continuously the O_2 or CO_2 concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer. The requirements for measuring and controlling the analyzer flow rate are not applicable if data are presented that demonstrate the analyzer is insensitive to flow variations over the range encountered during the test.

5.2 **Calibration Gases.** The calibration gases for CO_2 analyzers shall be CO_2 in N_2 or CO_2 in air. Alternatively, CO_2/SO_2, O_2/SO_2, or $O_2/CO_2/SO_2$ gas mixtures in N_2 may be used. Three calibration gases, as specified Section 5.3.1 through 5.3.3 of Method 6C, shall be used. For O_2 monitors that cannot analyze zero gas, a calibration gas concentration equivalent to less than 10 percent of the span may be used in place of zero gas.

6. Measurement System Performance Test Procedures

Perform the following procedures before measurement of emissions (Section 7).

6.1 **Calibration Concentration Verification.** Follow Section 6.1 of Method 6C, except if calibration gas analysis is required, use Method 3 and change the acceptance criteria for agreement among Method 3 results to 5 percent (or 0.2 percent by volume, whichever is greater).

6.2 **Interference Response**. Conduct an interference response test of the analyzer prior to its initial use in the field. Thereafter, recheck the measurement system if changes are made in the instrumentation that could alter the interference response (e.g., changes in the type of gas detector). Conduct the interference response in accordance with Section 5.4 of Method 20.

6.3 Measurement System Preparation, Analyzer Calibration Error, and Sampling System Bias Check. Follow Sections 6.2 through 6.4 of Method 6C.

7. Emission Test Procedure

7.1 **Selection of Sampling Site and Sampling Points.** Select a measurement site and sampling points using the same criteria that are applicable to tests performed using Method 3.

7.2 **Sample Collection.** Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the sampling system bias check. Maintain constant rate sampling (i.e., $\pm$ 10 percent) during the entire run. The sampling time per run shall be the same as for tests conducted using Method 3 plus twice the system response time. For each run, use only those measurements obtained after twice the response time of the measurement system has elapsed to determine the average effluent concentration.

7.3 **Zero and Calibration Drift Test.** Follow Section 7.4 of Method 6C.

8. Quality Control Procedures

The following quality control procedures are recommended when the results of this method are used for an emission rate correction factor, or excess air determination. The tester should select one of the following options for validating measurement results:

8.1 If both O_2 and CO_2 are measured using Method 3A, the procedures described in Section 4.4 of Method 3 should be followed to validate the O_2 and CO_2 measurement results.

8.2 If only O_2 is measured using Method 3A, measurements of the sample stream CO_2 concentration should be obtained at the sample by-pass vent discharge using an Orsat or Fyrite analyzer, or equivalent. Duplicate samples should be obtained concurrent with at least one run. Average the duplicate Orsat or Fyrite analysis results for each run. Use the average CO_2 values for comparison with the O_2 measurements in accordance with the procedures described in Section 4.4 of Method 3.

8.3 If only CO_2 is measured using Method 3A, concurrent measurements of the sample stream CO_2 concentration should be obtained using an Orsat or Fyrite analyzer as described in Section 8.2. For each run, differences greater than 0.5 percent between the Method 3A results and the average of the duplicate Fyrite analysis should be investigated.

9. Emission Calculation

For all CO_2 analyzers, and for O_2 analyzers that can be calibrated with zero gas, follow Section 8 of Method 6C, except express all concentrations as percent, rather than ppm.

For O_2 analyzers that use a low-level calibration gas in place of a zero gas, calculate the effluent gas concentration using Equation 3A-1.

$$C_{gas} = \frac{C_{ma} - C_{oa}}{C_m - C_o} - (\overline{C} - C_m) + C_{ma} \quad Eq.\ 3A - 1$$

Where:

C_{gas} = Effluent gas concentration, dry basis, percent.
C_{ma} = Actual concentration of the upscale calibration gas, percent.
C_{oa} = Actual concentration of the low-level calibration gas, percent.
C_m = Average of initial and final system calibration bias check responses for the upscale calibration gas, percent.
C_o = Average of initial and final system calibration bias check responses for the low-level gas, percent.

$\overline{C}$ = Average gas concentration indicated by the gas analyzer, dry basis, percent.

10. Bibliography

Same as bibliography of Method 6C.

6. Measurement System Performance Test Procedures

Perform the following procedures before measurement of emissions (Section 7).

6.1 **Calibration Gas Concentration Verification.** There are two alternatives for establishing the concentrations of calibration gases. Alternative Number 1 is preferred.

6.1.1 **Alternative Number 1**—Use of calibration gases that are analyzed following the Environmental Protection Agency Traceability Protocol Number 1 (see Citation 1 in the Bibliography). Obtain a certification from the gas manufacturer that Protocol Number 1 was followed.

6.1.2 **Alternative Number 2**—Use of calibration gases not prepared according to Protocol Number 1. If this alternative is chosen, obtain gas mixtures with a manufacturer's tolerance not to exceed ± 2 percent of the tag value. Within 6 months before the emission test, analyze each of the calibration gases in triplicate using Method 6. Citation 2 in the Bibliography describes procedures and techniques that may be used for this analysis. Record the results on a data sheet (example is shown in Figure 6C-3). Each of the individual SO_2 analytical results for each calibration gas shall be within 5 percent (or 5 PPM, whichever is greater) of the triplicate set average; otherwise, discard the entire set, and repeat the triplicate analyses. If the average of the triplicate analyses is within 5 percent of the calibration gas manufacturer's cylinder tag value, use the tag value; otherwise, conduct at least three additional analyses until the results of six consecutive runs agree with 5 percent (or 5 PPM, whichever is greater) of their average. Then use this average for the cylinder value.

6.2 **Measurement System Preparation.** Assemble the measurement system by following the manufacturer's written instructions for preparing and preconditioning the gas analyzer and, as applicable, the other system components. Introduce the calibration gases in any sequence, and make all necessary adjustments to calibrate the analyzer and the data recorder. Adjust system components to achieve correct sampling rates.

6.3 **Analyzer Calibration Error.** Conduct the analyzer calibration error check by introducing calibration gases to the measurement system at any point upstream of the gas analyzer as follows:

6.3.1 After the measurement system has been prepared for use, introduce the zero, mid-range, and high-range gases to the analyzer. During this check, make no adjustments to the system except those necessary to achieve the correct calibration gas flow rate at the analyzer. Record the analyzer responses to each calibration gas on a form similar to Figure 6C-4.

Note: A calibration curve established prior to the analyzer calibration error check may be used to convert the analyzer response to the equivalent gas concentration introduced to the analyzer. However, the same correction procedure shall be used for all effluent and calibration measurements obtained during the test.

6.3.2 The analyzer calibration error check shall be considered invalid if the gas concentration displayed by the analyzer exceeds ± 2 percent of the span for any of the calibration gases. If an invalid calibration is exhibited, take corrective action, and repeat the analyzer calibration error check until acceptable performance is achieved.

6.4 **Sampling System Bias Check.** Perform the sampling system bias check by introducing calibration gases at the calibration valve installed at the outlet of the sampling probe. A zero gas and either the mid-range or high-range gas, whichever most closely approximates the effluent concentrations, shall be used for this check as follows:

6.4.1 Introduce the upscale calibration gas, and record the gas concentration displayed by the analyzer on a form similar to Figure 6C-5. Then introduce zero gas, and record the gas concentration displayed by the analyzer. During the sampling system bias check, operate the system at the normal sampling rate, and make no adjustments to the measurement system other than those necessary to achieve proper calibration gas flow rates at the analyzer. Alternately introduce the zero and upscale gases until a stable response is achieved. The tester shall determine the measurement system response time by observing the times required to achieve a stable response for both the zero and upscale gases. Note the longer of the two times as the response time.

6.4.2 The sampling system bias check shall be considered invalid if the difference between the gas concentrations displayed by the measurement system for the analyzer calibration error check and for the sampling system bias check exceeds ± 5 percent of the span for either the zero or upscale calibration gas. If an invalid calibration is exhibited, take corrective action, and repeat the sampling system bias check until acceptable performance is achieved. If adjustment to the analyzer is required, first repeat the analyzer calibration error check, then repeat the sampling system bias check.

7. Emission Test Procedure

7.1 **Selection of Sampling Site and Sampling Points.** Select a measurement site and sampling points using the same criteria that are applicable to Method 6.

7.2 **Interference Check Preparation.** For each individual analyzer, conduct an interference check for at least three runs during the initial field test on a particular source category. Retain the results, and report them with each test performed on that source category. If an interference check is being performed, assemble the modified Method 6 train (flow control valve, two midget impingers containing 3 percent H_2O_2, and dry gas meter) as shown in Figure 6C-2. Install the sampling train to obtain a sample at the measurement system sample by-pass discharge vent. Record the initial dry gas meter reading.

7.3 **Sample Collection.** Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the sampling system bias check. Maintain constant rate sampling (i.e., ± 10 percent) during the entire run. The sampling time per run shall be the same as for Method 6 plus twice the system response time. For each run, use only those measurements obtained after twice response time of the measurement system has elapsed, to determine the average effluent concentration. If an interference check is being performed, open the flow control valve on the modified Method 6 train concurrent with the initiation of the sampling period, and adjust the flow to 1 liter per minute (± 10 percent).

(Note: If a pump is not used in the modified Method 6 train, caution should be exercised in adjusting the flow rate since overpressurization of the impingers may cause leakage in the impinger train, resulting in positively biased results).

7.4 **Zero and Calibration Drift Tests.** Immediately preceding and following each run, or if adjustments are necessary for the measurement system during the run, repeat the sampling system bias check procedure described in Section 6.4 (Make no adjustments to the measurement system until after the drift checks are completed.) Record and analyzer's responses on a form similar to Figure 6C-5.

7.4.1 If either the zero or upscale calibration value exceeds the sampling system bias specification, then the run is considered invalid. Repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before repeating the run.

7.4.2 If both the zero and upscale calibration values are within the sampling system bias specification, then use the average of the initial and final bias check values to calculate the gas concentration for the run. If the zero or upscale calibration drift value exceeds the drift limits, based on the difference between the sampling system bias check responses immediately before and after the run, repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before conducting additional runs.

7.5 **Interference Check (if performed).** After completing the run, record the final dry gas meter reading, meter temperature, and barometric pressure. Recover and analyze the contents of the midget impingers, and determine the SO_2 gas concentration using the procedures of Method 6. (It is not necessary to analyze EPA performance audit samples for Method 6.) Determine the average gas concentration exhibited by the analyzer for the run. If the gas concentrations provided by the analyzer and the modified Method 6 differ by more than 7 percent of the modified Method 6 result, the run is invalidated.

8. Emission Calculation

The average gas effluent concentration is determined from the average gas concentration displayed by the gas analyzer, and is adjusted for the zero and upscale sampling system bias checks, as determined in accordance with Section 7.4. The average gas concentration displayed by the analyzer may be determined by integration of the area under the curve for chart recorders, or by averaging all of the effluent measurements. Alternatively, the average may be calculated from measurements recorded at equally spaced intervals over the entire duration of the run. For sampling run durations of less than 1 hour, measurements at 1—minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be used. For sampling run durations greater than 1 hour, measurements at 2—minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be used. Calculate the effluent gas concentration using Equation 6C-1.

$$\overline{C}_{gas} = (C - Co)\,\frac{C_{ma}}{C_m - Co} \quad Eq.\ 6C - 1$$

Where:

C_{gas} = Effluent gas concentration, dry basis, PPM.

$\overline{C}$ = Average gas concentration indicated by gas analyzer, dry basis, PPM.

Co = Average of initial and final system calibration bias check responses for the zero gas, PPM.

C_m = Average of initial and final system calibration bias check responses for the upscale calibration gas, PPM.

C_{ma} = Actual concentration of the upscale calibration gas, PPM.

9. Bibliography

1. Traceability Protocol for Establishing True Concentrations of Gases Used for Calibrations and Audits of Continuous Source Emission Monitors: Protocol Number 1. U.S. Environmental Protection Agency, Quality Assurance Division. Research Triangle Park, NC. June 1978.

2. Westlin, Peter R. and J. W. Brown. Methods for Collecting and Analyzing Gas Cylinder Samples. Source Evaluation Society Newsletter. 3(3):5-15. September 1978.

|_See_CFR_paper_publication_for_illustration_0809

|_See_CFR_paper_publication_for_illustration_0810

METHOD 0011

SAMPLING FOR SELECTED ALDEHYDE AND KETONE EMISSIONS FROM STATIONARY SOURCES

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the determination of Destruction and Removal Efficiency (DRE) of the analytes listed in the following table:

Analyte	CAS No.[a]
Formaldehyde	50-00-0
Acetaldehye	75-07-0
Acetophenone	98-86-2
Isophorone	78-59-1
Propionaldehyde	123-38-6

[a] Chemical Abstract Service Registry Number

This method has been applied specifically to the above analytes. Many laboratories have extended method application to other aldehydes and ketones. This method is possibly applicable to other aldehydes and ketones from stationary sources as specified in the regulations. However, this method is not applicable to quinone (CAS No. 106-51-4), acrolein (CAS No. 107-02-08), methyl ethyl ketone (CAS No. 78-93-3), and methyl isobutyl ketone (CAS No. 108-10-1).

1.2 The detection limit for a 30 ft^3 (849 L) sample over a 1 hour sampling period may be as low as 10 ppbv for acetophenone and isophorone, 60 ppbv for propionaldehyde, 40 ppbv for acetaldehyde, and 90 ppbv for formaldehyde. Because the derivatization reaction is based on the formation of an equilibrium state between reactants and products, for some compounds quantitative recoveries may not be achieved until the concentration exceeds 200 ppbv.

1.3 This method is restricted to use by, or under the close supervision of, analysts experienced in sampling organic compounds in air. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

Gaseous and particulate pollutants are withdrawn isokinetically from an emission source and are collected in aqueous acidic 2,4-dinitrophenylhydrazine. Formaldehyde present in the emissions reacts with the 2,4-dinitrophenylhydrazine to form the formaldehyde dinitrophenylhydrazone derivative. The dinitrophenylhydrazone derivative is extracted, solvent-exchanged, concentrated, and then analyzed by high performance liquid chromatography (HPLC) according to Method 8315 or other appropriate technique.

3.0 INTERFERENCES

3.1 A decomposition product of 2,4-dinitrophenylhydrazine, 2,4-dinitroaniline, can be an analytical interferant if concentrations are high. The 2,4-dinitroaniline can coelute with the 2,4-dinitrophenylhydrazone of formaldehyde under the high performance liquid chromatography conditions used for the analysis. High concentrations of highly oxygenated compounds, especially acetone, that have the same retention time or nearly the same retention time as the dinitrophenylhydrazone of formaldehyde, and that also absorb at 360 nm, will interfere with the analysis.

3.2 Formaldehyde, acetone, and 2,4-dinitroaniline contamination of the aqueous acidic 2,4-dinitrophenylhydrazine (DNPH) reagent is frequently encountered. The reagent must be prepared within five days of use in the field and must be stored in an uncontaminated environment both before and after sampling, in order to minimize blank problems. Some concentration of acetone contamination is unavoidable, because acetone is ubiquitous in laboratory and field operations. However, the acetone contamination must be minimized.

3.3 Dimethylolurea creates a slight positive interference; and hexamethylenetetramine and paraformaldehyde significantly interfere with the determination of formaldehyde. These compounds can decompose in the acidic reagent used to collect the sample to form formaldehyde;

3.4 Tolualdehyde interferes with the determination of acetophenone because they coelute chromatographically;

3.5 High levels of nitrogen dioxide can interfere by consuming all of the reagent.

4.0 APPARATUS AND MATERIALS

4.1 This sampling train configuration is adapted from Method 5 (see Ref. 1) procedures. The sampling train consists of the following components: Probe nozzle, pitot tube, differential pressure gauge, metering system, barometer, and gas density determination equipment. A schematic of the sampling train is shown in Figure 1.

4.1.1 Probe Nozzle - The probe nozzle shall be quartz or glass with sharp, tapered (30° angle) leading edge. The taper shall be on the outside to preserve a constant inner diameter. The nozzle shall be buttonhook or elbow design. A range of nozzle sizes suitable for isokinetic sampling should be available in increments of 0.16 cm (1/16 in.), e.g., 0.32 to 1.27 cm (1/8 to ½ in.), or larger if higher volume sampling trains are used. Each nozzle shall be calibrated according to the procedures outlined in Sec. 8.1.

4.1.2 Probe Liner - Borosilicate glass or quartz shall be used for the probe liner. The tester should not allow the temperature in the probe to exceed 120 ±14°C (248 ±25°F).

4.1.3 Pitot Tube - The pitot tube shall be Type S or any other appropriate device. The Type S pitot tube shall be made of metal tubing (e.g., stainless steel). It is recommended that the external tubing diameter be between 0.48 and 0.95 cm. There shall be an equal distance from the base of each leg to its face-opening plane; it is recommended that this distance be between 1.05 and 1.50 times the external tubing diameter. The face openings of the pitot tube shall, preferably, be aligned but slight misalignments of the openings are permissible. The Type S pitot tube assembly shall have a known coefficient, determined as outlined in Method 2 (see Ref. 1). The pitot tube shall be attached to the probe to allow constant monitoring of

the stack gas velocity. The impact (high pressure) opening plane of the pitot tube shall be even with or above the nozzle entry plane (see Method 2) during sampling.

4.1.4 Differential Pressure Gauge - The differential pressure gauge shall be an inclined manometer or equivalent device as described in Method 2. One manometer shall be used for velocity-head readings and the other for orifice differential pressure readings.

4.1.5 Impingers - The sampling train requires a minimum of five impingers, connected as shown in Figure 1, with ground glass (or equivalent) vacuum-tight fittings. For the first, third, fourth, and fifth impingers, use the Greenburg-Smith design, modified by replacing the tip with a 1.27 cm (½ in) inside diameter glass tube extending to 1.27 cm (½ in.) from the bottom of the flask. For the second impinger, use a Greenburg-Smith impinger with the standard tip. Place a thermometer capable of measuring temperature to within 1°C (2°F) at the outlet of the fifth impinger for monitoring purposes.

4.1.6 Metering System - The necessary components of the metering system are a vacuum gauge, leak-free pump, thermometers capable of measuring temperature within 3°C (5.4°F), dry-gas meter capable of measuring volume to within 1%, and related equipment as shown in Figure 1. At a minimum, the pump should be capable of 4 cfm free flow, and the dry gas meter should have a recording capacity of 0-999.9 cu ft with a resolution of 0.005 cu ft. Other metering systems may be used which are capable of maintaining sample volumes to within 2%. The metering system may be used in conjunction with a pitot tube to enable checks of isokinetic sampling rates.

4.1.7 Barometer - The barometer may be mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases, the barometric reading may be obtained from a nearby National Weather Service Station, in which case the station value (which is the absolute barometric pressure) is requested and an adjustment for elevation differences between the weather station and sampling point is applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase (vice versa for elevation decrease).

4.1.8 Gas Density Determination Equipment - The gas density determination equipment includes a temperature sensor and pressure gauge (as described in Method 2) and gas analyzer, if necessary (an Orsat of Fyrite type combustion gas analyzer, or equivalent. For analyzer maintenance and operation procedures, follow the instructions recommended by the manufacturer). The temperature sensor ideally should be permanently attached to the pitot tube or sampling probe in a fixed configuration such that the tip of the sensor extends beyond the leading edge of the probe sheath and does not touch any metal. Alternatively, the sensor may be attached just prior to use in the field. Note, however, that if the temperature sensor is attached in the field, the sensor must be placed in an interference-free arrangement with respect to the Type S pitot tube openings (see Method 2). As a second alternative, if a difference of no more than 1% in the average velocity measurement is to be introduced, the temperature gauge need not be attached to the probe or pitot tube.

4.2 Sample Recovery

4.2.1 Probe Liner - Probe nozzle and brushes; Teflon® bristle brushes with stainless steel wire handles are required. The probe brush shall have extensions of stainless steel, Teflon®, or inert material at least as long as the probe. The brushes shall be properly sized and shaped to brush out the probe liner, the probe nozzle, and the impingers.

4.2.2 Wash Bottles - Three wash bottles are required. Teflon® or glass wash bottles are recommended. Polyethylene wash bottles should not be used because organic contaminants may be extracted by exposure to the organic solvents used for sample recovery.

4.2.3 Graduated Cylinder and/or Balance - A graduated cylinder or balance is required to measure condensed water to the nearest 1 mL or 1 g. Graduated cylinders shall have divisions not greater than 2 mL. Laboratory balances capable of weighing to ±0.5 g are required.

4.2.4 Amber Glass Storage Containers - One-liter wide-mouth amber flint glass bottles with Teflon®-lined caps are required to store impinger water samples. The bottles must be sealed with Teflon® tape.

4.2.5 Rubber Policeman and Funnel - A rubber policeman and funnel are required to aid in the transfer of materials into and out of containers in the field.

4.3 Reagent Preparation

4.3.1 Bottles/Caps - Amber 1 - 4 L bottles with Teflon®-lined caps are required for storing cleaned DNPH solution. Additional 4-L bottles are required to collect waste organic solvents.

4.3.2 Large Glass Container - At least one large glass (8 to 16 L) is required for mixing the aqueous acidic DNPH solution.

4.3.3 Stir Plate/Large Stir Bars/Stir Bar Retriever - A magnetic stir plate and large stir bar are required for the mixing of the aqueous acidic DNPH solution. A stir bar retriever is needed for removing the stir bar from the large container holding the DNPH solution.

4.3.4 Buchner Filter/Filter Flask/Filter Paper - A large filter flask (2-4 L) with a buchner filter, appropriate rubber stopper, filter paper, and connecting tubing are required for filtering the aqueous acidic DNPH solution prior to cleaning.

4.3.5 Separatory Funnel - At least one large separatory funnel (2 L) is required for cleaning the DNPH prior to use.

4.3.6 Beakers - Beakers (150 mL, 250 mL, and 400 mL) are useful for holding/measuring organic liquids when cleaning the aqueous acidic DNPH solution and for weighing DNPH crystals.

4.3.7 Funnels - At least one large funnel is needed for pouring the aqueous acidic DNPH into the separatory funnel.

4.3.8 Graduated Cylinders - At least one large graduated cylinder (1 to 2 L) is required for measuring organic-free reagent water and acid when preparing the DNPH solution.

4.3.9 Top-loading Balance - A one-place top loading balance is needed for weighing out the DNPH crystals used to prepare the aqueous acidic DNPH solution.

4.3.10 Spatulas - Spatulas are needed for weighing out DNPH when preparing the aqueous DNPH solution.

4.4 Crushed Ice - Quantities of crushed ice ranging from 10-50 lb may be necessary during a sampling run, depending upon ambient temperature. Samples which have been taken must be stored and shipped cold; sufficient ice for this purpose must be allowed.

5.0 REAGENTS

5.1 Reagent Grade Chemicals - Reagent grade inorganic chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

5.2 Organic-free Reagent Water - All references to water in this method refer to organic-free reagent water, as defined in Chapter One.

5.3 Silica Gel - Silica gel shall be indicating type, 6-16 mesh. If the silica gel has been used previously, dry at 175°C (350°F) for 2 hours before using. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used.

5.4 2,4-Dinitrophenylhydrazine (DNPH), $[2,4\text{-}(0_2N)_2C_6H_3]NHNH_2$ - The quantity of water may vary from 10 to 30%.

5.4.1 The 2,4-dinitrophenylhydrazine reagent must be prepared in the laboratory within five days of sampling use in the field. Preparation of DNPH can also be done in the field, with consideration of appropriate procedures required for safe handling of solvent in the field. When a container of prepared DNPH reagent is opened in the field, the contents of the opened container should be used within 48 hours. All laboratory glassware must be washed with detergent and water and rinsed with water, methanol, and methylene chloride prior to use.

NOTE: DNPH crystals and DNPH solution are potential carcinogens and should be handled with plastic gloves at all times, with prompt and extensive use of running water in case of skin exposure.

5.4.2 Preparation of Aqueous Acidic DNPH Derivatizing Reagent - Each batch of DNPH reagent should be prepared and purified within five days of sampling, according to the procedure described below.

NOTE: Reagent bottles for storage of cleaned DNPH derivatizing solution must be rinsed with acetonitrile and dried before use. Baked glassware is not essential for preparation of DNPH reagent. The glassware must not be rinsed with acetone or an unacceptable concentration of acetone contamination will be introduced. If field preparation of DNPH is performed, caution must be exercised in avoiding acetone contamination.

5.4.2.1 Place an 8 L container under a fume hood on a magnetic stirrer. Add a large stir bar and fill the container half full of organic-free reagent water. Save the empty bottle from the organic-free reagent water. Start the stirring bar and adjust the stir rate to be as fast as possible. Using a graduated cylinder, measure 1.4 L of concentrated hydrochloric acid. Slowly pour the acid into the stirring water. Fumes may be generated and the water may become warm. Weigh the DNPH crystals to ±0.1 g (see Table 1 for approximate amounts) and add to the stirring acid solution. Fill the 8 L

container to the 8 L mark with organic-free reagent water and stir overnight. If all of the DNPH crystals have dissolved overnight, add additional DNPH and stir for two more hours. Continue the process of adding DNPH with additional stirring until a saturated solution has been formed, as evidenced by the presence of visible crystals after continued stirring. Filter the DNPH solution using vacuum filtration. Gravity filtration may be used, but a much longer time is required. Store the filtered solution in an amber bottle at room temperature.

5.4.2.2 Within five days of proposed use, place about 1.6 L of the DNPH reagent in a 2 L separatory funnel. Add approximately 200 mL of methylene chloride and stopper the funnel. Wrap the stopper of the funnel with paper towels to absorb any leakage. Invert and vent the funnel. Then shake vigorously for 3 minutes. Initially, the funnel should be vented frequently (every 10 - 15 seconds). After the layers have separated, discard the lower (organic) layer.

5.4.2.3 Extract the DNPH a second time with methylene chloride and finally with cyclohexane. When the cyclohexane layer has separated from the DNPH reagent, the cyclohexane layer will be the top layer in the separatory funnel. Drain the lower layer (the cleaned extracted DNPH reagent solution) into an amber bottle that has been rinsed with acetonitrile and allowed to dry.

5.4.3 DNPH Reagent Check - Take two aliquots of the extracted DNPH reagent. The size of the aliquots is dependent upon the exact sampling procedure used, but 100 mL is reasonably representative. Analyze one aliquot of the reagent according to Sec. 7 of Method 8315 as a Quality Control check to ensure that the background in the reagent is acceptable for field use. Save the other aliquot of aqueous acidic DNPH for use as a method blank when the analysis is performed. The reagent is acceptable for use if the background meets the AIC (Acceptable Impurity Concentration) as specified in Sec. 5.4.5.

5.4.4 Shipment to the Field - Tightly cap the bottle containing extracted DNPH reagent using a Teflon®-lined cap. Seal the bottle with Teflon® tape. After the bottle is labeled, the bottle may be placed in a friction-top can (paint can or equivalent) containing a 1-2 inch layer of granulated charcoal and stored at ambient temperature until use.

5.4.4.1 If the DNPH reagent has passed the Quality Control criteria, the reagent may be packaged to meet necessary shipping requirements and sent to the sampling area. If the Quality Control criteria are not met, the reagent solution may be re-extracted or the solution may be re-prepared and the extraction sequence repeated.

5.4.4.2 If the DNPH reagent is not used in the field within five days of extraction, an aliquot may be taken and analyzed as described in Sec. 7 of Method 8315. If the reagent meets the Quality Control requirements, the reagent may be used. If the reagent does not meet the Quality Control requirements, the reagent must be discarded and new reagent must be prepared and tested.

5.4.5 Calculation of Acceptable Concentrations of Impurities in DNPH Reagent - The acceptable impurity concentration (AIC, µg/mL) is calculated from the expected analyte concentration in the sampled gas (EAC, ppbv), the volume of air that will be sampled at standard conditions (SVOL, L), the formula weight of the analyte (FW, g/mol), and the volume of DNPH reagent that will be used in the impingers (RVOL, mL):

$$AIC = 0.1 \times [EAC \times SVOL \times FW/24.4 \times (FW + 180)/FW](RVOL/1{,}000)$$

where:

0.1 is the acceptable contaminant concentration,
24.4 is a factor relating ppbv to g/L,
180 is a factor relating underivatized to derivatized analyte, and
1,000 is a unit conversion factor.

5.4.6 Disposal of Excess DNPH Reagent - Excess DNPH reagent may be returned to the laboratory and recycled or treated as aqueous waste for disposal purposes. 2,4-Dinitrophenylhydrazine is a flammable solid when dry, so water should not be evaporated from the solution of the reagent.

5.5 Field Spike Standard Preparation - To prepare a formaldehyde field spiking standard at 4010 mg/L, use a 500 µL syringe to transfer 0.5 mL of 37% by weight of formaldehyde (401 g/L) to a 50 mL volumetric flask containing approximately 40 mL of methanol. Dilute to 50 mL with methanol.

5.6 Hydrochloric Acid, HCl - Reagent grade hydrochloric acid (approximately 12N) is required for acidifying the aqueous DNPH solution.

5.7 Methylene Chloride, CH_2Cl_2 - Methylene chloride (suitable for residue and pesticide analysis, GC/MS, HPLC, GC, Spectrophotometry or equivalent) is required for cleaning the aqueous acidic DNPH solution, rinsing glassware, and recovery of sample trains.

5.8 Cyclohexane, C_6H_{12} - Cyclohexane (HPLC grade) is required for cleaning the aqueous acidic DNPH solution.

NOTE: Do not use spectroanalyzed grades of cyclohexane if this sampling methodology is extended to aldehydes and ketones with four or more carbon atoms.

5.9 Methanol, CH_3OH - Methanol (HPLC grade or equivalent) is necessary for rinsing glassware.

5.10 Acetonitrile, CH_3CN - Acetonitrile (HPLC grade or equivalent) is required for rinsing glassware.

5.11 Formaldehyde, HCHO - Formaldehyde (analytical reagent grade, or equivalent) is required for preparation of standards. If other aldehydes or ketones are used, analytical reagent grade, or equivalent, is required.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 Because of the complexity of this method, field personnel should be trained in and experienced with the test procedures in order to obtain reliable results.

6.2 Laboratory Preparation

6.2.1 All the components shall be maintained and calibrated according to the procedure described in APTD-0576 (Air Pollution Technical Document, see references), unless otherwise specified.

6.2.2 Weigh several 200 to 300 g portions of silica gel in airtight containers to the nearest 0.5 g. Record on each container the total weight of the silica gel plus containers. As an alternative to preweighing the silica gel, it may instead be weighed directly in the impinger or sampling holder just prior to train assembly.

6.3 Preliminary Field Determinations

6.3.1 Select the sampling site and the minimum number of sampling points according to Method 1 (see Ref. 1) or other relevant criteria. Determine the stack pressure, temperature, and range of velocity heads using Method 2. A leak-check of the pitot lines according to Method 2 must be performed. Determine the stack gas moisture content using Approximation Method 4 (see Ref. 1) or its alternatives to establish estimates of isokinetic sampling-rate settings. Determine the stack gas dry molecular weight, as described in Method 2. If integrated Method 3 (see Ref. 1) sampling is used for molecular weight determination, the integrated bag sample shall be taken simultaneously with, and for the same total length of time as, the sample run.

6.3.2 Select a nozzle size based on the range of velocity heads so that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates below 28 L/min (1.0 cfm). During the run, do not change the nozzle. Ensure that the proper differential pressure gauge is chosen for the range of velocity heads encountered (see Sec. 2 of Method 2).

6.3.3 Select a suitable probe liner and probe length so that all traverse points can be sampled. For large stacks, to reduce the length of the probe, consider sampling from opposite sides of the stack.

6.3.4 A minimum of 45 ft^3 of sample volume is required for the determination of the Destruction and Removal Efficiency (DRE) of formaldehyde from incineration systems (45 ft^3 is equivalent to one hour of sampling at 0.75 dscf). Additional sample volume shall be collected as necessitated by the capacity of the DNPH reagent and analytical detection limit constraints. To determine the minimum sample volume required, refer to sample calculations in Sec. 10.0.

6.3.5 Determine the total length of sampling time needed to obtain the identified minimum volume by comparing the anticipated average sampling rate with the volume requirement. Allocate the same time to all traverse points defined by Method 1. To avoid timekeeping errors, the length of time sampled at each traverse point should be an integer or an integer plus 0.5 min.

6.3.6 In some circumstances (e.g., batch cycles) it may be necessary to sample for shorter times at the traverse points and to obtain smaller gas-volume samples. In these cases, careful documentation must be maintained in order to allow accurate calculation of concentrations.

6.4 Preparation of Collection Train

6.4.1 During preparation and assembly of the sampling train, keep all openings where contamination can occur covered with Teflon® film or aluminum foil until just prior to assembly or until sampling is about to begin.

NOTE: Appendix A at the end of this procedure contains guidance on the addition of a filter as a check on the survival of particulate material through the impinger system. This filter can be added to the impinger train either after the second impinger or after the third impinger.

6.4.2 Place 200 mL of purified DNPH reagent in the first impinger and 100 mL of reagent in the second and third impingers, and leave the fourth impinger empty. Transfer approximately 200 to 300 g of preweighed silica gel from its container to the fifth impinger. Care should be taken to ensure that the silica gel is not entrained and carried out from the impinger during sampling. Place the silica gel container in a clean place for later use in the sample recovery. Alternatively, the weight of the silica gel plus impinger may be determined to the nearest 0.5 g and recorded.

6.4.3 With a glass or quartz liner, install the selected nozzle using a Viton-A O-ring when stack temperatures are less than 260°C (500°F) and a woven glass-fiber gasket when temperatures are higher. See APTD-0576 (Rom, 1972) for details. Other connecting systems utilizing either 316 stainless steel or Teflon® ferrules may be used. Mark the probe with heat-resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

6.4.4 Assemble the train as shown in Figure 1. During assembly, do not use any silicone grease on ground-glass joints upstream of the impingers. Use Teflon® tape, if required. A very light coating of silicone grease may be used on ground-glass joints downstream of the impingers, but the silicone grease should be limited to the outer portion (see APTD-0576) of the ground-glass joints to minimize silicone grease contamination. If necessary, Teflon® tape may be used to seal leaks. Connect all temperature sensors to an appropriate potentiometer/display unit. Check all temperature sensors at ambient temperature.

6.4.5 Place crushed ice all around the impingers.

6.4.6 Turn on and set the probe heating system at the desired operating temperature. Allow time for the temperature to stabilize.

6.5 Leak-Check Procedures

6.5.1 Pre-test Leak Check

6.5.1.1 After the sampling train has been assembled, turn on and set the probe heating system at the desired operating temperature. Allow time for the temperature to stabilize. If a Viton-A O-ring or other leak-free connection is used in assembling the probe nozzle to the probe liner, leak-check the train at the sampling site by plugging the nozzle and pulling a 381 mm Hg (15 in. Hg) vacuum.

NOTE: A lower vacuum may be used, provided that the lower vacuum is not exceeded during the test.

6.5.1.2 If an asbestos string is used, do not connect the probe to the train during the leak check. Instead, leak-check the train by first attaching a carbon-filled leak check impinger to the inlet and then plugging the inlet and pulling a 381 mm Hg (15 in. Hg) vacuum. (A lower vacuum may be used if this lower vacuum is not exceeded during the test.) Then connect the probe to the train and leak-check at about 25 mm Hg (1 in. Hg) vacuum. Alternatively, leak-check the probe with the rest of the sampling train in one

step at 381 mm Hg (15 in. Hg) vacuum. Leakage rates no greater than 4% of the average sampling rate or less than or equal to 0.00057 m^3/min (0.02 cfm), whichever is less, are acceptable.

6.5.1.3 The following leak check instructions for the sampling train described in APTD-0576 and APTD-0581 may be helpful. Start the pump with the fine-adjust valve fully open and coarse-adjust valve completely closed. Partially open the coarse-adjust valve and slowly close the fine-adjust valve until the desired vacuum is reached. Do not reverse direction of the fine-adjust valve, as liquid will back up into the train. If the desired vacuum is exceeded, either perform the leak check at this higher vacuum or end the leak check, as shown below, and start over.

6.5.1.4 When the leak check is completed, first slowly remove the plug from the inlet to the probe. When the vacuum drops to 127 mm (5 in.) Hg or less, immediately close the coarse-adjust valve. Switch off the pumping system and reopen the fine-adjust valve. Do not reopen the fine-adjust valve until the coarse-adjust valve has been closed to prevent the liquid in the impingers from being forced backward into the sampling line and silica gel from being entrained backward into the third impinger.

6.5.2 Sampling Run Leak Check

6.5.2.1 If, during the sampling run, a component change (i.e., impinger) becomes necessary, a leak check shall be conducted immediately after the interruption of sampling and before the change is made. The leak check shall be done according to the procedure described in Sec. 6.5.1, except that it shall be done at a vacuum greater than or equal to the maximum value recorded up to that point in the test. If the leakage rate is found to be no greater than 0.00057 m^3/min (0.02 cfm) or 4% of the average sampling rate (whichever is less), the results are acceptable. If a higher leakage rate is obtained, the tester must void the sampling run.

NOTE: Any correction of the sample volume by calculation reduces the integrity of the pollutant concentration data generated and must be avoided.

6.5.2.2 Immediately after a component change and before sampling is reinitiated, a leak check similar to a pre-test leak check must also be conducted.

6.5.3 Post-test Leak Check - A leak check is mandatory at the conclusion of each sampling run. The leak check shall be done with the same procedures as the pre-test leak check, except that the post-test leak check shall be conducted at a vacuum greater than or equal to the maximum value reached during the sampling run. If the leakage rate is found to be no greater than 0.00057 m^3/min (0.02 cfm) or 4% of the average sampling rate (whichever is less), the results are acceptable. If, however, a higher leakage rate is obtained, the tester shall record the leakage rate and void the sampling run.

6.6 Sampling Train Operation

6.6.1 During the sampling run, maintain an isokinetic sampling rate to within 10% of true isokinetic, below 28 L/min (1.0 cfm). Maintain a temperature around the probe of 120°C (248° ±25°F).

6.6.2 For each run, record the data on a data sheet such as the one shown in Figure 2. Be sure to record the initial dry-gas meter reading. Record the dry-gas meter readings at

the beginning and end of each sampling time increment, when changes in flow rates are made, before and after each leak check, and when sampling is halted. Take other readings required by Figure 2 at least once at each sample point during each time increment and additional readings when significant adjustments (20% variation in velocity head readings) necessitate additional adjustments in flow rate. Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse.

6.6.3 Clean the stack access ports prior to the test run to eliminate the chance of sampling deposited material. To begin sampling, remove the nozzle cap, verify that the filter and probe heating systems are at the specified temperature, and verify that the pitot tube and probe are properly positioned. Position the nozzle at the first traverse point, with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Nomographs, which aid in the rapid adjustment of the isokinetic sampling rate without excessive computations, are available. These nomographs are designed for use when the Type S pitot tube coefficient is 0.84 ±0.02 and the stack gas equivalent density (dry molecular weight) is equal to 29 ±4. APTD-0576 details the procedure for using the nomographs. If the stack gas molecular weight and the pitot tube coefficient are outside the above ranges, do not use the nomographs unless appropriate steps are taken to compensate for the deviations.

6.6.4 When the stack is under significant negative pressure (equivalent to the height of the impinger stem), take care to close the coarse-adjust valve before inserting the probe into the stack in order to prevent liquid from backing up through the train. If necessary, the pump may be turned on with the coarse-adjust valve closed.

6.6.5 When the probe is in position, block off the openings around the probe and stack access port to prevent nonrepresentative dilution of the gas stream.

6.6.6 Traverse the stack cross section, as required by Method 1, being careful not to bump the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe through the access port, in order to minimize the chance of extracting deposited material.

6.6.7 During the test run, make periodic adjustments to keep the temperature around the probe at the proper levels. Add more ice and, if necessary, salt, to maintain a temperature of less than 20°C (68°F) at the silica gel outlet. Also, periodically check the level and zero of the manometer.

6.6.8 A single train shall be used for the entire sampling run, except in cases where simultaneous sampling is required in two or more separate ducts or at two or more different locations within the same duct, or in cases where equipment failure necessitates a change of trains. An additional train or additional trains may also be used for sampling when the capacity of a single train is exceeded.

6.6.9 When two or more trains are used, separate analyses of components from each train shall be performed. If multiple trains have been used because the capacity of a single train would be exceeded, first impingers from each train may be combined, and second impingers from each train may be combined.

6.6.10 At the end of the sampling run, turn off the coarse-adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final dry gas meter reading, and

conduct a post-test leak check. Also, leak check the pitot lines as described in Method 2. The lines must pass this leak check in order to validate the velocity-head data.

6.6.11 Calculate percent isokinetic variation (see Method 5) to determine whether the run was valid or another test should be made.

7.0 SAMPLE RECOVERY AND PREPARATION FOR ANALYSIS

7.1 Preparation

7.1.1 Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period. Allow the probe to cool. When the probe can be handled safely, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over the tip to prevent losing or gaining particulate matter. Do not cap the probe tip tightly while the sampling train is cooling because a vacuum will be created, drawing liquid from the impingers back through the sampling train.

7.1.2 Before moving the sampling train to the cleanup site, remove the probe from the sampling train and cap the open outlet, being careful not to lose any condensate that might be present. Remove the umbilical cord from the last impinger and cap the impinger. If a flexible line is used, let any condensed water or liquid drain into the impingers. Cap off any open impinger inlets and outlets. Ground glass stoppers, Teflon® caps, or caps of other inert materials may be used to seal all openings.

7.1.3 Transfer the probe and impinger assembly to an area that is clean and protected from wind so that the chances of contaminating or losing the sample are minimized.

7.1.4 Inspect the train before and during disassembly, and note any abnormal conditions.

7.1.5 Save a portion of all washing solution (methylene chloride, water) used for cleanup as a blank. Transfer 200 mL of each solution directly from the wash bottle being used and place each in a separate, pre-labeled sample container.

7.2 Sample Containers

7.2.1 Container 1 - Probe and Impinger Catches. Using a graduated cylinder, measure to the nearest mL, and record the volume of the solution in the first three impingers. Alternatively, the solution may be weighed to the nearest 0.5 g. Transfer the impinger solution from the graduated cylinder into the amber flint glass bottle. Taking care that dust on the outside of the probe or other exterior surfaces does not get into the sample, clean all surfaces to which the sample is exposed (including the probe nozzle, probe fitting, probe liner, first impinger, and impinger connector) with methylene chloride. Use less than 500 mL for the entire wash (250 mL would be better, if possible). Add the washings to the sample container.

7.2.1.1 Carefully remove the probe nozzle and rinse the inside surface with methylene chloride from a wash bottle. Brush with a Teflon® bristle brush, and rinse until the rinse shows no visible particles or yellow color, after which make a final rinse of the inside surface. Brush and rinse the inside parts of the Swagelok fitting with methylene chloride in a similar way.

7.2.1.2 Rinse the probe liner with methylene chloride. While squirting the methylene chloride into the upper end of the probe, tilt and rotate the probe so that all inside surfaces will be wetted with methylene chloride. Let the methylene chloride drain from the lower end into the sample container. The tester may use a funnel (glass or polyethylene) to aid in transferring the liquid washes to the container. Following the rinse with a Teflon® brush. Hold the probe in an inclined position, and squirt methylene chloride into the upper end as the probe brush is being pushed with a twisting action through the probe. Hold the sample container underneath the lower end of the probe, and catch any methylene chloride, water, and particulate matter that is brushed from the probe. Run the brush through the probe three times or more. Rinse the brush with methylene chloride or water, and quantitatively collect these washings in the sample container. After the brushings, make a final rinse of the probe as described above.

NOTE: Between sampling runs, brushes must be kept clean and free from contamination.

7.2.1.3 Rinse the inside surface of each of the first three impingers (and connecting tubing) three separate times. Use a small portion of methylene chloride for each rinse. Water will be required for the recovery of the impingers in addition to the specified quantity of methylene chloride. There will be at least two phases in the impingers. This two-phase mixture does not pour well, and a significant amount of the impinger catch will be left on the walls. The use of water as a rinse makes the recovery quantitative. Make a final rinse of each surface, using both methylene chloride and water.

7.2.1.4 After all methylene chloride and water washings and particulate matter have been collected in the sample container, tighten the lid so that solvent, water, and DNPH reagent will not leak out when the container is shipped to the laboratory. Mark the height of the fluid level to determine whether leakage occurs during transport. Seal the container with Teflon® tape. Label the container clearly to identify its contents.

7.2.1.5 If the first two impingers are to be analyzed separately to check for breakthrough, separate the contents and rinses of the two impingers into individual containers. Care must be taken to avoid physical carryover from the first impinger to the second. The formaldehyde hydrazone is a solid which floats and froths on top of the impinger solution. Any physical carryover of collected moisture into the second impinger will invalidate a breakthrough assessment.

7.2.2 Container 2 - Sample Blank. Prepare a sample blank by using an amber flint glass container and adding a volume of DNPH reagent and methylene chloride equal to the total volume in Container 1. Process the blank in the same manner as Container 1.

7.2.3 Container 3 - Silica Gel. Note the color of the indicating silica gel to determine whether it has been completely spent and make a notation of its condition. The impinger containing the silica gel may be used as a sample transport container with both ends sealed with tightly fitting caps or plugs. Ground-glass stoppers or Teflon® caps may be used. The silica gel impinger should then be labeled, covered with aluminum foil, and packaged on ice for transport to the laboratory. If the silica gel is removed from the impinger, the tester may use a funnel to pour the silica gel and a rubber policeman to remove the silica gel from the impinger. It is not necessary to remove the small amount of dust particles that may adhere to the impinger wall and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use water or other liquids to transfer the silica gel. If a balance

is available in the field, the spent silica gel (or silica gel plus impinger) may be weighed to the nearest 0.5 g.

7.2.4 Sample containers should be placed in a cooler, cooled by although not in contact with ice. Sample containers must be placed vertically and, since they are glass, protected from breakage during shipment. Samples should be cooled during shipment so they will be received cold at the laboratory.

7.3 The dinitrophenylhydrazone derivative is then analyzed by high performance liquid chromatography (HPLC) (Method 8315) or other appropriate technique.

8.0 CALIBRATION

8.1 Probe Nozzle - Probe nozzles shall be calibrated before their initial use in the field. Using a micrometer, measure the inside diameter of the nozzle to the nearest 0.025 mm (0.001 in.). Make measurements at three separate places across the diameter and obtain the average of the measurements. The difference between the high and low numbers shall not exceed 0.1 mm (0.004 in.). When the nozzles become nicked or corroded, they shall be replaced and calibrated before use. Each nozzle must be permanently and uniquely identified.

8.2 Pitot Tube - The Type S pitot tube assembly shall be calibrated according to the procedure outlined in Method 2, or assigned a nominal coefficient of 0.84 if it is not visibly nicked or corroded and if it meets design and intercomponent spacing specifications.

8.3 Metering System

8.3.1 Before its initial use in the field, the metering system shall be calibrated according to the procedure outlined in APTD-0576. Instead of physically adjusting the dry-gas meter dial readings to correspond to the wet-test meter readings, calibration factors may be used to correct the gas meter dial readings mathematically to the proper values. Before calibrating the metering system, it is suggested that a leak check be conducted. For metering system having diaphragm pumps, the normal leak check procedure will not detect leakages within the pump. For these cases, the following leak check procedure will apply: make a ten-minute calibration run at 0.00057 m^3/min (0.02 cfm). At the end of the run, take the difference of the measured wet-test and dry-gas meter volumes and divide the difference by 10 to get the leak rate. The leak rate should not exceed 0.00057 m^3/min (0.02 cfm).

8.3.2 After each field use, check the calibration of the metering system by performing three calibration runs at a single intermediate orifice setting (based on the previous field test). Set the vacuum at the maximum value reached during the test series. To adjust the vacuum, insert a valve between the wet-test meter and the inlet of the metering system. Calculate the average value of the calibration factor. If the calibration has changed by more than 5%, recalibrate the meter over the full range of orifice settings, as outlined in APTD-0576.

8.3.3 Leak Check of Metering System - The portion of the sampling train from the pump to the orifice meter (see Figure 1) should be leak-checked prior to initial use and after each shipment. Leakage after the pump will result in less volume being recorded than is actually sampled. Use the following procedure: Close the main valve on the meter box. Insert a one-hole rubber stopper with rubber tubing attached into the orifice exhaust pipe. Disconnect and vent the low side of the orifice manometer. Close off the low side orifice tap. Pressurize the system to 13 - 18 cm (5 - 7 in.) water column by blowing into the rubber tubing. Pinch off the

tubing and observe the manometer for 1 min. A loss of pressure on the manometer indicates a leak in the meter box. Leaks must be corrected.

NOTE: If the dry-gas-meter coefficient values obtained before and after a test series differ by greater than 5%, either the test series must be voided or calculations for test series must be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

8.4 Probe Heater - The probe heating system must be calibrated before its initial use in the field according to the procedure outlined in APTD-0576. Probes constructed according to APTD-0581 need not be calibrated if the calibration curves in APTD-0576 are used.

8.5 Temperature Gauges - Each thermocouple must be permanently and uniquely marked on the casting. All mercury-in-glass reference thermometers must conform to ASTM E-1 63C or 63F (American Society for Testing and Materials) specifications. Thermocouples should be calibrated in the laboratory with and without the use of extension leads. If extension leads are used in the field, the thermocouple readings at the ambient air temperatures, with and without the extension lead, must be noted and recorded. Correction is necessary if the use of an extension lead produces a change greater than 1.5%.

8.5.1 Impinger and Dry-gas Meter Thermocouples - For the thermocouples used to measure the temperature of the gas leaving the impinger train, a three-point calibration at ice water, room air, and boiling water temperatures is necessary. Accept the thermocouples only if the readings at all three temperatures agree to ±2°C (3.6°F) with those of the absolute value of the reference thermometer.

8.5.2 Probe and Stack Thermocouple - For the thermocouples used to indicate the probe and stack temperatures, a three-point calibration at ice water, boiling water, and hot oil bath temperatures must be performed. Use of a point at room air temperature is recommended. The thermometer and thermocouple must agree to within 1.5% at each of the calibration points. A calibration curve (equation) may be constructed (calculated) and the data extrapolated to cover the entire temperature range suggested by the manufacturer.

8.6 Barometer - Adjust the barometer initially and before each test series to agree to within ±2.5 mm Hg (0.1 in. Hg) of the mercury barometer or the corrected barometric pressure value reported by a nearby National Weather Service Station (same altitude above sea level).

8.7 Triple-beam or Electronic Balance - Calibrate the balance before each test series, using Class S standard weights. The weights must be within ±0.5% of the standards, or the balance must be adjusted to meet these limits.

9.0 CALCULATIONS

Perform calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculations.

9.1 Total Formaldehyde - Determine the total formaldehyde in mg, using the following equation:

$$\text{Total mg formaldehyde} = C_d \times V \times DF \times \frac{\text{[g/mole aldehyde]}}{\text{[g/mole DNPH derivative]}} \times 10^{-3}\ \text{mg/µg}$$

where:

C_d = measured concentration of DNPH-formaldehyde derivative, µg/mL
V = organic extract volume, mL
DF = dilution factor

9.2 Formaldehyde Concentration In Stack Gas - Determine the formaldehyde concentration in the stack gas using the following equation:

$$C_f = K\ [\text{total formaldehyde, mg}] / V_{m(std)}$$

where:

K = 35.31 ft^3/m^3 if $V_{m(std)}$ is expressed in English units
= 1.00 m^3/m^3 if $V_{m(std)}$ is expressed in metric units
$V_{m(std)}$ = volume of gas sample as measured by dry gas meter, corrected to standard conditions, dscm (dscf)

9.3 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop are obtained from the data sheet.

9.4 Dry Gas Volume - Calculate $V_{m(std)}$ and adjust for leakage, if necessary, using the equation in Sec. 6 of Method 5.

9.5 Volume of Water Vapor and Moisture Content - Calculate the volume of water vapor and moisture content from Equations 5-2 and 5-3 of Method 5.

10.0 DETERMINATION OF VOLUME TO BE SAMPLED

To determine the minimum sample volume to be collected, use the following sequence of equations.

10.1 From prior analysis of the waste feed, the concentration of formaldehyde (FORM) introduced into the combustion system can be calculated. The degree of destruction and removal efficiency that is required is used to determine the maximum amount of FORM allowed to be present in the effluent. This amount may be expressed as:

$$\text{Max FORM}_t\ \text{Mass} = [(WF)(FORM_i\ \text{conc})(100 - \%DRE)] / 100$$

where:

WF = mass flow rate of waste feed per h, g/h (lb/h)
$FORM_i$ = concentration of FORM (wt %) introduced into the combustion process
DRE = percent Destruction and Removal Efficiency required
Max FORM = mass flow rate (g/h [lb/h]) of FORM emitted from the combustion sources

10.2 The average discharge concentration of the FORM in the effluent gas is determined by comparing the Max FORM with the volumetric flow rate being exhausted from the source. Volumetric flow rate data are available as a result of preliminary Method 1 - 4 determinations:

$$\text{Max FORM}_i \text{ conc} = [\text{Max FORM}_i \text{ Mass}] / DV_{eff(std)}$$

where:

$DV_{eff(std)}$ = volumetric flow rate of exhaust gas, dscm (dscf)
FORM_i conc = anticipated concentration of the FORM in the exhaust gas stream, g/dscm (lb/dscf)

10.3 In making this calculation, it is recommended that a safety margin of at least ten be included.

$$[LDL_{FORM} \times 10] / [\text{FORM}_i \text{ conc}] = V_{tbc}$$

where:

LDL_{FORM} = detectable amount of FORM in entire sampling train
V_{tbc} = minimum dry standard volume to be collected at dry-gas meter

10.4 The following analytical detection limits and DNPH Reagent Capacity (based on a total volume of 200 mL in two impingers) must also be considered in determining a volume to be sampled.

11.0 QUALITY CONTROL

11.1 Sampling - See EPA Manual 600/4-77-027b for Method 5 quality control.

11.2 Analysis - The quality assurance program required for this method includes the analysis of field and method blanks, procedure validations, analysis of field spikes, and analysis of reagent checks. The assessment of combustion data and positive identification and quantitation of formaldehyde are dependent on the integrity of the samples received and the precision and accuracy of the analytical methodology. Quality Assurance procedures for this method are designed to monitor the performance of the analytical methodology and to provide the required information to take corrective action if problems are observed in laboratory operations or in field sampling activities.

11.2.1 Field Blanks - Field blanks may be submitted with the samples collected at each sampling site. The field blanks include the sample bottles containing aliquots of sample recovery solvents, methylene chloride and water, and unused DNPH reagent. In the case of results exceeding regulatory limits, field blank data may be useful for convincing the regulatory official that contamination was the cause. This may result in retesting rather than a violation charge. Collection of the field blank is optional but recommended.

11.2.2 Method Blanks - A method blank must be prepared for each set of analytical operations, to evaluate contamination and artifacts that can be derived from glassware, reagents, and sample handling in the laboratory.

11.2.3 Field Spikes - A field spike is performed by introducing 200 µL of the Field Spike Standard into an impinger containing 200 mL of DNPH solution. Standard impinger recovery

procedures are followed and the field spike sample is returned to the laboratory for analysis. The field spike is used as a check on field handling and recovery procedures. An aliquot of the field spike standard is retained in the laboratory for derivatization and comparative analysis.

11.2.4 Matrix Spike Sample - In addition to those stack samples necessary for basic data needs, one complete sample (of the same time duration) must be collected for use as a matrix spike sample as described in Sec. 8.0 of Method 8315. This sample must be recovered and shipped in exactly the same manner as the other stack samples. Every effort should be made to ensure that this sample represents the average stack matrix of the sample batch. For example, the matrix spike sample should be taken the same day as the other samples in the group, if at all possible. If it is known or suspected that the stack gas matrix is varying widely during the overall sampling run, it is advisable to take more than one matrix spike sample and composite them.

11.2.5 DNPH Reagent Checks - An aliquot of the extracted DNPH reagent is prepared and analyzed according to the procedure in Sec. 5.4.3 to ensure that the background in the reagent is acceptable for field use.

12.0 METHOD PERFORMANCE

Method performance evaluation - The expected method performance parameters for precision, accuracy, and detection limits are provided in Table 3.

13.0 REFERENCES

1. 40 CFR Part 60, Appendix A, Test Methods.

2. Martin, R.M., "Construction Details of Isokinetic Source-Sampling Equipment", U.S. Environmental Protection Agency, Research Triangle Park, NC, Air Pollution Technical Document (APTD) 0581, April 1971.

3. Rom, J.J., "Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment", U.S. Environmental Protection Agency, Research Triangle Park, NC, Air Pollution Technical Document (APTD) 0576, March 1972.

4. Annual Book of ASTM Standards. Part 26. Gaseous Fuels; Coal and Coke; Atmospheric Analysis. American Society for Testing and Materials (ASTM), Philadelphia, PA, 1974, pp. 617-622.

TABLE 1

APPROXIMATE AMOUNT OF CRYSTALLINE DNPH USED TO PREPARE A SATURATED SOLUTION

Amount of Moisture in DNPH	Weight Required per 8 L of Solution
10 weight percent	36 g
15 weight percent	38 g
30 weight percent	46 g

TABLE 2

OPTIMUM STACK DETECTION LIMITS[a] AND REAGENT SAMPLING CAPACITY[b] FOR FORMALDEHYDE ANALYSIS

Analyte	CAS No.	Detection Limit[a] (ppbv)	Reagent Capacity	
			ppmv	mg/m^3
Formaldehyde	50-00-0	36	7.5	9
Acetaldehyde	75-07-0	34	7.5	14
Acetone	67-64-1	30	7.5	17
Propionaldehyde	123-38-6	30	7.5	17
Butyraldehyde	123-72-8	30	7.5	21
Valeraldehyde	110-62-3	30	7.5	25
Isovaleraldehyde	590-86-3	28	7.5	25
Hexaldehyde	66-25-1	26	7.5	30
Benzaldehyde	100-52-7	28	7.5	33
Acetophenone	98-86-2	28	7.5	37
o-Tolualdehyde	529-20-4	26	7.5	37
m-Tolualdehyde	620-23-5	26	7.5	37
p-Tolualdehyde	104-87-0	26	7.5	37
2,5-Dimethylbenzaldehyde	5779-94-2	24	7.5	41
Isophorone	78-59-1	24	7.5	42

[a]Detection limits are determined based on 400 mL of reagent and 10 times the instrument detection limit using hydrazones in solvent, and therefore, represent the optimum capability of the method.

[b]Based on 400 mL of reagent, a reagent concentration of 10 mM DNPH, a 1.3 cubic meter sample size and a safety factor of 10.

TABLE 3

EXPECTED METHOD PERFORMANCE BASED ON DUAL TRAINS

Compound	Precision (%RPD)[1]	Accuracy (%)[2]	Detection Limit (ppbv)[3]
Formaldehyde	±21	±10	±90
Acetaldehyde	±17	±21	±40
Propionaldehyde	±49	±23	±60
Acetophenone	±44	±10	±10
Isophorone	±9	±8	±10

[1] Relative percent difference limit for dual trains.
[2] Limit for field spike recoveries.
[3] The lower reporting limit having less than 1% probability of false positive detection.

FIGURE 1
SAMPLING TRAIN FOR ALDEHYDES AND KETONES

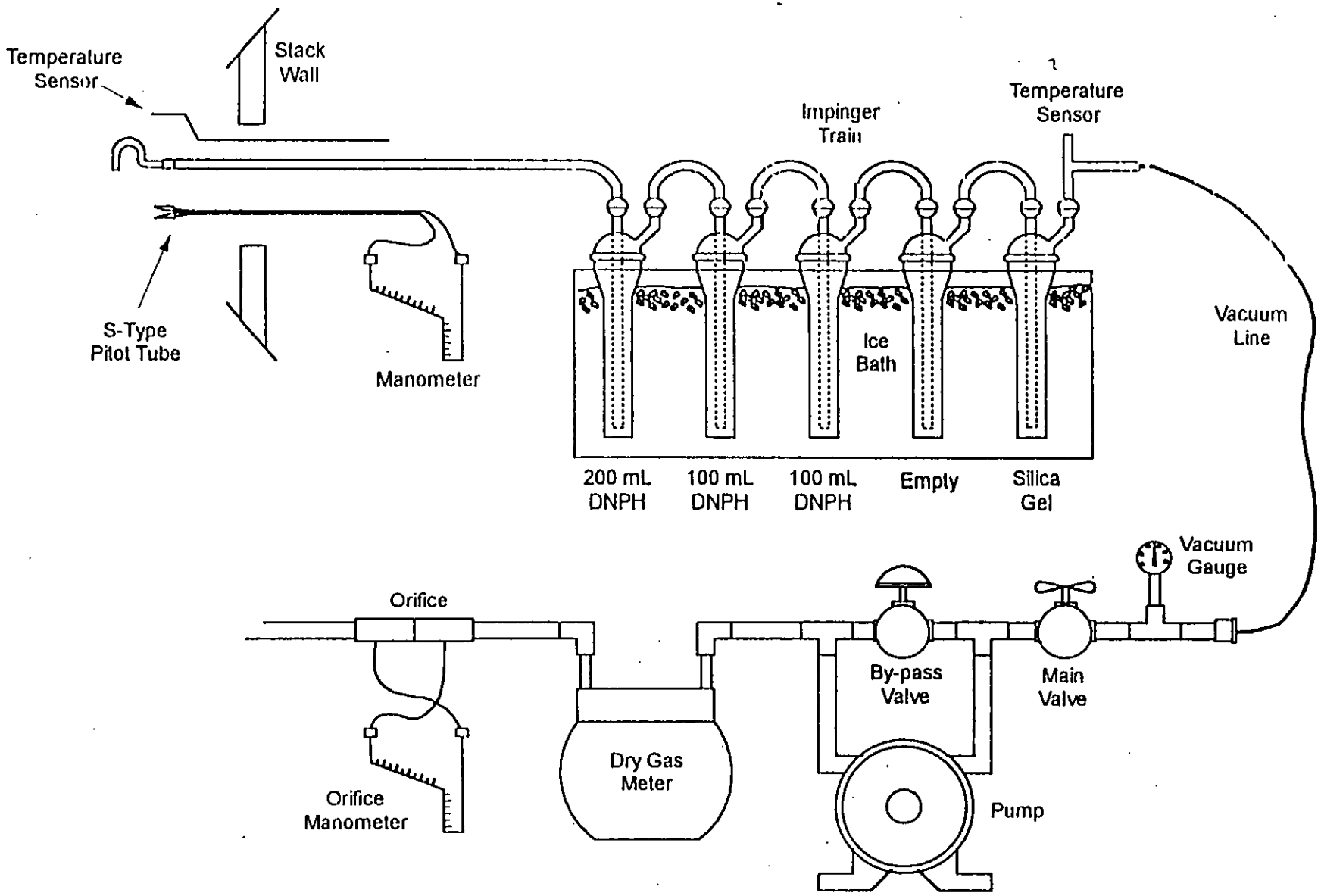


FIGURE 2
FIELD SAMPLING DATA FORM

Plant _____

Location _____

Operator _____

Date _____

Run Number _____

Sample Box No. _____

Meter Box No. _____

Meter H@ _____

C Factor _____

Pitot Tube Coefficient C_p _____

Schematic of Stack Cross Section

Ambient Temperature _____

Barometric Pressure _____

Assumed Moisture % _____

Probe Length _____ m (ft)

Nozzle Ident. No. _____

Average Calibrated Nozzle Diameter _____ cm (in)

Probe Heating Setting _____

Leak Rate _____ m^3/min (cfm)

Probe Liner Material _____

Static Pressure _____ mm Hg (in.Hg)

Filter No. _____

Traverse Point Number	Sampling Time (Min.)	Vacuum mm Hg (in. Hg)	Stack Temperature (T_s) °C (°F)	Velocity head (ΔP) mm (in) H_2O	Pressure Differential Across Orifice Meter mm (H_2O) (in. H_2O)	Gas Sample Volume m^3 (ft^3)	Gas Sample Temp. at Dry Gas Meter		Filter Holder Temp. °C (°F)	Temp. of Gas Leaving Last Impinger °C (°F)
							Inlet °C (°F)	Outlet °C (°F)		
Total							Avg	Ave		
Average										

APPENDIX A

ADDITION OF A FILTER TO THE FORMALDEHYDE SAMPLING TRAIN

As a check on the survival of particulate material through the impinger system, a filter can be added to the impinger train either after the second impinger or after the third impinger. Since the impingers are in an ice bath, there is no reason to heat the filter at this point.

Any suitable medium (e.g., paper, organic membrane) may be used for the filter if the material conforms to the following specifications:

1) The filter has at least 95% collection efficiency (<5% penetration) for 3 µm dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM standard method D2986-71. Test data from the supplier's quality control program are sufficient for this purpose.

2) The filter has a low aldehyde blank value (<0.015 mg formaldehyde/cm^2 of filter area). Before the test series, determine the average formaldehyde blank value of at least three filters (from the lot to be used for sampling) using the applicable analytical procedures.

Recover the exposed filter into a separate clean container and return the container over ice to the laboratory for analysis. If the filter is being analyzed for formaldehyde, the filter may be recovered into a container or DNPH reagent for shipment back to the laboratory. If the filter is being examined for the presence of particulate material, the filter may be recovered into a clean dry container and returned to the laboratory.

APPENDIX K

CALCULATION EQUATIONS

METHOD 2
CALCULATION EQUATIONS

$$\overline{V_s} = 85.49\ C_p\ (\sqrt{\Delta p})_{avg}\ \sqrt{\frac{T_{s(avg)}}{P_s\ M_s}}$$

$$Q_{s,\,d} = 60\ (1 - B_{ws})\ \overline{V_s}\ A\ (\frac{528}{T_{s\ (avg)}})\ (\frac{P_s}{29.92})$$

$$Q_a = 60\ \overline{V_s}\ A$$

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

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

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

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

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

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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, °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 °R (68 °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

METHOD 3
CALCULATION EQUATIONS

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

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

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

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

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METHOD 5
CALCULATION EQUATIONS

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

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

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

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

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

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

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

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

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

CALCULATION OF (GR/DSCF) AND
(LB/HR) FROM (PPM,D)

$$ppm = \frac{uL}{L} = \frac{mL}{m^3}$$

$$\frac{LB}{DSCF} = \frac{uL}{L} \times \frac{28.316\ L}{DSCF} \times \frac{M\ (ug)}{24.054\ uL} \times \frac{g}{10^6 ug} \times \frac{LB}{453.6\ g}$$

OR,

$$\frac{LB}{DSCF} = 2.595 \times 10^{-9}\ M\ (ppm,d)$$

where M = Molecular weight of compound.

Then,

$$\frac{LB}{HR} = \frac{LB}{DSCF} \times \frac{DSCF}{MIN} \times \frac{60\ MIN}{HR}$$

Calculation Of Emission Factors From (GR/DSCF) And (PPM, D)

$$E = [\frac{DSCF}{10_6\ BTU}]\ [\frac{LB}{DSCF}]\ [\frac{20.9}{20.9\ -\ O_2}]$$

$$C_s^{LB}\ (\frac{LB}{DSCF}) = [\frac{GR}{DSCF}]\ x\ \frac{LB}{7000\ GR}$$

$$E = F_d\ \frac{20.9}{7000}\ x\ \frac{GR}{DSCF}\ x\ \frac{1}{20.9\ -\ O_2}$$

$$= \frac{2.9857\ x\ 10^{-3}\ F_d\ (GR/DSCF)}{20.9\ -\ O_2}$$

$$PPM = \frac{\mu L}{L} = \frac{mL}{m^3}$$

$$[\frac{LB}{DSCF}] = (\frac{\mu L}{L})\ x\ \frac{28.316\ L}{DSCF}\ x\ \frac{M(ug)}{24.054\ \mu L}\ x\ \frac{g}{10^6\ \mu g}\ x\ \frac{LB}{453.6\ g}$$

$$[\frac{LB}{DSCF}] = 2.595\ x\ 10^{-9}\ M\ (PPM,\ d)$$

Substitution Gives:

$$E = F_d\ (2.595\ x\ 10^{-9})\ M\ (PPM,\ D)\ x\ \frac{20.9}{20.9\ -\ O_2}$$

$$E = \frac{5.424\ x\ 10^{-8}\ MF_d\ (C_{ppm,\ d})}{20.9\ -\ O_2}$$

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APPENDIX L

SAMPLING TRAIN CALIBRATION DATA

Meter Calibration Sheet EPA/Method 5

Date 8/31/99
Bar. Press 29.00 IN.HG
Wet Test Meter No. AL-20

Control Module No. 5
Serial No. DTM 949230
Technician D. Van Hoever

ΔH (IN.WC.) Nominal	ΔH (IN.WC.) Actual	Gas Volume Wet Test Meter (ft³)	* Cal Index * (%)	* Diff Wet Test Meter ΔP_w (IN.WC.)	Gas Volume Dry Test Meter (ft³) V_{df}	Gas Volume Dry Test Meter (ft³) V_{di}	Gas Temperatures Wet Test T_w (°F)	Gas Temperatures Dry Test t_{df} (°F)	Gas Temperatures Dry Test t_{di} (°F)	Time (Min/Sec)	Meter Coeff. Y	Orifice Const. ΔH@	C_i
0.5	.5	~~2~~ 3	99.6	0.01	232.165	235.25	72.9	95	83	7:36	.9965	1.83	
1.2	1.2	3	99.8	0.025	228.565	231.65	72.8	98	82	4:58	9987	1.86	
2	2.0	3	100.00	0.055	219.40	222.47	72.6	99	81	3:53	1.0038	1.89	
3.3	3.8	5	100.00	0.09	236.275	241.36	72.9	100	83	5:03	1.0088	1.89	
1	2	3	4	5	6	7	8	9	10	11	12		
										Avg		10020	1.87

Positive leak check performed by [signature]

Meter was in tolerance ☒

Approved by [signature]

Meter was not in tolerance ☐: readjusted linkage

Meter was not in tolerance ☐:changed dry test meter

Date 9/3/99

*Based on AL-20 wet test meter calibration in April 1997 against Bell Prover (NBS Traceable) - Carl Poe Co.

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: November 22, 1999

Meter Box No. : 5 (Rockwell Dry Test Meter Serial No. 949230)

Date of Last Calibration: August 31, 1999
Calibration Technician: D. Van Hoever
Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
October 7-8, 1999	9-13597	243.00	568.00	325.00	325.00

* Total volume through meter since last calibration.

INTERPOLL LABORATORIES, INC.
(612) 786-6020

EPA Method 5 Gas Metering System Quality Control Check Data Sheet

Job Mathy 46 / Danbury, WI Date 10-7-99
Operator M. Koehler Module No. 5

Instructions:
Operate the control module at a flow rate equal to ΔH@ for 10 minutes before attaching the umbilical.

Record the following data:

Bar press 28.05 in.Hg θ = 1.0020 ΔH@ 1.07 in.WC.

Time (min)	Volume (CF)	Meter Temp (°F)	
		Inlet	Outlet
	(243.00)		
2.5	244.77	54	51
5.0	246.60	56	51
7.5	248.47	57	52
10	250.28	58	52
	V_m = 7.28	Avg(t_m) = 53.88	°F

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(1.0020)\ (7.28)}\ \left[\frac{(53.88) + 460}{(28.05)}\right]^{0.5}$$

Y_{cn} = 1.03

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

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

Interpoll Laboratories, Inc.
(612) 786-6020

S-Type Pitot Tube Inspection Sheet

Pitot Tube No. 31-4

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .46 IN.
3. Base to Side B opening plane (P_B) .46 IN.

Alignment:

4. α_1 < 10° 0
5. α_2 < 10° 0

6. B_1 < 5° 1
7. B_2 < 5° 4

8. Z <.125" .045
9. W <.0625" 0

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .760 IN.
11. Pitot to probe sheath 3.0 IN.
12. Pitot to thermocouple (parallel to probe) 3.0 IN.
13. Pitot to thermocouple (perpendicular to probe) NA IN.

☒ Meets all EPA design criteria thus C_p = 0.84
☐ Does not meet EPA design criteria - thus calibrate in wind tunnel.
C_p = _____

Date of Inspection: 4/2/99

Inspected by: [signature]

CFR Title 40 Part 60 Appendix A Method 2

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 12-30-95
Technician Mark Bachelor
Mercury Column Barometer No. LAB 1
Aneroid Barometer No. 21029604

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjusted Mercury Barometer Read	Initial Aneroid Barometer Read	Difference (P_{ba} - P_{bm})
29.27	65	.098	29.172	29.15	.022

Has this barometer shown any consistent problems with calibration? Yes (No) If yes, explain. _____

Has problem been alleviated? Yes/No. How? _____

Note: Aneroid barometers will be calibrated periodically against a mercury column barometer. The aneroid barometer to be calibrated should be placed in close proximity to the mercury barometer and left to equilibrate for 20 - 30 minutes before calibrating. Aneroid barometer will be calibrated to the adjusted mercury barometer readings.

INTERPOLL LABORATORIES, INC.
(612) 786-6020

Temperature Measurement Device Calibration Sheet

Unit Under Test:
Vendor: Omega
Model: HH 21
Range: 0-2100 °F
Date of Calibration: 12-30-95
Serial Number: 73JX1495
Thermocouple Type: K
Technician: Mark Gardner
PDT No. 31

Method of Calibration:

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

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

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation	
			Δt (°F)	(%)
0		-5	5	1.09
100		96	4	.71
200		198	2	.30
300		296	4	.53
400		395	5	.58
500		496	4	.42
600		597	3	.28
700		696	4	.34
800		798	2	.16
900		897	3	.22
1000		997	3	.21
1100		1096	4	.26
1200		1197	3	.18
1300		1295	5	.28
1400		1398	2	.11
1500		1496	4	.20
1600		1599	1	.05
1700		1696	4	.19
1800		1798	2	.09
1900		1895	5	.21
2000		1996	4	.16
2100		2093	7	.27
		Averages:	3.64	0.31

OF = off scale response by unit under test (°F)
☐ Unit in tolerance

% dev = 100 Δt/(460 + t)
☐ Unit was not in tolerance: recalibrated - See new calibration sheet.

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INTERPOLL LABORATORIES, INC.
(612) 786-6020

Temperature Measurement Device Calibration Sheet

Unit Under Test:
Vendor: Omega
Model: HH81
Range: 0-2100 °F
Date of Calibration: 12-30-95
Serial Number: 785X0796
Thermocouple Type: K
Technician: Mark Goehler
PDT No.: 67

Method of Calibration:

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

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

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation at (°F)	Deviation (%)
0		-3	3	.65
100		98	2	.36
200		200	0	.00
300		298	2	.26
400		397	3	.35
500		498	2	.21
600		599	1	.09
700		699	1	.09
800		801	1	.08
900		900	0	.00
1000		999	1	.07
1100		1098	2	.13
1200		1201	1	.06
1300		1298	2	.11
1400		1401	1	.05
1500		1499	1	.05
1600		1602	2	.10
1700		1700	0	.00
1800		1802	2	.09
1900		1899	1	.04
2000		2000	0	.00
2100		2098	2	.05
		Averages:	1.36	0.13

OF = off scale response by unit under test (°F)
☐ Unit in tolerance

% dev = 100 at/(460 + t)
☐ Unit was not in tolerance - recalibrated - See new calibration sheet.

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Interpoll Laboratories
(612) 786-6020

Nozzle Calibration Data Sheet

Date: 10/7/99
Technician: M.Kaehler
Nozzle Number: 1-4

The nozzle is rotated in 60 degree increments and the diameter at each point is measured to the nearest 0.001 inch. The observed readings and average are shown below.

Position	Diameter (inches)
1	0.252
2	0.251
3	0.252
Average	0.252

Interpoll Laboratories
(612) 786-6020

Nozzle Calibration Data Sheet

Date: 10/7/99
Technician: M.Kaehler
Nozzle Number: Glass

The nozzle is rotated in 60 degree increments and the diameter at each point is measured to the nearest 0.001 inch. The observed readings and average are shown below.

Position	Diameter (inches)
1	0.252
2	0.254
3	0.252
Average	0.253