

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.

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

TEL: (612) 786-6020
FAX: (612) 786-7854

**RESULTS OF THE MARCH 29 - 31, 1994
AIR EMISSION COMPLIANCE TESTS
AT THE LOUISIANA PACIFIC OSB
PLANT IN MONTROSE, COLORADO**

Submitted to:

LOUISIANA PACIFIC CORPORATION
Route 8, Box 8263
Hayward, Wisconsin 54843

Attention:

Sue Somers

Approved by:



Daniel J. Despen
Manager
Stationary Source Testing Department

Report Number 4-2558
April 21, 1994
SP/slp

#41
4-70

TABLE OF CONTENTS

	ABBREVIATIONS	iii
1	INTRODUCTION	1
2	SUMMARY AND DISCUSSION	4
3	RESULTS	13
	3.1 Results of Orsat and Moisture Determinations	14
	3.2 Results of Particulate Determinations	20
	3.3 Results of Carbon Monoxide Determinations	23
	3.4 Results of Formaldehyde Determinations	25
	3.5 Results of MDI Determinations	28
4	RESULTS OF FUEL ANALYSIS	30

APPENDICES:

- A - Volumetric Flow Rate Determinations
- B - Location of Test Ports
- C - Press Vent Field Data Sheets
- D - Dryer Field Data Sheets
- E - Interpoll Laboratories Analytical Results
- F - THC and CO Stripcharts
- G - Analyzer Specifications
- H - Measurement Systems Performance Specifications
- I - Calibration Gas Certification Sheets
- J - Process Rate Information
- K - Procedures
- L - Calculation Equations
- M - 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 ⁶ BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
LTPD	long tons per day
MW	megawatt
mg/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.

1 INTRODUCTION

During the Period March 29 - 31, 1994 Interpoll Laboratories personnel conducted air emission compliance tests on the Dryer Stack and the Press and Unloader Vent at the Louisiana Pacific Corporation (LP) OSB Plant located in Montrose, Colorado. On-site testing was performed by D. Van Hoever, K. Rosenthal, and M. Kaehler. Coordination between testing activities and plant operation was provided by Sue Somers of LP. The test was witnessed by Charles D. Cox of the Colorado Department of Health, Air Pollution Control Division.

The Wafer Dryer tested is a Model 1260 TNW/L dryer manufactured by MEC Company. It is equipped with a pneumatic injection system for firing wood fines and has a design heat input capacity of 40 10^6 BTU/HR. Particulate emissions from the Wafer Dryer are controlled by a primary cyclone followed by a secondary multicyclone also manufactured by MEC Company in series with an E-Tube wet electrostatic precipitator manufactured by Geoenergy, Inc. Cleaned flue gas is emitted to the atmosphere by a 103-foot high radial steel stack which has a diameter of 48 inches.

The press vents tested are the exhaust from general ventilators positioned over the board press and unloader. The press and unloader vent exhausts are emitted to the atmosphere via a common stack which has a diameter of 4'-11.5".

Particulate evaluations were performed in accordance with EPA Methods 2-5, CFR Title 40, Part 60, Appendix A (revised July 1, 1992). A preliminary determination of the gas linear velocity profile was made at each test location before the first particulate determination to allow selection of the appropriate nozzle diameter for isokinetic sample withdrawal. An Interpoll Labs sampling train which meets or exceeds specifications in the above-cited reference was used to isokinetically extract particulate samples by means of a heated glass-lined probe. Wet catch samples were collected in the back half of the Method 5 sampling train and analyzed in accordance with EPA Method 202.

Carbon monoxide determinations were performed in accordance with Method 10. A slip stream of sample gas was withdrawn from the exhaust gas stream using a heated stainless steel probe equipped with a filter to remove interfering particulate material. The

particulate-free gas was transported to the analyzers by means of a heat-traced probe and filter assembly. After passing through the filter, the gas passed through a chilled condenser-type moisture removal system. The particulate-free dry gas was then transported to the analyzers 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 analyzers. A three-way valve on the probe was used to introduce standard gas for the "system bias check".

The analog response of the carbon monoxide analyzer was recorded with a strip chart recorder. The analyzer was calibrated with Scott Specialty, National Specialty, and Linde Gases (EPA Protocol 1) and Certified Master standard gases. The instrument was calibrated before and after each run as per EPA Method 10. The sample probe was moved through a three-point traverse (1/6, 3/6, 5/6 of the stack diameter) to measure carbon monoxide concentrations.

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.

Total gaseous hydrocarbon concentrations were determined instrumentally using a Ratfisch Model RS55 heated flame ionization detector (HFID) calibrated against propane in air standards. The THC concentration was continuously monitored by extracting a slipstream of exhaust gas by means of a heated probe and filter holder. A heat-traced teflon line was used to transport the sample gas from the filter holder outlet to the analyzer inlet.

MDI concentrations were determined in accordance with the 1,2-PP Method as developed by Radian Corporation under contract to USEPA. This method employs collection of MDI samples in 1,2-PP in toluene, with analysis by HPLC.

Integrated flue gas samples were extracted simultaneously with each of the above-referenced sampling trains at the dryer test site 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

checked at 15 IN.HG. vacuum with an in-line rotameter. Bags with any detectable inleakage are discarded.

Testing on the Dryer was conducted from two test ports oriented at 90 degrees on the stack. These test ports are located 3.4 stack diameters downstream of the nearest flow disturbance and 10.5 stack diameters upstream of the stack exit. A 24-point traverse was used to collect the particulate and formaldehyde samples. Each traverse point was sampled 2.5 minutes for the particulate sampling for a total of 60 minutes per run and 3 minutes per point for the formaldehyde sampling to give a total sampling time of 72 minutes per run.

All of the testing on the Press Vent was conducted from two test ports oriented at 90 degrees on the stack. These test ports are located 3.2 diameters downstream of the nearest flow disturbance and 2.3 diameters upstream of the stack exit. A 24-point traverse was used to collect the particulate, formaldehyde and MDI samples. Each traverse point was sampled 2.5 minutes for a total sampling time of 60 minutes per run. Runs 2 & 3 of the formaldehyde test, each traverse point was sampled 3 minutes for a total sampling time of 72 minutes per run.

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

2 SUMMARY AND DISCUSSION

The important results of the particulate emission compliance test are summarized in Tables 1 and 2. The particulate results have been calculated using the dry catch only ("a" Table) and again with the dry plus wet catch ("b" Table). As will be noted, the particulate emission rate averaged 5.57 LB/HR for the Dryer (dry catch only) and 2.64 LB/HR for the Press and Unloader Vent (dry catch only).

The carbon monoxide results are summarized in Table 3. The emission rate averaged 29.3 LB/HR for the Dryer. The carbon monoxide concentration at the dryer inlet averaged 55 ppm,d. A summary of the formaldehyde results are presented in Table 4. The formaldehyde emission rate averaged 3.75 LB/HR for the Dryer and 0.72 LB/HR for the Press and Unloader Vent.

The results of the Total Hydrocarbons tests are summarized in Table 5. The total hydrocarbon emission rate averaged 18.7 LB/HR for the Dryer 2.18 LB/HR for the Press Vent and Unloader Vent.

A summary of the MDI results for the Press and Unloader Vent are presented in Table 6. The MDI emission rate averaged 0.0122 LB/HR.

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.

Table 1a Summary of the Results of the March 30, 1994 Particulate Emission Compliance Test on the Dryer Stack at the Louisiana Pacific Corporation Plant Located in Montrose, Colorado.

ITEM	Run 1	Run 2	Run 3
Date of test	03-30-94	03-30-94	03-30-94
Time runs were done (HRS)	1402/1514	1617/1721	1755/1858
Process rate (TON/HR)	10.5	10.5	10.5
Volumetric flow actual (ACFM)	62230	62208	61794
standard (DSCFM)	40156	37686	38255
Gas temperature (DEG-F)	125	134	131
Moisture content (%V/V)	15.55	19.50	18.18
Gas composition (%V/V, dry)			
carbon dioxide	2.30	2.70	2.80
oxygen	18.60	18.20	18.10
nitrogen	79.10	79.10	79.10
Isokinetic variation (%)	100.7	99.9	100.0
Particulate concentration actual (GR/ACF)	.0130	.00917	.00922
standard (GR/DSCF)	.0201	.0151	.0149
Part. emission rate (LB/HR)	6.93	4.89	4.89
Part emission Factor (LB/TON FP)	0.66	0.47	0.47

Note: Dry Catch Only

62077
38699

5.57

Table 1b. Summary of the Results of the March 30, 1994 Particulate Emission Compliance Test on the Dryer Stack at the Louisiana Pacific Corporation Plant Located in Montrose, Colorado.

ITEM	Run 1	Run 2	Run 3
Date of test	03-30-94	03-30-94	03-30-94
Time runs were done (HRS)	1402/1514	1617/1721	1755/1858
Process rate (TON/HR)	10.5	10.5	10.5
Volumetric flow actual (ACFM)	62230	62208	61794
standard (DSCFM)	40156	37686	38255
Gas temperature (DEG-F)	125	134	131
Moisture content (%V/V)	15.55	19.50	18.18
Gas composition (%V/V, dry)			
carbon dioxide	2.30	2.70	2.80
oxygen	18.60	18.20	18.10
nitrogen	79.10	79.10	79.10
Isokinetic variation (%)	100.7	99.9	100.0
Particulate concentration actual (GR/ACF)	.0180	.0146	.0149
standard (GR/DSCF)	.0280	.0240	.0240
Part. emission rate (LB/HR)	9.62	7.77	7.88
Part emission factor (LB/TON FP)	0.92	0.74	0.75

842

Note: Dry + Method 202 Condensible Particulate Material

Table 2a Summary of the Results of the March 31, 1994 Particulate Emission Compliance Test on the Press & Unloading Vent Stack at the Louisiana Pacific Corporation Plant Located in Montrose, Colorado.

ITEM	Run 1	Run 2	Run 3
Date of test	03-31-94	03-31-94	03-31-94
Time runs were done (HRS)	922/1025	1119/1227	1317/1425
Process rate (TON/HR)	11.4	11.4	11.4
Volumetric flow actual (ACFM)	89858	89258	89991
standard (DSCFM)	73755	72829	72517
Gas temperature (DEG-F)	73	79	82
Moisture content (%V/V)	0.99	0.56	1.22
Gas composition (%V/V, dry)			
carbon dioxide	0.03	0.03	0.03
oxygen	20.90	20.90	20.90
nitrogen	79.07	79.07	79.07
Isokinetic variation (%)	99.8	99.4	100.1
Particulate concentration actual (GR/ACF)	.00415	.00269	.00345
standard (GR/DSCF)	.00505	.00329	.00428
Part. emission rate (LB/HR)	3.20	2.06	2.66
Part emission factor (LB/TON FP)	0.28	0.18	0.23

Note: Dry Catch Only

Table 2b Summary of the Results of the March 31, 1994 Particulate Emission Compliance Test on the Press & Unloading Vent Stack at the Louisiana Pacific Corporation Plant Located in Montrose, Colorado.

ITEM	Run 1	Run 2	Run 3
Date of test	03-31-94	03-31-94	03-31-94
Time runs were done (HRS)	922/1025	1119/1227	1317/1425
Process rate (TON/HR)	11.4	11.4	11.4
Volumetric flow actual (ACFM) standard (DSCFM)	89858 73755	89258 72829	89991 72517
Gas temperature (DEG-F)	73	79	82
Moisture content (%V/V)	0.99	0.56	1.22
Gas composition (%V/V, dry) carbon dioxide oxygen nitrogen	0.03 20.90 79.07	0.03 20.90 79.07	0.03 20.90 79.07
Isokinetic variation (%)	99.8	99.4	100.1
Particulate concentration actual (GR/ACF) standard (GR/DSCF)	.00730 .00890	.00419 .00514	.00612 .00760
Part. emission rate (LB/HR)	5.63	3.21	4.72
Part emission factor (LB/TON FP)	0.49	0.28	0.41

Note: Dry + Method 202 Condensible Particulate Material

Table 3. Summary of the March 30, 1994 **Carbon Monoxide** Emission Compliance Tests at the Louisiana Pacific OSB Plant in Montrose, Colorado.

Date	Time (HRS)	Concentration (ppm,d)	Emission Rate	
			(LB/HR)	(LB/TFP)
(Dryer Stack)				
3-30-94	1430-1535	103	18.1	1.73
3-30-94	1617-1722	155	25.5	2.44
3-30-94	1756-1900	265	44.2	4.23
Avg.		174	29.3	2.80
(Dryer Inlet)				
3-30-94	1430-1535	57	N/A	N/A
3-30-94	1617-1722	59	N/A	N/A
3-30-94	1756-1900	50	N/A	N/A
Avg.		55	N/A	N/A

TFP = Ton Finished Product (10.45 TON/HR 3-30-94)

Table 4. Summary of the March 29 - 31, 1994 **Formaldehyde** Emission Compliance Tests at the Louisiana Pacific OSB Plant in Montrose, Colorado.

Date	Time (HRS)	Concentration (ppm,d)	Emission Rate	
			(LB/HR)	(LB/TFP)
(Dryer Stack)				
3-29-94	0953-1107	18	3.18	0.291
3-30-94	0912-1139	25	4.54	0.434
3-30-94	1211-1325	20	3.52	0.337
Avg.		21	3.75	0.354
(Press & Unloading Vent Stack)				
3-31-94	0923-1027	3.1	1.08	0.099
3-31-94	1121-1233	1.8	0.60	0.057
3-31-94	1317-1429	1.4	0.49	0.047
Avg.		2.1	0.72	0.068

TFP = Ton Finished Product (10.92 TON/HR 3-29-94, 10.45 TON/HR 3-30-94)

Table 5. Summary of the March 30 & 31, 1994 **Total Hydrocarbon** Emission Compliance Tests at the Louisiana Pacific OSB Plant in Montrose, Colorado.

Date	Time (HRS)	Concentration (ppmC,w)	Emission Rate	
			(LB/HR)	(LB/TFP)
(Dryer Stack)				
3-30-94	1223-1326	305	26.4	2.53
3-30-94	1430-1535	151	13.9	1.33
3-30-94	1617-1722	183	15.8	1.51
Avg.		213	18.7	1.79
(Press & Unloading Vent Stack)				
3-31-94	0923-1027	17.3	2.41	0.21
3-31-94	1121-1233	14.8	2.03	0.18
3-31-94	1317-1429	15.3	2.10	0.18
Avg.		15.8	2.18	0.19

TFP = Ton Finished Product (10.45 TON/HR 3-30-94, 11.43 TON/HR 3-31-94)

Table 6. Summary of the March 31, 1994 **MDI** Emission Compliance Tests at the Louisiana Pacific OSB Plant in Montrose, Colorado.

Date	Time (HRS)	Concentration (ppm,d)	Emission Rate	
			(LB/HR)	(LB/TFP)
(Dryer Stack)				
3-31-94	1726-1831	0.004	0.0125	0.0011
3-31-94	1919-2023	0.004	0.0121	0.0107
3-31-94	2106-2208	0.004	0.0121	0.0107
Avg.		0.004	0.0122	0.0075

TFP = Ton Finished Product (11.27 TON/HR 3-31-94)

3 RESULTS

The results of all field and laboratory evaluations are presented in this section. Gas composition (orsat and moisture) are presented first followed by the computer printout of the particulate, carbon monoxide, formaldehyde and MDI 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. 1
Dryer Stack

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

Formaldehyde, THC

	Run 1	Run 2	THC Run 3
Date of run	03-29-94	03-30-94	03-30-94

Dry basis (orsat)

carbon dioxide.....	3.00	2.90	3.20
oxygen.....	17.60	17.70	17.40
nitrogen.....	79.40	79.40	79.40

Wet basis (orsat)

carbon dioxide.....	2.43	2.39	2.57
oxygen.....	14.23	14.59	13.96
nitrogen.....	64.19	65.44	63.70
water vapor.....	19.15*	17.58*	19.77*

Dry molecular weight.....	29.18	29.17	29.21
Wet molecular weight.....	27.04	27.21	26.99
Specific gravity.....	0.934	0.940	0.932
Water mass flow.....(LB/HR)	0.00	0.00	0.00

* Free or condensed water in the gas stream.

FO	1.100	1.103	1.094
----	-------	-------	-------

Test No. 2
Dryer Stack

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

PM, CO, THC

	THC	THC	
	Run 1	Run 2	Run 3
Date of run	03-30-94	03-30-94	03-30-94

Dry basis (orsat)

carbon dioxide.....	2.30	2.70	2.80
oxygen.....	18.60	18.20	18.10
nitrogen.....	79.10	79.10	79.10

Wet basis (orsat)

carbon dioxide.....	1.94	2.17	2.29
oxygen.....	15.71	14.65	14.81
nitrogen.....	66.80	63.67	64.72
water vapor.....	15.55*	19.50	18.18*

Dry molecular weight.....	29.11	29.16	29.17
Wet molecular weight.....	27.38	26.98	27.14
Specific gravity.....	0.946	0.932	0.938
Water mass flow.....(LB/HR)	22664	25614	26607

* Free or condensed water in the gas stream.

FO	1.000	1.000	1.000
----	-------	-------	-------

Test No. 5
Press & Unloading Vent Stack

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

Date of run Run 1 Run 2 Run 3
03-31-94 03-31-94 03-31-94

Dry basis (orsat)

carbon dioxide.....	0.03	0.03	0.03
oxygen.....	20.90	20.90	20.90
nitrogen.....	79.07	79.07	79.07

Wet basis (orsat)

carbon dioxide.....	0.03	0.03	0.03
oxygen.....	20.69	20.78	20.64
nitrogen.....	78.29	78.63	78.10
water vapor.....	0.99	0.56	1.22
Dry molecular weight.....	28.84	28.84	28.84
Wet molecular weight.....	28.73	28.78	28.71
Specific gravity.....	0.993	0.994	0.992
Water mass flow.....(LB/HR)	2069	1155	2522

Test No. 6
Press & Unloading Vent Stack

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

Formaldehyde,
THC

Date of run	Run 1 03-31-94	Run 2 03-31-94	Run 3 03-31-94
-------------	-------------------	-------------------	-------------------

Dry basis (orsat)

carbon dioxide.....	0.03	0.03	0.03
oxygen.....	20.90	20.90	20.90
nitrogen.....	79.07	79.07	79.07

Wet basis (orsat)

carbon dioxide.....	0.03	0.03	0.03
oxygen.....	20.68	20.81	20.71
nitrogen.....	78.23	78.72	78.37
water vapor.....	1.07	0.45	0.89
Dry molecular weight.....	28.84	28.84	28.84
Wet molecular weight.....	28.73	28.79	28.74
Specific gravity.....	0.992	0.995	0.993
Water mass flow.....(LB/HR)	0.00	0.00	0.00

Test No. 8
Press & Unloading Vent Stack

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

MDI

	Run 1	Run 2	Run 3
Date of run	03-31-94	03-31-94	03-31-94

Dry basis (orsat)

carbon dioxide.....	0.03	0.03	0.03
oxygen.....	20.90	20.90	20.90
nitrogen.....	79.07	79.07	79.07

Wet basis (orsat)

carbon dioxide.....	0.03	0.03	0.03
oxygen.....	20.75	20.69	20.75
nitrogen.....	78.50	78.26	78.50
water vapor.....	0.72	1.03	0.72

Dry molecular weight.....	28.84	28.84	28.84
Wet molecular weight.....	28.76	28.73	28.76
Specific gravity.....	0.994	0.992	0.994
Water mass flow.....(LB/HR)	0.00	0.00	0.00

3.2 Results of Particulate Determinations

Test No. 2
Dryer Stack

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

	Run 1 03-30-94	Run 2 03-30-94	Run 3 03-30-94
Date of run			
Time run start/end.....(HRS)	1402/1514	1617/1721	1755/1858
Static pressure.....(IN.WC)	0.32	0.32	0.32
Cross sectional area (SQ.FT)	12.44	12.44	12.44
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	148.0	164.0	171.0
desiccant.....(GRAMS)	9.0	12.0	12.0
total.....(GRAMS)	157.0	176.0	183.0
Total particulate material..			
.....collected(grams)	0.0667	0.0534	0.0542
Gas meter coefficient.....	0.9946	0.9946	0.9946
Barometric pressure...(IN.HG)	25.30	25.30	25.30
Avg. orif.pres.drop...(IN.WC)	1.45	1.30	1.33
Avg. gas meter temp...(DEG-F)	64.5	73.4	70.0
Volume through gas meter....			
at meter conditions...(CF)	43.29	41.00	41.39
standard conditions.(DSCF)	36.79	34.25	34.80
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.186	.186	.186
Avg.stack gas temp ..(DEG-F)	125	134	131
Volumetric flow rate.....			
actual.....(ACFM)	62230	62208	61794
dry standard.....(DSCFM)	40156	37686	38255
Isokinetic variation.....(%)	100.7	99.9	100.0
Particulate concentration...			
actual.....(GR/ACF)	0.01804	0.01456	0.01487
dry standard.....(GR/DSCF)	0.02796	0.02404	0.02402
Particle mass rate...(LB/HR)	9.624	7.765	7.877

Test No. 5
Press & Unloading Vent Stack

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

	Run 1 03-31-94	Run 2 03-31-94	Run 3 03-31-94
Date of run			
Time run start/end.....(HRS)	922/1025	1119/1227	1317/1425
Static pressure.....(IN.WC)	-1.00	-1.00	-1.00
Cross sectional area (SQ.FT)	19.63	19.63	19.63
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	-5.0	-9.0	-6.0
desiccant.....(GRAMS)	14.0	14.0	17.0
total.....(GRAMS)	9.0	5.0	11.0
Total particulate material..			
.....collected(grams)	0.0245	0.0139	0.0206
Gas meter coefficient.....	0.9997	0.9997	0.9997
Barometric pressure..(IN.HG)	25.13	25.13	25.13
Avg. orif.pres.drop..(IN.WC)	2.06	2.05	2.09
Avg. gas meter temp..(DEF-F)	57.6	73.3	82.4
Volume through gas meter....			
at meter conditions...(CF)	49.26	49.89	50.89
standard conditions.(DSCF)	42.43	41.71	41.83
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.186	.186	.186
Avg.stack gas temp ..(DEG-F)	73	79	82
Volumetric flow rate.....			
actual.....(ACFM)	89858	89258	89991
dry standard.....(DSCFM)	73755	72829	72517
Isokinetic variation.....(%)	99.8	99.4	100.1
Particulate concentration...			
actual.....(GR/ACF)	0.00730	0.00419	0.00612
dry standard.....(GR/DSCF)	0.00890	0.00514	0.00760
Particle mass rate...(LB/HR)	5.627	3.209	4.722

OFFICIAL EMISSION TEST REPORT

for

Engineering Data

of

Wafer Dryer

for

Particulate

on

Dryer WESP Exhaust Stack

Louisiana-Pacific Corporation, Montrose, CO

Prepared for:

Louisiana-Pacific Corporation

Northern Division

Engineering

Rt. 8 Box 8263 Gehrts Rd.

Hayward, WI, 54843

Mr. Robert W. Schultz, Environmental Engineer

(715) 634-3454

Prepared by:

THE EMISSION MEASUREMENT GROUP, INC.

P.O. Box 4953, Englewood, CO 80155-4953

800-222-4187, 303-680-0406

Date of Report: June 9, 1995

3.3 Results of Carbon Monoxide Determinations

Test No. 3
Dryer Stack

Results of CO Determinations -----Method 10

	Run 1	Run 2	Run 3
Date of run	03-30-94	03-30-94	03-30-94
Time run start/end.....(HRS)	1430-1535	1617-1722	1756-1900
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	15.55	19.50	18.18
O2 Concentration.....(%V/V)	18.60	18.20	18.10
Volumetric flow rate (DSCFM)	40156	37686	38255
CO concentration.....			
(GR/DSCF).....	0.0524	0.0789	0.1348
(MG/DSCM).....	120.00	180.58	308.72
(PPM-WET).....	86.98	124.78	216.82
(PPM-DRY).....	103.00	155.00	265.00
(PPM-DRY @ 7% O2).....	600.83	775.00	%1279.31
CO emission rate.....(LB/HR)	18.039	25.476	44.214

CO = Carbon monoxide

A trailing '<' symbol indicates that the true value
is less than or equal to the reported value

3.4 Results of Formaldehyde Determinations

Test No. 1
Dryer Stack

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

	Run 1 03-29-94	Run 2 03-30-94	Run 3 03-30-94
Date of run			
Time run start/end.....(HRS)	953/1107	912/1139	1211/1325
Static pressure.....(IN.WC)	0.32	0.32	0.32
Cross sectional area (SQ.FT)	12.44	12.44	12.44
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	300.0	323.0	315.0
desiccant.....(GRAMS)	19.0	24.0	23.0
total.....(GRAMS)	319.0	347.0	338.0
Formaldehyde in sample..(uG)	37700	55000	42500
Gas meter coefficient.....	1.0029	0.9946	0.9946
Barometric pressure..(IN.HG)	25.02	25.30	25.30
Avg. orif.pres.drop..(IN.WC)	2.51	2.73	2.71
Avg. gas meter temp..(DEF-F)	59.2	42.6	64.1
Volume through gas meter....			
at meter conditions...(CF)	68.00	69.31	70.19
standard conditions.(DSCF)	58.40	61.70	59.92
Total sampling time....(MIN)	72.00	72.00	72.00
Nozzle diameter.....(IN)	.225	.225	.225
Avg.stack gas temp ..(DEG-F)	132	129	134
Volumetric flow rate.....			
actual.....(ACFM)	61379	61165	61629 6139
dry standard.....(DSCFM)	37035	38223	37212 374%
Isokinetic variation.....(%)	98.7	101.0	100.8
CH2O concentration.....			
(GR/DSCF).....	0.0100	0.0139	0.0110
(MG/DSCM).....	22.97	31.74	25.26
(PPM-DRY).....	18.40	25.42	20.23
(PPM-WET).....	15.16	20.92	16.71
CH2O emission rate...(LB/HR)	3.18407	4.54039	3.51714

CH2O = Formaldehyde

A trailing '<' symbol indicates that the true value
is less than or equal to the reported value

Test No. 6
Press & Unloading Vent Stack

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

	Run 1 03-31-94	Run 2 03-31-94	Run 3 03-31-94
Date of run			
Time run start/end.....(HRS)	923/1027	1121/1233	1317/1430
Static pressure.....(IN.WC)	-1.00	-1.00	-1.00
Cross sectional area (SQ.FT)	19.63	19.63	19.63
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	-5.0	-10.0	-4.0
desiccant.....(GRAMS)	15.0	15.0	14.0
total.....(GRAMS)	10.0	5.0	10.0
Formaldehyde in sample..(uG)	4830	3220	2630
Gas meter coefficient.....	0.9946	0.9946	0.9946
Barometric pressure..(IN.HG)	25.13	25.13	25.13
Avg. orif.pres.drop..(IN.WC)	2.10	2.14	2.19
Avg. gas meter temp..(DEF-F)	63.6	75.5	82.5
Volume through gas meter....			
at meter conditions...(CF)	51.63	63.39	64.50
standard conditions.(DSCF)	43.74	52.52	52.76
Total sampling time....(MIN)	60.00	72.00	72.00
Nozzle diameter.....(IN)	.189	.189	.189
Avg.stack gas temp ..(DEG-F)	73	79	82
Volumetric flow rate.....			
actual.....(ACFM)	89768	90480	90991
dry standard.....(DSCFM)	73665	73929	73575
Isokinetic variation.....(%)	99.8	99.5	100.4
CH2O concentration.....			
(GR/DSCF).....	0.0017	0.0010	0.0008
(MG/DSCM).....	3.92	2.18	1.77
(PPM-DRY).....	3.14	1.75	1.42
(PPM-WET).....	3.11	1.74	1.41
CH2O emission rate...(LB/HR)	1.08197	0.60300	0.48802

CH2O = Formaldehyde

A trailing '<' symbol indicates that the true value
is less than or equal to the reported value

3.5 Results of MDI Determinations

Test No. 8
Press & Unloading Vent Stack

Results of MDI Determinations.....

	Run 1 03-31-94	Run 2 03-31-94	Run 3 03-31-94
Date of run			
Time run start/end.....(HRS)	1726/1831	1919/2023	2106/2208
Static pressure.....(IN.WC)	-1.00	-1.00	-1.00
Cross sectional area (SQ.FT)	19.63	19.63	19.63
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	-43.0	-51.0	-38.0
desiccant.....(GRAMS)	50.0	61.0	45.0
total.....(GRAMS)	7.0	10.0	7.0
MDI in sample.....(ug)			
Gas meter coefficient.....	0.9946	0.9946	0.9946
Barometric pressure..(IN.HG)	25.13	25.13	25.13
Avg. orif.pres.drop..(IN.WC)	2.30	2.32	2.32
Avg. gas meter temp..(DEF-F)	78.3	76.8	73.9
Volume through gas meter....			
at meter conditions...(CF)	54.89	54.90	54.80
standard conditions.(DSCF)	45.26	45.40	45.56
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.189	.189	.189
Avg.stack gas temp ..(DEG-F)	83	77	76
Volumetric flow rate.....			
actual.....(ACFM)	94304	93609	93527
dry standard.....(DSCFM)	76261	76287	76660
Isokinetic variation.....(%)	99.7	100.0	99.9
MDI Concentration			
..... (ppm)			
MDI Emission Rate			
.....(LB/HR)			

4 RESULTS OF FUEL ANALYSIS

INTERPOL LABORATORIES, INC.

Fuel Laboratory

(612) 786-6020

4/19/94

Client : LOUISIANA PACIFIC/MONTROSE

Laboratory Log Number : 2558-67-7439

Source: DRYER

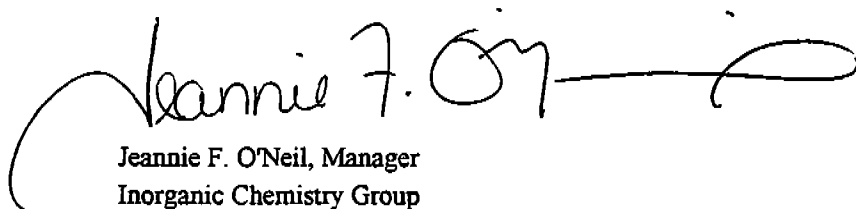
Sample Identification : WOOD

3/94

Short Proximate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			3.00
Ash		0.83	0.81
Sulfur	0.31	0.31	0.30
Heating Value, BTU/LB.	8564	8493	8238

Respectfully submitted,



Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

4-2558

APPENDIX A

VOLUMETRIC FLOW RATE DETERMINATIONS

Test No. 6
Press & Unloading Vent Stack

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

Date of Determination.....	03-31-94
Time of Determination.....(HRS)	900
Barometric pressure.....(IN.HG)	25.13
Pitot tube coefficient.....	.84
Number of sampling ports.....	2
Total number of points.....	24
Shape of duct.....	Round
Stack diameter.....(IN)	60
Duct area.....(SQ.FT)	19.63
Direction of flow.....	UP
Static pressure.....(IN.WC)	-1
Avg. gas temp.....(DEG-F)	73
Moisture content.....(% V/V)	1.07
Avg. linear velocity.....(FT/SEC)	77.2
Gas density.....(LB/ACF)	.06188
Molecular weight.....(LB/LBMOLE)	28.84
Mass flow of gas.....(LB/HR)	337501
Volumetric flow rate.....	
actual.....(ACFM)	90896
dry standard.....(DSCFM)	74602

APPENDIX B

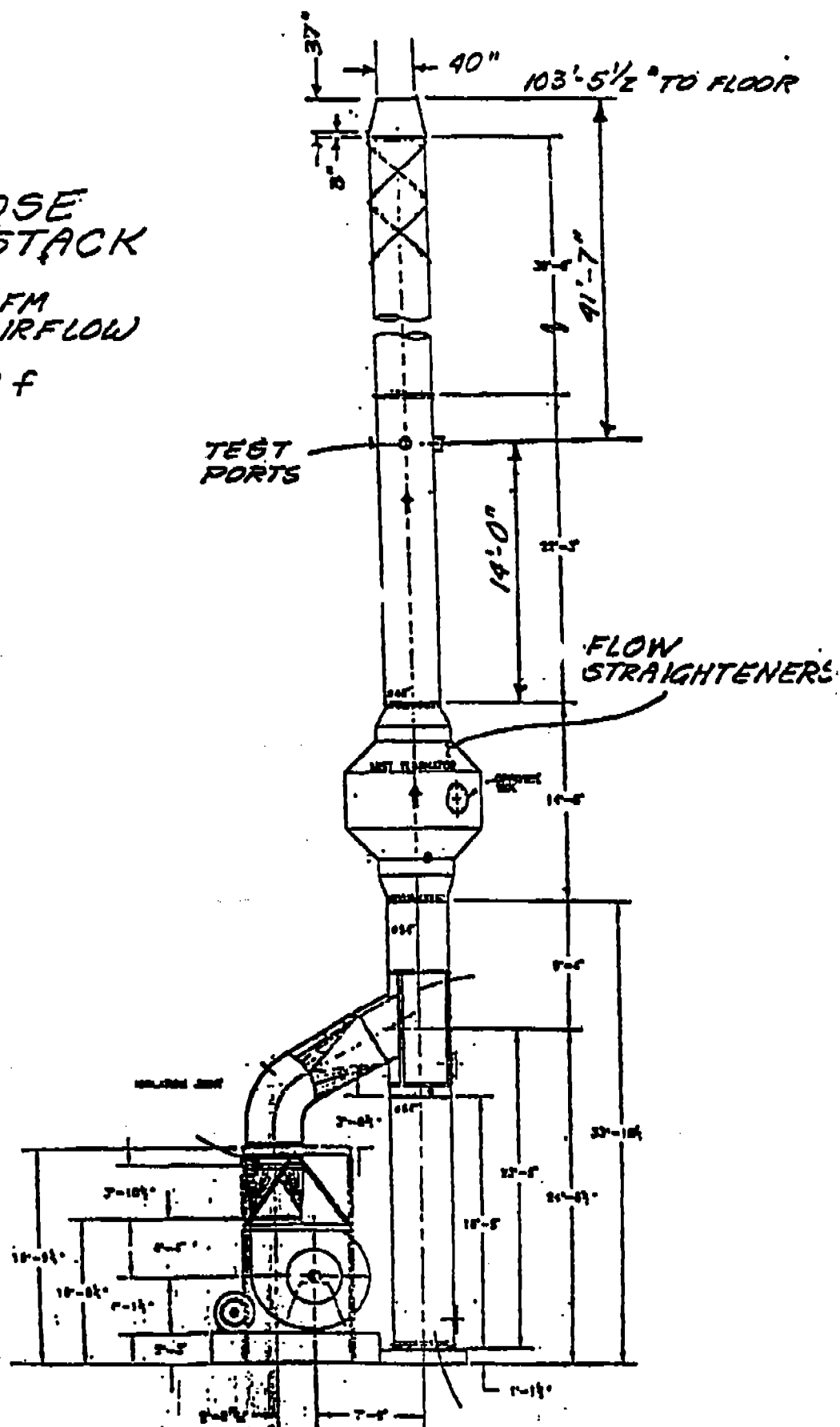
LOCATION OF TEST PORTS

MONTROSE DRYER STACK

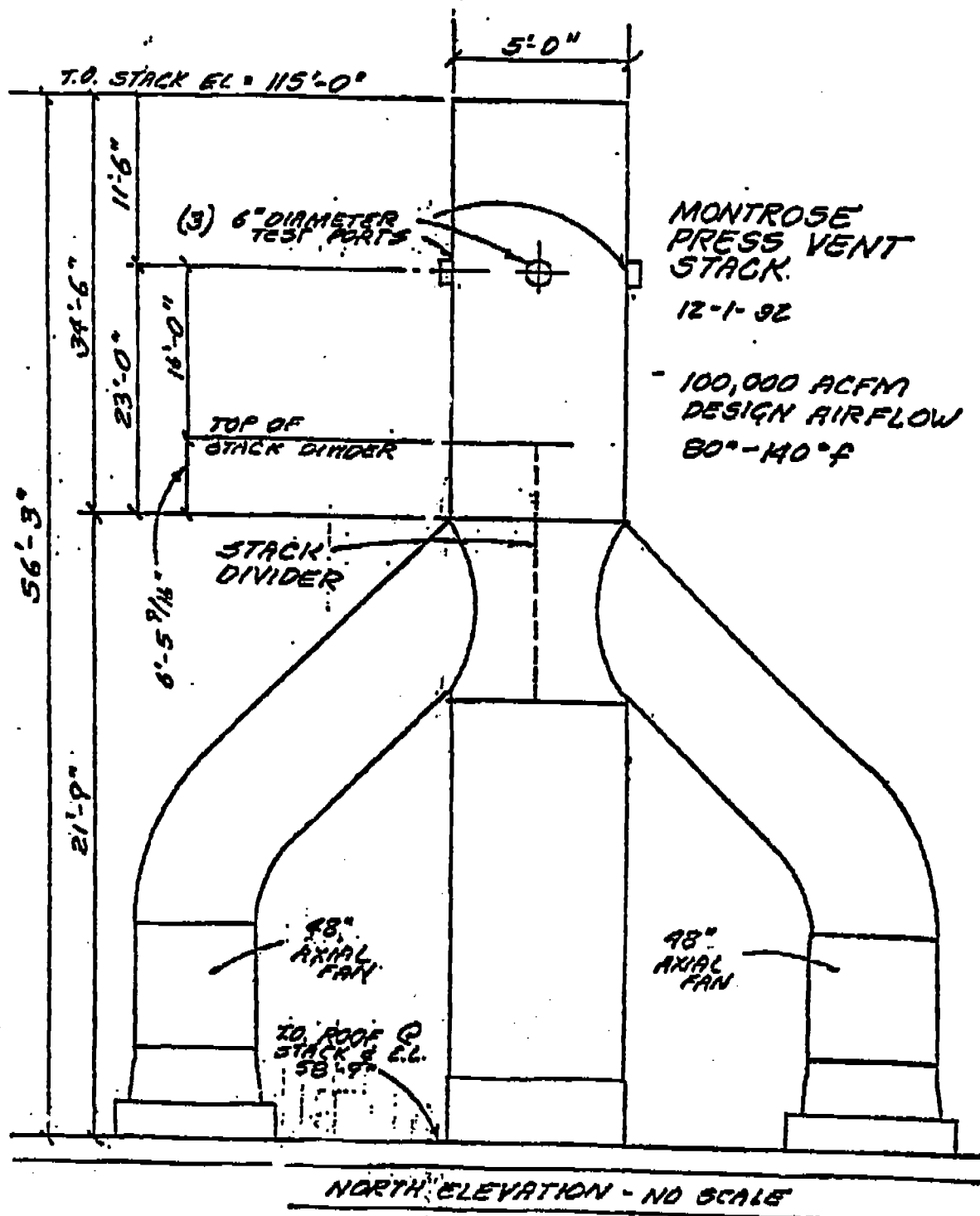
60,000 ACFM
DESIGN AIRFLOW

140° - 160° F

12-2-92

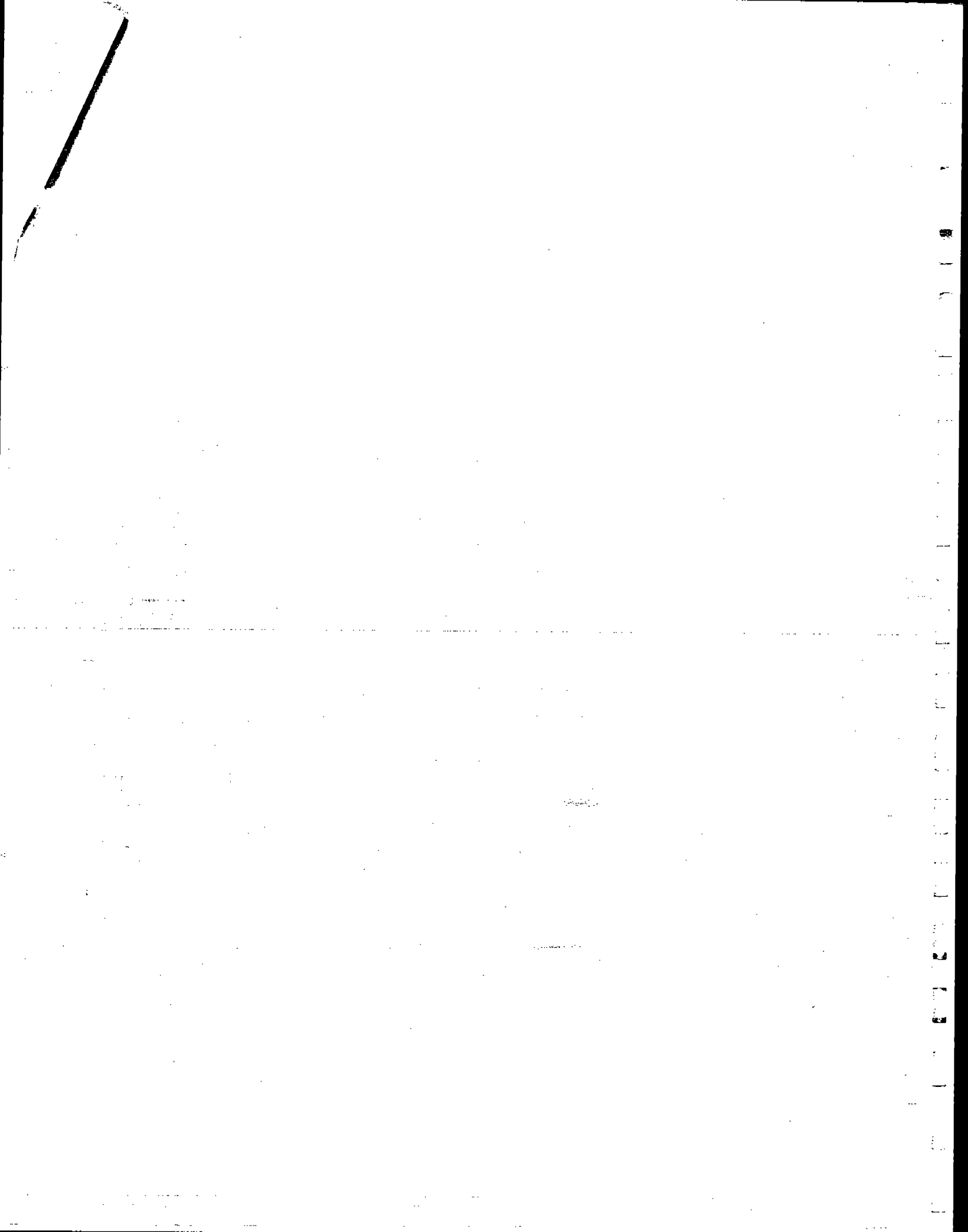


EAST ELEVATION - NOT TO SCALE



APPENDIX C

DRYER FIELD DATA SHEETS



INTERPOL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job L.P. / MONTROSE
 Source DRYER STACK
 Test 1 Run 1 Date 3/29/94
 Stack dimen. 47.75 IN.
 Dry bulb °F Wet bulb °F
 Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
 Barometric pressure 25.02 in Hg
 Static pressure +1.32 in WC
 Operators D. Van Hoever & K. Rosenthal
 Pitot No. V23-5 C_p .84

Cross-section
ViewElevation
ViewDrawing
of Test Site

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length: <u>6</u> in.		Time start: <u> </u> hrs	
A 1	.021	1	7		
2	.067	3.20	9.2		
3	.118	5.63	11.63		
4	.177	8.45	14.45		
5	.25	11.93	17.93		
6	.356	16.99	23		
7	.644	30.75	36.75		
8	.750	35.81	41.81		
9	.823	39.3	45.3		
10	.882	42.12	48.12		
11	.933	44.55	50.55		
12	.979	46.75	52.74		
B 1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
Temp. meas. device & S/N:				Time end: <u> </u> hrs	

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. MONTROSE Date 3/29/94 Test 1 Run 1
 Source DRYER STACK No. of traverse points 24
 Method 0011 Filter holder: NA Filter type: NA

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☐
 Posttest: 0 cfm at 12 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: _____ Recovery solvent(s) _____

_____ ☐ acetone
 _____ ☒ other(s) MELLS & DE H₂O

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

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	<u>500</u>	<u>200</u>	<u>300</u>
Impinger No. 3			
Condenser			
Desiccant	<u>1398</u>	<u>1379</u>	<u>19</u>
Total			<u>319</u>

Integrated Gas Sampling Data:

Bag Pump No. 239 Box No. 19 Bag No. 1

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

Pretest leak check: 0 cc/min at 14 in. Hg.

Time start: 0957 (HRS) Time end: 1107 (HRS)

Sampling rate: 400 cc/min Operator: DWH

S/N of O₂ Analyzer used to monitor train outlet: 4

CF-023

INTERPOL LABORATORIES L. A. WEINCO 5 FIELD DATA SHEET

 Job Source L.P. MONTROSE
 Date 9/29/94

 Operator's Meter Box No. 5
 Gas meter count. 1001

 Operator's DEUTER
 Meter Box No. 5
 Gas meter count. 1002

 Pitot No. 123-5
 Bar. Press. 23.0
 Nozzle No. 6/655

 CP 1.84
 IN Hg 12.0
 Nozzle Dia 2.25 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (in H ₂ O)	Drifted Meter (in H ₂ O)	VAC. in Hg	Temperature (°F)				Oxygen (xv/v)
						Stack	Probe	Duct	Gas In	Gas Out
A 12	0953	581.85	1.50	2.34	7	135	241	239	74	44
11	3	584.56	1.50	2.36	7	135			48	44
10	6	587.35	1.60	2.53	7.5	136			53	44
9	9	590.12	1.60	2.53	7.5	135	237	250	58	44
8	13	593.95	1.70	2.71	8	135			60	45
7	15	595.84	1.45	2.31	7.5	136			63	46
6	18	598.57	1.35	2.17	7.5	135	236	251	66	47
5	21	601.30	1.35	2.17	7.5	135			69	49
4	24	603.91	1.30	2.11	7	134			70	50
3	27	606.70	1.30	2.11	7	134	239	252	73	53
2	30	609.16	1.30	2.14	7	130			76	53
1	33	611.86	1.20	1.95	7	139			74	52
	36	614.31	1.70	2.75	8	139	250	255	68	48
B 12	39	617.50	1.70	2.72	8	128			70	48
11	42	620.25	1.80	2.93	8	128			70	48
10	45	623.30	1.80	3.14	9	127	251	253	72	50
9	48	626.46	1.80	3.15	9	128			73	52
8	51	629.63	1.55	2.72	8	129	248	261	74	54
7	54	632.61	1.25	2.20	8	126			77	55
6	57	635.45	1.40	2.48	8	127			78	56
5	60	638.08	1.60	2.84	9	127			78	57
4	63	641.16	1.6	2.84	9	127	237	260	79	58
3	66	644.11	1.5	2.67	9	127			79	59
2	69	647.17	1.3	2.31		128				
1	72	649.85								
	1107									
		V _s = 68.00	V _m = 2.57						Av _g = 59.2	
		θ = 72								

W = 128%

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. MONTROSE Date 3/29/84 Test 1 Run 2
 Source DRYER STACK No. of traverse points 24
 Method 0011 Filter holder: NA Filter type: NA

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: .008 cfm at 10 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: _____ Recovery solvent(s) _____
 _____ ☐ acetone
 _____ ☒ other(s) MEL₂ & DI H₂O
 No. of probe wash bottles: 1
 Sample recovered by: DLH

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1		} 200	
Impinger No. 2	523		323
Impinger No. 3			
Condenser			
Desiccant	1484	1460	24
Total			347

Integrated Gas Sampling Data:

Bag Pump No. 239 Box No. 19 Bag No. 2
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 14 in. Hg.
 Time start: 915 (HRS) Time end: 1139 (HRS)
 Sampling rate: 400 cc/min Operator: DLH
 S/N of O₂ Analyzer used to monitor train outlet: _____

CF-023

Sub	L.P. MONTROSE
Sub	Dyer Stock
Sub	3/30/64
Sub	1961

ଜଣକ

DATE 14 APR 1964

2011-8579

Pilot No. 12
Bar. Press. 30
Nozzle No. 66

3-5 CP 10H9 87
as. 3c NOZIL 8 Dia

125-11.

[illegible]

07560
Stop
← Rest
1110

INTERPOL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. MONTROSE Date 3/29/94 Test 1 Run 3
 Source DRYER STACK No. of traverse points 24
 Method 0011 Filter holder: NA Filter type: NA

Sample Train Leak Check:

Pretest: { 0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: { 0 cfm at 11 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: _____ Recovery solvent(s) _____

_____ ☐ acetone
 _____ ☒ other(s) MELC₂ + DI H₂O

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

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	515	200	315
Impinger No. 3			
Condenser			
Desiccant	1411	1388	23
Total			338

Integrated Gas Sampling Data:

Bag Pump No. 23a Box No. 19 Bag No. 3
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 14 in. Hg.
 Time start: 1215 (HRS) Time end: 1325 (HRS)
 Sampling rate: 400 cc/min Operator: DVH
 S/N of O₂ Analyzer used to monitor train outlet: 4

CF-023

INTERPOL LABORATORIES A METHOD 5 FIELD DATA SHEET

Job I.P. MONTROSE

Source DEVER STACK

Date 3/20/84

Page 1

Run 3

Operator DVA K.R.

Water Box No. 14

Generator Serial No. 8846

Pilot No. 123-5

Bar. Press. 25.30 inHg

Nozzle No. 6255

DP 5.4

Water Box No. 14

Generator Serial No. 8846

Pilot No. 123-5

Bar. Press. 25.30 inHg

Nozzle No. 6255

DP 5.4

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inH ₂ O)	Orifice Meter (inH ₂ O)	Des. Vol. (cf)	VAC. inHg	Temperature (°F)					Oxygen (xv/v)	
							Stack	Probe	Duct	Gas In	Gas Out		
A 12	1211	620.60	1.50	2.60	3.41	7	134	251	243	37	57	56	17.6
11	3	623.40	1.60	2.87	6.41	8	130				60	55	17.4
10	9	626.36	1.75	3.15	9.54	10	130				62	55	17.4
9	12	629.56	1.80	3.24	2.72	10	131	256	248	39	63	55	17.3
8	15	632.70	1.40	2.51	5.54	8	133				64	55	17.4
7	18	635.60	1.40	2.50	8.34	8	136				65	55	17.4
6	21	638.40	1.40	2.51	1.15	8	136	257	253	46	66	55	17.5
5	24	643.97	1.35	2.43	3.92	8	133				67	55	17.3
4	27	646.83	1.45	2.62	6.79	8	132				67	56	17.7
3	30	649.70	1.35	2.44	9.57	8	131	258	257	46	68	56	17.3
2	33	652.46	1.30	2.36	2.31	8	130				69	57	17.4
1	36	655.15	1.25	2.28	4.99	8	129				70	57	17.4
B 12	39	658.26	1.80	3.28	8.21	10	129	257	259	46	68	58	17.6
11	42	661.37	1.85	3.35	1.46	10	132				71	59	17.9
10	45	664.64	1.85	3.36	4.73	10	132				73	59	17.6
9	48	667.90	1.85	3.33	7.98	10	139	250	251	45	74	60	17.5
8	51	671.04	1.85	3.13	1.14	10	139				75	61	17.6
7	54	673.81	1.20	2.03	3.69	7	142				76	62	17.9
6	57	676.57	1.50	2.54	6.54	8	142	251	256	48	76	62	18.0
5	60	679.73	1.70	2.92	9.60	9	134				76	63	18.0
4	63	682.61	1.60	2.75	2.56	9	134				76	63	18.3
3	66	685.61	1.55	2.66	5.48	9	134	257	258	49	76	64	18.1
2	69	688.37	1.35	2.32	8.22	9	134				77	64	18.1
1	72	690.74	1.10	1.89	0.69		135				77	65	17.8
Σ		70.19		2.71							Avg. = 64.1		

INTERPOL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job L.P. / MONTROSE
 Source RIYER STACK
 Test 2 Run Date 3/30/94
 Stack dimen. 47.75 IN.
 Dry bulb °F Wet bulb °F
 Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
 Barometric pressure in Hg
 Static pressure in WC
 Operators D. VanHoever & K. Rosenthal
 Pitot No. Cp

Cross-section
ViewElevation
ViewDrawing
of Test Site

Particulate

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length: <u>6</u>	in.	Time start: <u> </u>	hrs
A 1	.021	1	7		
2	.067	3.20	9.20		
3	.118	5.63	11.63		
4	.177	8.45	14.45		
5	.25	11.93	17.93		
6	.356	16.99	23		
7	.644	30.75	36.75		
8	.750	35.81	41.81		
9	.823	39.3	45.3		
10	.882	42.12	48.12		
11	.933	44.55	50.55		
12	.979	46.74	52.74		
B 1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
Temp. meas. device & S/N: <u> </u>					
				Time end: <u> </u>	hrs

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

S-3921

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / MONTROSE Date 3/29/94 Test 2 Run 1
 Source DRYER STACK No. of traverse points 26
 Method 5 Filter holder: glass Filter type: glass fiber

Sample Train Leak Check:

Pretest: { 0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: { 0 cfm at 7 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: Recovery solvent(s)

☒ acetone
☐ other(s)

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

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	<u>348</u>	<u>200</u>	<u>148</u>
Impinger No. 3			
Condenser			
Desiccant	<u>1493</u>	<u>1484</u>	<u>9</u>
Total			<u>157</u>

Integrated Gas Sampling Data:

Bag Pump No. 239 Box No. 23 Bag No. 1
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 14 in. Hg.
 Time start: 1405 (HRS) Time end: 1514 (HRS)
 Sampling rate: 400 cc/min Operator: DWH
 S/N of O₂ Analyzer used to monitor train outlet: 4

CF-023

INTERPOL LABORATORIES EPA METHOD'S FIELD DATA SHEET

Job L.P. MONTEOSE Operator D.W. KRE Pitot No. 123-5 Ep 84
 Source DEVERE STACK Meter Box No. 14 Air 2.88 TR BE IN BE Bar. Press. 25.50 IN HG H2O 30
 Date 3/30/84 1984 2 APR 1 Gas meter const. 994 Nozzle No. 7-3 Nozzle Dia. 1/2 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inH ₂ O)	Drifts (inH ₂ O)	Dec. Vol. (cf)	WAD. inHg	Temperature (°F)				Gas Det	Oxygen (xv/v)
							Stack	Probe	Dryn	Wet		
B 12	140.2	691.11	1.90	1.55	2.96	5.5	131	237	242	43	70	18.0
11	2.5	692.96	1.95	1.61	4.86	6	129				71	18.0
10	5	694.91	2.0	1.65	6.78	6	128				71	18.4
9	7.5	696.77	2.0	1.68	8.72	6	124	265	250	44	73	17.7
8	10	698.75	1.90	1.69	0.66	6	122				74	17.7
7	12.5	700.69	1.90	1.71	2.62	6	122				75	17.7
6	15	702.59	1.85	1.25	4.29	5	123	263	252	40	75	17.7
5	17.5	704.27	1.35	1.53	6.15	5	120				74	17.2
4	20	706.16	1.65	1.48	7.97	5	123				75	17.4
3	22.5	707.90	1.60	1.48	9.79	5	123	270	256	41	75	17.3
2	25	709.66	1.60	1.48	1.61	5	124				75	17.2
1	27.5	711.60	1.60	1.48	3.25	5	128				80	17.3
A 12	30	713.26	1.30	1.20	5.09	5	126	270	257	42	77	17.4
11	32.5	715.11	1.60	1.48	6.94	5	126				79	17.4
10	35	716.94	1.65	1.52	8.81	5	119				80	17.3
9	37.5	718.81	1.65	1.55	0.71	5	118	266	257	43	80	17.4
8	40	720.66	1.70	1.60	2.52	5	121				82	17.1
7	42.5	722.53	1.50	1.46	4.33	5	129				82	17.0
6	45	724.35	1.50	1.44	6.10	5	129	269	264	43	82	17.3
5	47.5	726.11	1.45	1.39	7.77	5	128				82	17.1
4	50	727.90	1.40	1.22	9.43	5	129				82	17.0
3	52.5	729.54	1.40	1.22	1.10	5	126	267	266	43	82	17.0
2	55	731.30	1.40	1.23	2.77	5	126				82	17.0
1	57.5	733.90	1.40	1.23	4.38	5	125				82	17.0
	60	734.40	1.30	1.14								
	(1514)	43.29										
	Q =	W =		H = 145							Avg. = 64.5	

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. MONTROSE Date 3/29/94 Test 2 Run 2
 Source DRYER STACK No. of traverse points 24
 Method 5 Filter holder: glass Filter type: glass fiber

Sample Train Leak Check:

Pretest: { 0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: 0 cfm at 7 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used: _____ Recovery solvent(s) _____

☒ acetone
☐ other(s) _____

No. of probe wash bottles: 1

Sample recovered by: Not

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	364	200	164
Impinger No. 3			
Condenser			
Desiccant	1423	1411	12
Total			176

Integrated Gas Sampling Data:

Bag Pump No. 23a Box No. 23 Bag No. 2

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

Pretest leak check: 0 cc/min at 14 in. Hg.

Time start: 1620 (HRS) Time end: 1721 (HRS)

Sampling rate: 400 cc/min Operator: Not

S/N of O₂ Analyzer used to monitor train outlet: _____

CF-023

INTERPOL LABORDAIRIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. MONTROSE Operators Don & R Pitot No. V23-5 Cp 58
 Source DAVEY STARK Meter Box No. 14 Air 1.58 IN-NC 25.30 10Hg 15.8
 Date 3/20/84 Computer Code 9946 Nozzle No. 7-3 Nozzle Dia 1.88 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inHG)	Driftless Meter (inHG)	Dep. Vol. (cf)	VAC. inHG	Temperature (°F)					Gas/Dot	Oxygen (xy/y)
							Stack	Probe	Down	Impq.	Gas In		
A 12	1617	734.70					131	262	255	43	69	69	17.4
11	5	736.46	1.6	1.36	6.43	5	135				68	68	17.4
10	7.5	738.32	1.70	1.45	8.23	5	135				68	68	17.0
9	10	740.16	1.70	1.44	0.02	5	134	26.1	25.4	43	72	68	17.3
8	12.5	741.91	1.75	1.49	1.84	5	132				75	70	17.2
7	15	743.71	1.70	1.46	3.65	5	132				76	70	17.1
6	17.5	745.50	1.70	1.46	5.46	5	132	26.3	25.7	44	76	70	16.9
5	20	747.31	1.40	1.21	7.11	5	132				77	70	16.9
4	22.5	748.78	1.40	1.21	8.76	5	131				77	70	16.7
3	25	750.46	1.40	1.21	0.41	5	131				78	70	17.0
2	27.5	752.16	1.40	1.21	2.06	5	130	26.0	25.8	42	78	70	16.7
1	30	753.80	1.25	1.08	3.63	5	129				78	70	16.9
B 12	32.5	755.30	1.20	1.04	5.16	5	130	25.9	25.9	42	75	70	17.2
11	35	757.10	1.80	1.56	7.03	5	135				77	70	16.8
10	37.5	758.99	1.95	1.67	8.97	5	136				80	70	17.1
9	40	760.89	1.90	1.63	0.89	5	137	26.5	25.2	47	80	70	16.9
8	42.5	762.70	1.80	1.41	2.68	5	142				81	70	16.7
7	45	764.60	1.75	1.37	4.43	5	146				80	70	16.6
6	47.5	766.10	1.40	1.09	6.01	4	139	26.3	25.4	47	81	71	16.7
5	50	767.62	1.30	1.02	7.53	4	137				80	70	16.9
4	52.5	769.05	1.45	1.15	9.14	4	134				80	71	16.8
3	55	770.81	1.50	1.19	0.78	4	133	26.0	25.7	47	80	70	16.8
2	57.5	772.44	1.60	1.27	2.48	4	130				81	71	16.8
1	60	774.10	1.50	1.20	4.12	4	126				81	71	17.1
	(1721)	775.70	1.25	1.01	5.63	4							
Σ = 60		V = 41.00		ΔH = 0.30							Avg. = 73.4		

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / MONTROSE Date 3/29/94 Test 2 Run 3
 Source DRYER STACK No. of traverse points 24
 Method 5 Filter holder: 9/259 Filter type: glass fiber

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: 0 cfm at 7 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: _____ Recovery solvent(s) _____

_____ ☒ acetone _____
 _____ ☐ other(s) _____

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

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	371	200	171
Impinger No. 3			
Condenser			
Desiccant	1505	1493	12
Total			183

Integrated Gas Sampling Data:

Bag Pump No. 234 Box No. 23 Bag No. 3
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 14 in. Hg.
 Time start: 1800 (HRS) Time end: 1858 (HRS)
 Sampling rate: 400 cc/min Operator: DWH
 S/N of O₂ Analyzer used to monitor train outlet: 4

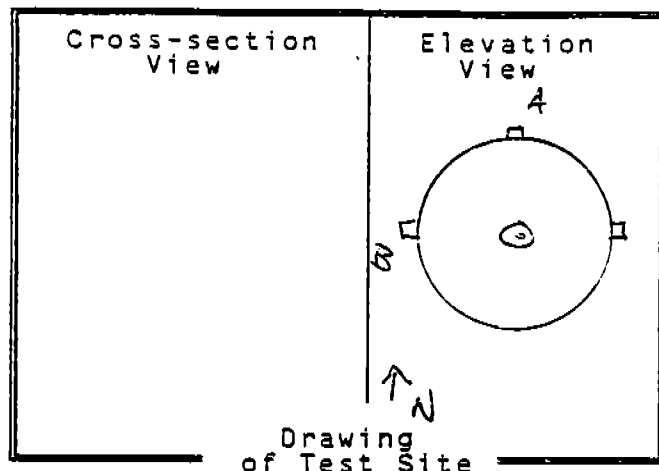
CF-023

APPENDIX D

PRESS AND UNLOADER VENT FIELD DATA SHEETS

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job L.P. Montrose
 Source Press & Unloading Port. Stack
 Test 5 Run Date 5/31/94
 Stack dimen. 60 IN.
 Dry bulb °F Wet bulb °F
 Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
 Barometric pressure 25.13 in Hg
 Static pressure -1.0 in WC
 Operators D. VanHoover & K. Rosenthal
 Pitot No. V23-6 C_p .84



Particulate *Part.*

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port. (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length: <u>4</u> in.	Time start: <u> </u> hrs		
A 1	.021	1.26	5.26		
2	.067	4.02	8.02		
3	.118	7.08	11.08		
4	.177	10.62	14.62		
5	.250	15	19		
6	.356	21.36	25.36		
7	.644	38.64	42.62		
8	.750	45	49		
9	.823	49.38	53.38		
10	.882	52.92	56.92		
11	.933	55.98	59.98		
12	.979	58.74	62.74		
B 1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
Temp. meas. device & S/N:				Time end:	hrs

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. MONTROSE Date 3/31/94 Test 5 Run 1
 Source PRESS + UNLOADING VENT STACK No. of traverse points 24
 Method 5 Filter holder: _____ Filter type: glass Fiber

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: .012 cfm at 8 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: _____ Recovery solvent(s) _____
6250 ☒ acetone _____
☐ other(s) _____
 No. of probe wash bottles: 1
 Sample recovered by: Dot

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		} 200	
Impinger No. 2	195		-5
Impinger No. 3			
Condenser			
Desiccant	1371	1357	14
Total			9

Integrated Gas Sampling Data: Ambient Air

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

CF-023

I.P. MONTECSE

Job	I.P. MONTRUSE		
EDUP 60	PRESS + UNLOADING	VENT	STACK
Unit 6	3/31/94	5	Run 1

Dr. H. J. B. Cox

Dist. & KR
12

7-666
867
JAN 19 1967

Pat. & Bur. No. 11

117
 116
 115
 114
 113
 112
 111
 110
 109
 108
 107
 106
 105
 104
 103
 102
 101
 100
 99
 98
 97
 96
 95
 94
 93
 92
 91
 90
 89
 88
 87
 86
 85
 84
 83
 82
 81
 80
 79
 78
 77
 76
 75
 74
 73
 72
 71
 70
 69
 68
 67
 66
 65
 64
 63
 62
 61
 60
 59
 58
 57
 56
 55
 54
 53
 52
 51
 50
 49
 48
 47
 46
 45
 44
 43
 42
 41
 40
 39
 38
 37
 36
 35
 34
 33
 32
 31
 30
 29
 28
 27
 26
 25
 24
 23
 22
 21
 20
 19
 18
 17
 16
 15
 14
 13
 12
 11
 10
 9
 8
 7
 6
 5
 4
 3
 2
 1

211

Traverse Point No.	Sampling Time (min)	Sample Volume (cfs)	Velocity Head (inH ₂ O)	Driftless Water (inH ₂ O)	Dev. Vol. (cfs)	VAD. inH ₂ O	Temperature (°F)						Gas/Dut	Oxygen (Xv/v)
							Stack	Probe	Dryn	Inq.	Gas/In			
B 12	0922	274.28	1.20	1.57	6.05	4	74	241	253	41	44	4-1	AMBIENT	
"	5	276.04	1.40	1.83	7.97	4	74				54	43	AIR	
10	7.5	277.97	1.45	1.92	9.94	5	74				56	43		
9	10	279.86	1.50	1.99	1.95	5	74	247	256	42	58	44		
8	12.5	281.90	1.50	1.99	3.96	5	74				59	44		
7	15	283.97	1.50	2.00	5.98	5	73				60	45		
6	17.5	285.97	1.50	2.00	8.01	5	73	253	256	43	59	46		
5	20	288.03	1.60	2.13	0.09	5	74				60	46		
4	22.5	290.03	1.50	2.01	2.12	5	70				59	47		
3	25	292.16	1.50	2.01	4.15	5	70	254	256	43	60	48		
2	27.5	294.16	1.20	1.61	5.97	4	72				59	48		
1	30	295.96	1.0	1.35	7.63	4	70				61	48		
A 12	32.5	297.68	2.1	2.82	0.03	7	90	257	254	44	61	50		
"	35	300.04	2.1	2.81	2.43	7	74				68	50		
10	37.5	302.35	1.95	2.63	4.76	7	94				71	51		
9	40	304.77	1.80	2.43	7.01	6	74	254	257	43	72	52		
8	42.5	307.05	1.60	2.17	9.13	5	74				73	53		
7	45	309.20	1.45	1.97	1.16	5	73				75	53		
6	47.5	311.20	1.45	1.97	3.19	5	74	257	256	44	76	54		
5	50	313.27	1.60	2.18	5.32	5	75				77	54		
4	52.5	315.36	1.60	2.18	7.46	5	75				78	56		
3	55	317.41	1.60	2.19	9.60	5	75	260	255	44	79	57		
2	57.5	319.61	1.50	2.05	1.68	5	76				79	57		
1	60	321.60	1.20	1.64	3.54		76				79	58		
	102.5	324.54												
		V _W = 49.26	M _W = 2.06											AVG = 57.6
		θ = 60												

INTERPOL LABORATORIES - PA METHOD 5 FIELD DATA SHEET

Job L.P. MONTROUSE Operator DMK Pitot No. U23-6 Cp 84
 Source Press & Unloading Vent Stack Motor Box No. 12 Bar. Press. 25.13 10Hg H2O X
 Date 3/31/04 Gun 2 Gunter count. 9867.28 Nozzle No. 7-3 Nozzle Dia. 0.82 IR.

Inversion Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (ft)	Drifts Meter (ft)	Des. Vol. (cf)	VAC. inHg	Temperature (°F)						Oxygen (X%)
							Stack	Probe	Duct	Inph.	Gas In	Gas Out	
A 12	119	325.80	2.00	2.67	6.14	7	77	261	253	44	63	63	AMBIENT
11	5	326.14	1.95	2.63	8.48	7	78				66	63	AIR
10	7.5	328.47	1.90	2.57	0.79	7	78				68	63	
9	10	330.70	1.70	2.30	2.99	7	78	264	254	45	71	63	
8	12.5	332.93	1.55	2.11	5.09	7	78				73	63	
7	15	335.04	1.45	1.97	7.13	6	78				76	63	
6	17.5	337.14	1.45	1.98	9.17	6	78	261	257	46	77	64	
5	20	339.17	1.50	2.05	1.25	6	79				79	64	
4	22.5	341.36	1.55	2.12	3.37	6	79				80	64	
3	25	343.50	1.60	2.19	5.52	6	80	264	260	47	81	65	
2	27.5	345.52	1.60	2.19	7.68	6	80				82	65	
1	30	347.70	1.40	1.92	9.70	6	79				83	66	
112	32.5	349.70	1.10	1.51	1.80	5	79	259	261	48	78	67	
11	35	351.50	1.40	1.92	3.52	5.5	79				81	67	
10	37.5	353.52	1.40	1.92	5.55	6	79				84	68	
9	40	355.55	1.35	1.86	7.54	6	79	260	261	46	84	68	
8	42.5	357.50	1.35	1.86	9.53	6	80				85	68	
7	45	359.54	1.35	1.86	1.53	6	80				85	69	
6	47.5	361.53	1.42	1.96	3.53	6	80	256	264	43	86	70	
5	50	363.60	1.45	2.01	5.65	6	79				87	70	
4	52.5	365.68	1.45	2.01	7.73	6	79				88	71	
3	55	367.64	1.40	1.94	9.78	6	79	257	263	43	88	72	
2	57.5	369.70	1.40	1.94	1.82	6	79				88	72	
1	60	371.79	1.20	1.67	3.72		79				88	72	
	(1221)												
	0 = 60												
	V = 49.89												
	AH = 2.05												

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. Montrose. Date 3/31/94 Test 5 Run 3
 Source Press & Unloading Vent Stack No. of traverse points 24
 Method 5 Filter holder: 9/655 Filter type: glass fiber

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: 0 cfm at 7 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: _____ Recovery solvent(s) _____
 _____ ☒ acetone _____
 _____ ☐ other(s) _____
 No. of probe wash bottles: 1
 Sample recovered by: DWH

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	194	200	-6
Impinger No. 3			
Condenser			
Desiccant	1388	1371	17
Total			11

Integrated Gas Sampling Data: - Ambient Air

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

CF-023

INTERPOL LABORATORIES' 2A METHOD 5 FIELD DATA SHEET

Job L.P. MontroseSource Press & Unloading Dept StackDate 3/31/84Operators DWH & KRMeter Box No. 12Counter Count. 0.5997Pitot No. U23-6Bar. Press. 25.13Hozzle No. 7-3

IN-DC

H2O /

H2O /

H2O /

H2O /

H2O /

H2O /

H2O /

H2O /

H2O /

H2O /

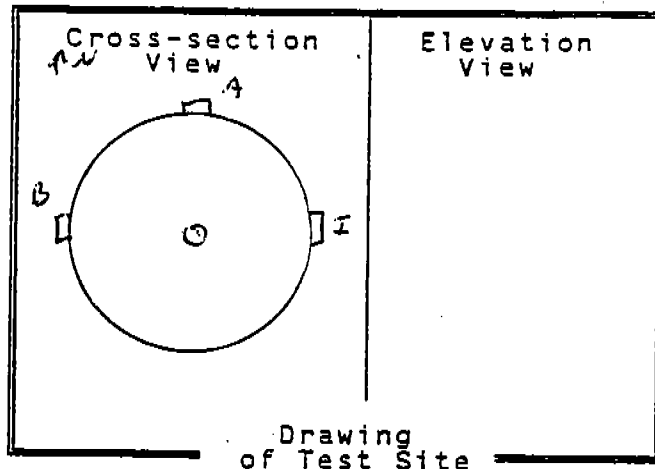
H2O /

H2O /

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inH ₂ O)	Drifts Meter (inH ₂ O)	VAC. inH ₂ O	Temperature (°F)				Gas/Dut	Oxygen (xv/v)
						Stack	Probe	Oven	Impg.		
B 12	13.7	374.10	1.10	1.50	5.88	82	251	257	42	75	75
11	2.5	375.86	1.35	1.85	7.87	81				78	74
10	7.5	377.87	1.35	1.86	9.86	81				80	74
9	10	379.81	1.40	1.93	1.90	81	257	259	43	83	74
8	14.5	381.77	1.40	1.93	3.93	82				83	74
7	15	383.80	1.50	2.07	6.04	82				86	74
6	17.5	388.26	1.60	2.21	8.22	82	257	260	43	87	74
5	20	390.24	1.50	2.07	0.33	83				88	75
4	22.5	392.46	1.45	2.01	2.41	82				88	75
3	25	394.59	1.40	1.94	4.46	82	256	263	44	90	75
2	27.5	396.61	1.50	2.09	6.59	81				90	76
1	30	398.60	1.30	1.81	8.57	80				90	76
A 12	32.5	400.99	1.90	2.65	0.96	80	261	263	45	85	77
11	35	403.37	1.95	2.70	3.37	81				90	77
10	37.5	405.80	1.85	2.57	5.73	82				90	77
9	40	408.10	1.75	2.43	8.02	82	261	264	46	92	77
8	42.5	410.25	1.60	2.23	0.22	83				92	77
7	45	412.45	1.60	2.23	2.41	83				93	78
6	47.5	414.60	1.60	2.23	4.61	83	259	263	46	93	78
5	50	416.71	1.55	2.16	6.78	83				94	79
4	52.5	418.87	1.55	2.16	8.95	83				94	79
3	55	421.03	1.40	1.95	1.02	83	260	261	47	94	79
2	57.5	423.16	1.40	1.95	3.08	83				95	79
1	60	424.99	1.20	1.68	4.99	83				95	79
	142.5										
		V ₀ = 50.89		ΔH = 2.09						Avg. = 82.4	

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job L.P. / Montrose, CO
 Source Press + Ventilation Vent / Stack
 Test 6 Run 0 Date 3-31-94
 Stack dimen. 6.0 IN.
 Dry bulb 23 °F Wet bulb °F
 Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
 Barometric pressure 25.13 in Hg
 Static pressure -1.0 in WC
 Operators M. K. Miller + L. R. Sutherland
 Pitot No. 23V-6 C_p .84



Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length: <u>4</u> in.	Time start: <u>0900</u> hrs		
A - 1	.021	1.26	5.26	1.75	
2	.067	4.02	9.02	1.47	
3	.118	2.08	11.08	1.53	
4	.177	10.62	14.62	1.61	
5	.1250	15.00	19.00	1.63	
6	.356	21.36	25.36	1.58	
7	.644	38.64	42.64	1.55	
8	.750	45.00	49.00	1.60	
9	.823	49.38	53.38	1.69	
10	.892	52.92	56.92	1.73	
11	.943	55.96	59.96	1.80	↑
12	.979	58.74	62.74	1.95	73
B - 1				1.45	
2				1.52	↓
3				1.63	
4				1.58	
5				1.55	
6				1.50	
7				1.51	
8				1.46	
9				1.49	
10				1.46	
11				1.44	
12				1.50	
Temp. meas. device & S/N: <u>PPT-31/TC</u>				Time end: <u>0907</u> hrs	

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / Montrose, CO
 Source Process + Volatilizing Vent / Stack
 Method 0011 Filter holder: NA

Date 3-31-94 Test 6 Run 1
 No. of traverse points 24
 Filter type: NA

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: 2 0.02 cfm at 11 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: NA Recovery solvent(s)
☐ acetone
☒ other(s) Me Cl₂
 No. of probe wash bottles: 1
 Sample recovered by: D. Valtierra + K. Ruentgen

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	459	464	(5)
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1419	1404	15
Total			10

Integrated Gas Sampling Data: NA / Ambient

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

CF-023

INTERPOL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. / Monrose, CO Operator Mr. Kuehler, L. Kuehler Pitot No. 236-6 Cp 0.94
 Source Press. / 100 ft. / 100 ft. / 100 ft. Meter Box No. 200 Bar. Press. 25.13 inHg H₂O X
 Date 5-31-94 Run 6 Computer Count 14 9946 Nozzle No. 644-3 Nozzle Dia. 1/8 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inHg)	Drifts Water (inHg)	Dep. Vol. (cf)	VAC. inHg	Temperature (°F)				Gas/Dot	Oxygen (x/v)
							Stack	Probe	Duct	Ingr.	Gas In	
A-12	0.93	829.02	2.10	2.78	1.45	10	74	253	261	43	47	47
11	2.5	831.42	2.05	2.73	3.87	9	74				63	47
10	5	833.89	1.93	2.61	6.36	9	74	250	260	43	66	47
9	7.5	836.32	1.77	2.40	8.55	8.5	74				65	47
8	10	838.57	1.61	2.19	0.74	2.5	74	254	252	44	69	48
7	12.5	840.80	1.50	2.16	2.92	7	73				71	49
6	15	842.94	1.55	2.13	5.09	7	72	249	253	44	72	50
5	17.5	845.15	1.62	2.23	7.30	7.5	72				73	50
4	20	847.23	1.60	2.21	9.51	2.5	70	245	260	44	74	51
3	22.5	849.47	1.55	2.15	1.69	7	70				74	52
2	25	851.68	1.52	2.11	3.85	7	70	248	257	44	75	53
1	27.5	853.82	1.21	1.68	5.79	6	70				76	54
B-12	30	855.84	1.35	1.87	2.83	6.5	71	252	257	43	71	55
11	32.5	857.85	1.48	2.04	9.96	7	74				76	55
10	35	859.94	1.46	2.02	2.88	7	74	251	261	43	76	56
9	37.5	862.09	1.41	1.95	4.16	7	74				77	57
8	40	864.10	1.40	1.94	6.25	7	74	246	262	44	79	57
7	42.5	866.28	1.48	2.06	8.39	7	73				79	58
6	45	868.33	1.50	2.08	0.55	7	74	244	259	44	79	59
5	47.5	870.53	1.51	2.10	2.72	7	75				80	59
4	50	872.72	1.45	2.01	4.85	7	75	242	255	45	80	60
3	52.5	874.82	1.38	1.92	6.42	7	75				80	60
2	55	876.90	1.15	1.60	8.82	5.5	75	245	254	45	80	61
1	57.5	878.83	1.05	1.47	0.64		73				79	61
	60	880.65										
	102.7											
Σ = 60		51.63	2.10								Av. = 63.6	

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / Montrose, CO
 Source Process Unloading Vent / Stack
 Method 0011 Filter holder: NA

Date 3-31-94 Test 6 Run 2
 No. of traverse points 24
 Filter type: NA

Sample Train Leak Check:

Pretest: { 0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: 20.02 cfm at 11 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: Recovery solvent(s)

NA ☐ acetone
☒ other(s) MeCl₂

No. of probe wash bottles: 1

Sample recovered by: D. Van Haveret + K. Rosenthal

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	<u>463</u>	<u>473</u>	<u>10</u>
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	<u>1350</u>	<u>1335</u>	<u>15</u>
Total			<u>5</u>

Integrated Gas Sampling Data: NA / Ambient

Bag Pump No. _____ Box No. _____ Bag No. _____

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

Pretest leak check: _____ cc/min at _____ in. Hg.

Time start: _____ (HRS) Time end: _____ (HRS)

Sampling rate: _____ cc/min Operator: _____

S/N of O₂ Analyzer used to monitor train outlet: _____

CF-023

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / Allen House, CO Date 3-31-94 Test 6 Run 3
 Source Dress + Unloading Vent / Stuck No. of traverse points 24
 Method Q11 Filter holder: NA Filter type: NA

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) 8
 Posttest: 0.02 cfm at 11 in. Hg. (vac) 8

Particulate Catch Data:

No.s of filters used: NA Recovery solvent(s)
☐ acetone
☒ other(s) MeCl₂

No. of probe wash bottles: 1
 Sample recovered by: D. Van Hoever + R. Roseenthal

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	<u>196</u>	<u>200</u>	<u>-4</u>
Impinger No. 3			
Condenser			
Desiccant	<u>1418</u>	<u>1404</u>	<u>14</u>
Total			<u>10</u>

Integrated Gas Sampling Data: NA / Ambient

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

CF-023

Sub L.P. / Montrose, CO
 Source Press & Unloading Unit / Steam
 Date 3-31-54 1954 6 NRN 3

Operator McKeebert, K. Kenneth
 Meter Box No. 14 14 14 14
 Computer Count. 9996

Pitot No. 23V-6 Cp 51
 Bar. Press. 25.13 inHg H2D Y
 Nozzle No. 6-3 Nozzle Dia. 105 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cfs)	Velocity Head (inH ₂ O)	Driftless Water (inH ₂ O)	Obs. Vol. (cfs)	VAC. inH ₂ O	Temperature (°F)					Oxygen (xv/v)	
							Stack	Probe	Duct	Ingh.	Gas In		Gas Out
A-12	1317	944.70	2.0	2.80	7.72	9	82	241	253	43	75	75	Amb. Air
11	6	947.67	2.05	2.87	0.77	9	81				76	75	
10	9	953.70	1.90	2.66	3.72	9	81	244	254	43	79	75	
9	12	956.58	1.83	2.57	6.02	8.5	81				82	74	
8	15	959.40	1.68	2.36	9.41	8.5	82	246	255	43	83	75	
7	18	962.05	1.55	2.19	2.09	8	82				85	75	
6	21	964.79	1.51	2.13	4.74	8	82	249	254	43	87	75	
5	24	967.48	1.57	2.12	2.45	8	82				87	75	
4	27	970.30	1.55	2.19	0.14	7	82	245	258	43	89	76	
3	30	972.98	1.50	2.14	2.90	7	80				89	76	
2	33	975.57	1.58	2.24	5.53	7.5	82	251	253	45	90	76	
1	36	978.17	1.39	1.98	8.08	7	82				90	76	
B-12	39	980.44	1.10	1.56	0.36	5.5	82	247	250	45	89	77	
11	42	983.00	1.50	2.13	3.02	7	81				90	77	
10	45	985.69	1.53	2.18	5.71	7	82	249	258	45	91	77	
9	48	989.35	1.50	2.13	8.37	7	82				91	77	
8	51	991.03	1.47	2.09	1.01	7	83	246	262	45	92	78	
7	54	993.70	1.45	2.06	3.65	7	83				92	78	
6	57	996.30	1.48	2.12	6.14	7	83	244	263	46	92	79	
5	60	998.95	1.48	2.11	8.93	7	83				92	79	
4	63	1001.60	1.43	2.04	1.54	7	83	249	263	46	93	80	
3	66	1004.27	1.44	2.13	4.10	7	83				93	80	
2	69	1006.86	1.44	2.06	6.82	7	82	252	260	46	94	80	
1	72	1009.20	1.10	1.58	9.12	6	82				94	81	
	(144)												
		V = 64.5		W = 2.19							Av. = 62.5		

INTERPOL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job L.P. MONTROSE
 Source Press & Unloading Vent Stack
 Test 8 Run Date 3/31/94
 Stack dimen. 60 IN.
 Dry bulb °F Wet bulb °F
 Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
 Barometric pressure 25.13 in Hg
 Static pressure -1.0 in WC
 Operators D. VanHoever & K. Rosenthal
 Pitot No. V23-6 C_p .84

Cross-section View	Elevation View
Drawing of Test Site	

MDI

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length: in.		Time start: hrs	
A 1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
B 1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
Temp. meas. device & S/N:				Time end: hrs	

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LIP
 Source PRESS & UNLOADING VENT STACK
 Method MDE Filter holder: NA

Date 3/31/94 Test 8 Run 1
 No. of traverse points 24
 Filter type: NA

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: 0 cfm at 17 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: _____ Recovery solvent(s) _____

☐ acetone
☒ other(s) Toluene & Acetonitrile

No. of probe wash bottles: 1

Sample recovered by: DVK

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	<u>271</u>	<u>300</u>	<u>-29</u>
Impinger No. 2	<u>186</u>	<u>200</u>	<u>-14</u>
Impinger No. 3			
Condenser			
Desiccant			<u>13</u>
<u>Charcoal</u>			<u>37</u>
Total			<u>7</u>

Integrated Gas Sampling Data: - Ambient Air

Bag Pump No. _____ Box No. _____ Bag No. _____

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

Pretest leak check: _____ cc/min at _____ in. Hg.

Time start: _____ (HRS) Time end: _____ (HRS)

Sampling rate: _____ cc/min Operator: _____

S/N of O₂ Analyzer used to monitor train outlet: _____

CF-023

INTERPOL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job L.P. MONTROSE Operator DW & KR Pilot No. V23-L Cp. 84
 Source Press & Unloading Vent Meter Box No. 17 SHF 188 IN NC Sur. Press. 25.13 IN HG H2O / X
 Date 3/2/84 Computer code. 9946 Nozzle No. 6455 Nozzle Dia. 82 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (in WC)	Driftless Meter (in WC)	Obs. Vol. (cf)	VAC. in Hg	Temperature (°F)				Gas In	Gas Out	Oxygen (xv/v)
							Stack	Probe	Oven	Inpg.			
B 12	1726	11.66	1.5	2.06	3.80	11	83	259	251	43	76	76	AMBIEN
11	2.5	13.80	1.6	2.22	6.05	12	83				79	76	AIR
10	5	16.10	1.5	2.09	8.23	12	82				71	76	
9	7.5	18.24	1.5	2.08	0.41	12	82	261	257	43	78	76	
8	10	20.50	1.55	2.15	2.62	12	83				78	76	
7	12.5	22.74	1.60	2.22	4.87	12	83				78	76	
6	15	24.91	1.65	2.29	7.16	12	82	257	261	43	79	76	
5	17.5	27.27	1.55	2.16	9.37	12	83				80	76	
4	20	29.41	1.55	2.15	1.59	12	83	259	260	45	80	76	
3	22.5	31.66	1.55	2.16	3.81	12	83				80	77	
2	25	33.84	1.55	2.16	6.02	12	83				80	77	
1	27.5	36.04	1.50	2.09	8.21	12	83	260	261	47	81	77	
A 12	30	38.23	2.0	2.78	0.72	15	83				80	77	
11	32.5	40.73	2.0	2.78	3.24	15	83				80	77	
10	35	43.29	2.0	2.78	5.76	15	83				80	77	
9	37.5	45.77	1.90	2.64	8.21	15	83	260	262	48	80	77	
8	40	48.31	1.70	2.36	0.52	14	82				82	78	
7	42.5	50.59	1.80	2.51	2.92	14	83				83	78	
6	45	52.97	1.70	2.37	5.25	14	84	261	263	47	82	78	
5	47.5	55.25	1.70	2.37	7.58	14	83				81	78	
4	50	57.50	1.70	2.37	9.91	14	83				81	78	
3	52.5	59.93	1.70	2.37	2.23	14	83	263	264	47	82	79	
2	55	62.28	1.60	2.24	4.50	14	83				83	80	
1	57.5	64.53	1.30	1.82	6.54		83				81	78	
	60	66.55											
	1831												
		V _m = 54.89		H = 2.3							Avg. = 78.3		
		Q = 60											

INTERPOL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. MONTROSE Date 3/31/94 Test 8 Run 2
 Source PRESS & UNLOADING VENT STACK No. of traverse points 24
 Method NM2 Filter holder: NA Filter type: NA

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☐
 Posttest: 0.01 cfm at 16 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: _____ Recovery solvent(s) _____

_____ ☐ acetone
 _____ ☒ other(s) TOLUENE + ACETONITRILE

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

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	<u>280</u>	<u>300</u>	<u>-20</u>
Impinger No. 2	<u>169</u>	<u>200</u>	<u>-31</u>
Impinger No. 3			
Condenser			
Desiccant	<u>1427</u>	<u>1404</u>	<u>23</u>
<u>Charcoal</u>	<u>818</u>	<u>780</u>	<u>38</u>
Total			<u>10</u>

Integrated Gas Sampling Data: - Ambient Air

Bag Pump No. _____ Box No. _____ Bag No. _____

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

Pretest leak check: _____ cc/min at _____ in. Hg.

Time start: _____ (HRS) Time end: _____ (HRS)

Sampling rate: _____ cc/min Operator: _____

S/N of O₂ Analyzer used to monitor train outlet: _____

CF-023

INTERPOL LABORATORY EPA METHOD 5 FIELD DATA SHEET

Job L.P. / MANTROSE
 Source PROCESS UNLOADING VENT STACK
 Date 3/31/94

Operator DUN GKR
 Meter Box No. 14
 Gas meter serial 9946

Pilot No. V23-6 CP .84
 Bar. Press. 25.73 inHg H₂O /
 Nozzle No. 6855 Nozzle Dia. .82 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inH ₂ O)	Drifted Meter (inH ₂ O)	Dep. Vol. (cf)	VAC. inHg	Temperature (°F)					Oxygen (xv/v)
							Stack	Probe	Oven	Inlet	Gas Out	
A 12	19.9	68.00	2.1	2.95	0.59	15	77	237	246	77	77	AMBIENT
11	25	70.50	2.0	2.80	3.11	15	77			78	76	AIR
10	5	73.15	1.95	2.73	5.60	15	77			78	76	
9	7.5	75.61	1.80	2.53	8.00	15	77	246	250	78	76	
8	10	77.90	1.70	2.39	0.33	14	77			83	78	
7	12.5	80.25	1.70	2.40	2.67	14	78			78	76	
6	15	82.60	1.65	2.31	4.96	14	78	251	257	78	76	
5	17.5	84.87	1.70	2.38	7.29	14	78			78	76	
4	20	87.19	1.70	2.38	9.62	14	78			78	76	
3	22.5	89.50	1.70	2.38	1.94	14	78	253	256	78	76	
2	25	91.80	1.70	2.38	4.27	14	78			78	76	
1	27.5	94.16	1.40	1.97	6.37	13	77			79	76	
B 12	30	96.29	1.65	2.32	8.69	14	77	257	256	77	76	
11	32.5	98.54	1.6	2.25	0.95	14	76			77	76	
10	35	100.95	1.70	2.39	3.28	14	76			77	76	
9	37.5	103.26	1.70	2.39	5.60	14	76	257	258	77	76	
8	40	105.57	1.70	2.38	7.93	14	77			77	75	
7	42.5	107.90	1.60	2.25	0.19	14	76			78	75	
6	45	110.11	1.60	2.24	2.45	14	77	260	261	78	75	
5	47.5	112.40	1.65	2.31	4.74	14	77			78	75	
4	50	114.68	1.60	2.24	7.00	14	77			78	75	
3	52.5	117.00	1.60	2.24	9.26	14	77	263	260	77	75	
2	55	119.20	1.10	1.55	1.14	10	76			77	75	
1	57.5	121.19	1.0	1.47	2.93	10	76			77	75	
	60	122.90										
	(20.33)											
	Ø = 60	V _m = 54.9		ΔH = 2.32								Avg. = 76.8

INTERPOL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LP MONTROSE Date 3/31/94 Test 8 Run 3
 Source PRESS & UNLOADING VENT STACK No. of traverse points 24
 Method MDE Filter holder: NR Filter type: NR

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: +0.1 cfm at 16 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: Recovery solvent(s)

☐ acetone
☒ other(s) TOLUENE & ACETONITRILE

No. of probe wash bottles: 2
 Sample recovered by: DULL

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	261	300	-39
Impinger No. 2	201	200	1
Impinger No. 3			
Condenser			
Desiccant	1420	1407	13
Charcoal	839	807	32
Total			7

Integrated Gas Sampling Data: - Ambient Air

Bag Pump No. _____ Box No. _____ Bag No. _____

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

Pretest leak check: _____ cc/min at _____ in. Hg.

Time start: _____ (HRS) Time end: _____ (HRS)

Sampling rate: _____ cc/min Operator: _____

S/N of O₂ Analyzer used to monitor train outlet: _____

CF-023

APPENDIX E

INTERPOLL LABORATORIES ANALYTICAL DATA

TABLE OF CONTENTS

Orsat	1
Particulate	3
Formaldehyde	10
MDI	11
Sample Deposition Sheets	12

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job L.P. / Mentore CO
Team Leader D. Van Hever
Date Submitted 3-30-94
Test No. 1
Date of Analysis 3-30-94

Source Dry
Test Site Stack
Date of Test 3-30-94
No. of Runs Completed 2
Technician Mark Baehler

Test/ Run	Sample Log Number and Type	No. of An.	Buret Readings (ml)			Conc. CO ₂ %v/v Dry	Conc. O ₂ %v/v Dry	F _o
			Zero Pt.	After CO ₂	After O ₂			
1/1	☒ B ☐ F	1	0.00	3.00	20.60	3.00	17.60	1.100
		2	0.00	3.00	20.60	3.00	17.60	1.100
		Avg				3.00	17.60	
1/2	☒ B ☐ F	1	0.00	2.90	20.60	2.90	17.70	1.103
		2	0.00	2.90	20.60	2.90	17.70	1.103
		Avg				2.90	17.70	
1/3	☒ B ☐ F	1	0.00	3.20	20.60	3.20	17.40	1.094
		2	0.00	3.20	20.60	3.20	17.40	1.094
		Avg				3.20	17.40	
	☐ B ☐ F	1						
		2						
		Avg						
	☐ B ☐ F	1						
		2						
		Avg						
	☐ B ☐ F	1						
		2						
		Avg						
	☐ B ☐ F	1						
		2						
		Avg						
	☐ B ☐ F	1						
		2						
		Avg						
	☐ B ☐ F	1						
		2						
		Avg						
	☐ B ☐ F	1						
		2						
		Avg						

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

Where $F_o = 20.9 - O_2$
CO₂

EPA Method 3 Guidelines
Fuel Type F_o Range

Coal:
Anthracite/Lignite 1.016-1.130
Bituminous 1.083-1.230
Oil:
Distillate 1.260-1.413
Residual 1.210-1.370
Gas:
Natural 1.600-1.836
Propane 1.434-1.586
Butane 1.405-1.553
E-1 Wood/Wood Bark 1.000-1.130

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

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job L.P. Montrose

Team Leader DWH

Date Submitted 4-8-94

Test No. 2

Date of Analysis 4-4-94

Source Dryer

Test Site Stack

Date of Test 3-30-94

No. of Runs Completed 3

Technician C. Helgeson

Test/ Run	Sample Log Number and Type	No. of An.	Buret Readings (ml)			Conc. CO ₂ %v/v Dry	Conc. O ₂ %v/v Dry	F _o
			Zero Pt.	After CO ₂	After O ₂			
2/1	5558-39 B B F	1	0.00	2.30	20.90	2.30	18.60	1.00
		2	0.00	2.30	20.90	2.30	18.60	1.00
		Avg				2.30	18.60	
2/2	-40 B B F	1	0.00	2.70	20.90	2.70	18.20	1.00
		2	0.00	2.70	20.90	2.70	18.20	1.00
		Avg				2.70	18.20	
2/3	-41 B B F	1	0.00	2.80	20.90	2.80	18.10	1.00
		2	0.00	2.80	20.90	2.80	18.10	1.00
		Avg				2.80	18.10	
	B B F	1						
		2						
		Avg						
	B B F	1						
		2						
		Avg						
	B B F	1						
		2						
		Avg						
	B B F	1						
		2						
		Avg						
	B B F	1						
		2						
		Avg						
	B B F	1						
		2						
		Avg						
	B B F	1						
		2						
		Avg						
	B B F	1						
		2						
		Avg						

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

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

EPA Method 3 Guidelines
Fuel Type F_o Range

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

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

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Impinger Catch/~~Wisconsin~~ Protocol M 202

Job L. P. Montrose Source P U Vent
Team Leader DVH Test Site Stack
Date Submitted 4-4-94 Date of Test 3-31-94
Test No. 5 No. of Runs Completed 3
Date of Analysis 4-4-94 Technician C. Helgeson

	Solvent Phase	Aqueous Phase
0	Test <u>Run 0</u> Field Blank Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
1	Test <u>5</u> Run <u>1</u> Log Number <u>2558-45</u> Comments _____	Dish No. <u>312</u> Dish Tare Wt. <u>45.2372</u> g Dish+Sample Wt. <u>45.2463</u> g Sample Wt. <u>0.0091</u> g
2	Test <u>5</u> Run <u>2</u> Log Number <u>-49</u> Comments _____	Dish No. <u>328</u> Dish Tare Wt. <u>41.9670</u> g Dish+Sample Wt. <u>41.9695</u> g Sample Wt. <u>0.0025</u> g
3	Test <u>5</u> Run <u>3</u> Log Number <u>-53</u> Comments _____	Dish No. <u>403</u> Dish Tare Wt. <u>47.0978</u> g Dish+Sample Wt. <u>47.1052</u> g Sample Wt. <u>0.0074</u> g
4	Test <u>Run</u> _____ Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
5	Test <u>Run</u> _____ Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g

Results Solvent Phase:

Field Blk.	Run 1	Run 2	Run 3	Blank Solvent Wt. <u>0.0002g</u>	Run 4	Run 5
	<u>0.0089</u>	<u>0.0023</u>	<u>0.0072</u>			

Results Aqueous Phase:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	<u>0.0022</u>	<u>0.0032</u>	<u>0.0023</u>	<u>E-6</u>	

LSC-03WYR

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job L.P. Montrose Source P-U vent
Team Leader DVH Test Site Stack
Date Submitted 4-4-94 Date of Test 3-31-94
Test No. 5 No. of Runs Completed 3
Date of Analysis 4-4-94 Technician C. Helgeson
Transport Leakage ☒ None ☐ _____ ml Solvent Acetone

0	Test <u>Run 0</u> Field Blank Log Number _____ Vol. of Solvent _____ ml *Solvent Residue <u>3.00</u> ug/ml	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
1	Test <u>5</u> Run <u>1</u> Vol. of Solvent <u>125</u> ml Log Number <u>2558-42</u> Comments _____	Dish No. <u>405</u> Dish Tare Wt. <u>48.4892</u> g Dish+Sample Wt. <u>48.5010</u> g Sample Wt. <u>0.0118</u> g
2	Test <u>5</u> Run <u>2</u> Vol. of Solvent <u>140</u> ml Log Number <u>-47</u> Comments _____	Dish No. <u>502</u> Dish Tare Wt. <u>46.9010</u> g Dish+Sample Wt. <u>46.9674</u> g Sample Wt. <u>0.0064</u> g
3	Test <u>5</u> Run <u>3</u> Vol. of Solvent <u>150</u> ml Log Number <u>-51</u> Comments _____	Dish No. <u>504</u> Dish Tare Wt. <u>50.0208</u> g Dish+Sample Wt. <u>50.0298</u> g Sample Wt. <u>0.0090</u> g
4	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
5	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g

Solvent Residue _____ ug/ml = [(Sample Wt. _____ g) (10)] / Vol. of Sol. _____ ml
EPA-M5 Acetone Residue Blank Spec. {7.3 ug/ml

Results:

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

	<u>0.0114</u>	<u>0.0060</u>	<u>0.0085</u>	<u>E-7</u>	
--	---------------	---------------	---------------	------------	--

1 cc 0110

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job C.P. Montrose Source Press + Unloading Vent
Team Leader DUH Test Site Sfeck
Date Submitted 4-4-94 Date of Test 3-31-94
Test No. 5 No. of Runs Completed 3
Date of Analysis 4-4-94 Technician C. Helgeson

0	Test <u>5</u> Run <u>0</u> Field Blank Log Number <u>2558-43</u> Comments _____	Filter No. <u>6254</u> Filter Type <u>4"GF</u> Filter Tare Wt. <u>.8641</u> g Filter+Sample Wt. <u>.8644</u> g Sample Wt. <u>.0003</u> g
1	Test <u>5</u> Run <u>1</u> Log Number <u>-44</u> Comments _____	Filter No. <u>6250</u> Filter Type <u>4"GF</u> Filter Tare Wt. <u>.9050</u> g Filter+Sample Wt. <u>.9075</u> g Sample Wt. <u>0.0025</u> g
2	Test <u>5</u> Run <u>2</u> Log Number <u>-48</u> Comments _____	Filter No. <u>6251</u> Filter Type <u>4"GF</u> Filter Tare Wt. <u>.9110</u> g Filter+Sample Wt. <u>.9139</u> g Sample Wt. <u>0.0029</u> g
3	Test <u>5</u> Run <u>3</u> Log Number <u>-52</u> Comments _____	Filter No. <u>6252</u> Filter Type <u>4"GF</u> Filter Tare Wt. <u>.8630</u> g Filter+Sample Wt. <u>.8661</u> g Sample Wt. <u>0.0031</u> g
4	Test _____ Run _____ Log Number _____ Comments _____	Filter No. _____ Filter Type _____ Filter Tare Wt. _____ g Filter+Sample Wt. _____ g Sample Wt. _____ g
5	Test _____ Run _____ Log Number _____ Comments _____	Filter No. _____ Filter Type _____ Filter Tare Wt. _____ g Filter+Sample Wt. _____ g Sample Wt. _____ g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0025	0.0029	0.0031		

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

Interpoll Laboratories, Inc.
(612) 786-6020

Ion Chromatography Laboratory

DIONEX MODEL 40001 WITH ANION MICRO MEMBRANE SUPPRESSION

Analyst: Sms

Date of Analysis: 4-5-94

Job: L.P. Montrose

Source: Test 2 Dryer 5700 X
Test 5 Press Unloading Site

Chromatography Conditions

Column	Flow Rate	Eluent	Flow Rate	Suppressor Acid
AS3	ml/min	2.4 mM Na ₂ CO ₃ & 3.0 mM NaHCO ₃	10 ml/min	12.5 mM Sulfuric Acid
X AS4A	2 ml/min	1.8 mM Na ₂ CO ₃ & 1.7 mM NaHCO ₃	ml/min	
AS5	ml/min	100 mM NaOH	X	Isocratic
	ml/min			Gradient (List program below)

Gradient Program	Time (Min.)									
Eluent	0.0									
% A										
% B										

Results of Sulfate Determination

Sample Name	Interpoll Log Number	Tot. Sample Volume (ml)	Dilution	Solution Conc. (ug/ml)	Total ug Sulfate	meq of Sulfate
2/6	2558-25		1	x 0.147		
2/1	-28		1	x 0.706		
2/2	-32		1	x 0.965		
2/3	-36		1	x 0.433 0.440		
5/1	-45		1	x 0.549		
5/2	-49		1	x 0.141		
5/3	-53		1	x 0.114		

Total ug = (Sample Vol.) x (Dilution) x (Solution Conc.)

meq = Total ug / 48000

25ml aliquot received from Curt H.

LSC-08RR

EPA Method 202 Calculations

Report No. 4-2558

Job: LOUISIANA PACIFIC - Montrose

Date: 30-Mar-94

Dryer Stack

RUN	Vic (ml)	Sulfate (mg/ml)	Mc (mg)	Mr (mg)	Mi (mg)	Mo (mg)	Mb (mg)	ENTER IN CPM COMPUTER (mg) (g)
1	250	7.08E-04	0.03	9.3	9.27	9.9	0.5	18.67 0.018668
2	250	9.65E-04	0.04	10.6	10.56	9.7	0.5	19.76 0.019756
3	250	4.33E-04	0.02	10.9	10.88	10.2	0.5	20.58 0.02058

EPA Method 201A/202 Totals

RUN	Probe (mg)	Filter (mg)	CPM (mg)	Total (mg)
1	32.9	15.1	18.67	66.66752
2	20.4	13.2	19.76	53.35681
3	20.4	13.2	20.58	54.18008

Press & Unloading Vent Stack

RUN	Vic (ml)	Sulfate (mg/ml)	Mc (mg)	Mr (mg)	Mi (mg)	Mo (mg)	Mb (mg)	ENTER IN CPM COMPUTER (mg) (g)
1	250	5.49E-04	0.03	2.2	2.17	8.9	0.5	10.57 0.010575
2	250	1.46E-04	0.01	3.2	3.19	2.3	0.5	4.99 0.004993
3	250	1.14E-04	0.01	2.3	2.29	7.2	0.5	8.99 0.008995

EPA Method 201A/202 Totals

RUN	Probe (mg)	Filter (mg)	CPM (mg)	Total (mg)
1	11.4	2.5	10.57	24.47475
2	6	2.9	4.99	13.89328
3	8.5	3.1	8.99	20.59476

INTERPOLL LABORATORIES INC.

Formaldehyde Results By EPA Method 0011 For L.P. Montrose Collected 3/29 - 3/31/94

Item	Field Spike*			Test 3		
	Actual	Found	% Recovery	F. Blank	Run 1	Run 2
Dryer Stack						
Log #		2558-24		2558-01	2558-02/03	2558-04/05
Date Analyzed		4/22/94		4/19/94	4/20/94	4/20/94
Mass (ug)**	750	588	78	2.68	37700	55000
Press & Unloading Vent						
Log #				2558-16	2558-17/18	2558-19/20
Date Analyzed				4/20/94	4/20/94	4/20/94
Mass (ug)**				4.90	4830	3220
						2630

** = Total Mass of formaldehyde in the sample in ug.

INTERPOLL LABORATORIES INC.

MDI Results For L.P. Montrose Collected 3/29 - 3/31/94

Press & Unloading Vent	Test 8					
	Field Blank	Run 1 First Impinger, Catch, Probe Wash & Rinse	Run 1 Second Impinger Catch & Rinse	Run 2 First Impinger, Catch, Probe Wash & Rinse	Run 2 Second Impinger Catch & Rinse	Run 3 First Impinger, Catch, Probe Wash & Rinse
Log #	2558-08	2558-10	2558-11	2558-12	2558-13	2558-14
Date Analyzed	4/24/94	4/24/94	4/24/94	4/24/94	4/25/94	4/25/94
Mass (ug)	<2.5	56.0	<2.5	54.5	<2.5	54.5
						Second Impinger Catch & Rinse
						2558-15
						4/25/94
						<2.5

Interpoll Laboratories

(612) 786-6020

SAMPLE CHAIN OF CUSTODY

Job L.P. MONTROSE Source DEYER STACK Site 3
 Field Engineer D-14 Date of Test 3/29/94 Test No. 1 No. of Runs 3

# ITEMS	SAMPLE TYPE	ANALYSIS	LOG NUMBER	COMMENTS
3	Probe Wash: ☐ Acetone ☒ MeCl ₂	☐ EPA M-5 ☐ EPA M-29	☐ EPA M-201A ☒ <u>0011</u>	
	Filter: ☐ 4" Glass ☐ 55 Thimble	☐ EPA M-5 ☐ EPA M-29 ☐ EPA M-201A	☐ EPA M-17	
5	Impingers: ☐ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☒ 2,4-DNPH	☐ MN Protocol ☐ WI Protocol ☐ EPA M-202 ☐ EPA M-6,8 ☐ Acid Gases	☐ IIA Protocol ☐ Formaldehyde ☐ EPA M-29 ☐ EPA M-26 ☒ <u>0011</u>	<u>1 SPIKE</u> <u>a</u> <u>1 Blank</u> <u>INCLUDED</u>
	Integrated Gas: ☐ Tedlar Bag	☐ EPA M-3	☐ EPA M-10	
	Oxides of Nitrogen:	☐ EPA M-7A		
	Fuel Lab: ☐ Fuel Sample	☐ 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
<u>Diane Van Hower</u>	<u>Scotty, J. Toypul</u>	<u>4/4/94 0900</u>

Interpoll Laboratories
(612) 786-6020

SAMPLE CHAIN OF CUSTODY

Job L.P. MONTROSE Source Dryer Site Stack
Field Engineer DW Date of Test 3/29/94 Test No. 2 No. of Runs 3

# ITEMS	SAMPLE TYPE	ANALYSIS	LOG NUMBER	COMMENTS
4	Probe Wash: ☒ Acetone ☐ MeCl ₂	☒ EPA M-5 ☐ EPA M-29	☐ EPA M-201A ☐	
4	Filter: ☒ 4" Glass ☐ SS Thimble	☒ EPA M-5 ☐ EPA M-29 ☐ EPA M-201A	☐ EPA M-17	
4 pairs	Impingers: ☒ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☐ 2,4-DNPH ☒ H ₂ SO ₄ ☐ HNO ₃ /H ₂ O ₂ ☐ KMnO ₄ /H ₂ SO ₄ ☒ MECC ₂	☐ MN Protocol ☐ WI Protocol ☒ EPA M-202 ☐ EPA M-6,8 ☐ Acid Gases	☐ IIA Protocol ☐ Formaldehyde ☐ EPA M-29 ☐ EPA M-26 ☐	
	Integrated Gas: ☒ Tedlar Bag	☒ EPA M-3 ☐	☐ EPA M-10	
	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 <u>Joanne Conner</u>	Accepted by/Affiliation <u>Bob Sney, Interpoll</u>	Date <u>4/4/94</u>
		<u>0900</u>

Interpoll Laboratories

(612) 786-6020

SAMPLE CHAIN OF CUSTODY

Job L.P. Montrose Source Press & Unloading Site Stack
 Field Engineer DW Date of Test 3/31/91 Test No. 5 No. of Runs 1

# ITEMS	SAMPLE TYPE	ANALYSIS	LOG NUMBER	COMMENTS
4	Probe Wash: ☒ Acetone ☐ MeCl ₂ ☐ DI Water ☐	☒ EPA M-5 ☐ EPA M-29 ☐ EPA M-201A		
4	Filter: ☒ 4" Glass ☐ SS Thimble ☐ Pallflex ☐ 2.5" Glass	☒ EPA M-5 ☐ EPA M-29 ☐ EPA M-201A		
4	Impingers: ☒ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☐ 2,4-DNPH ☒ H ₂ SO ₄ ☐ HNO ₃ /H ₂ O ₂ ☐ KMnO ₄ /H ₂ SO ₄ ☒ MECC-7 Base	☐ MN Protocol ☐ WI Protocol ☒ EPA M-202 ☐ EPA M-6,8 ☐ Acid Gases ☐ IIA Protocol ☐ Formaldehyde ☐ EPA M-29 ☐ EPA M-26		
0	Integrated Gas: ☐ Tedlar Bag ☐	☐ EPA M-3 ☐ EPA M-10		Ambient Air
	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 ☐ Wood: ☐ Wood Waste ☐ Oil: ☐ Waste Oil ☐ Natural Gas
☐ Anthracite ☐ Dust ☐ No. 2 ☐ RDF
☐ Lignite ☐ Bark ☐ No. 6 ☐

Relinquished by/Affiliation <u>Dwane Van Haver</u>	Accepted by/Affiliation <u>Bobbing, J. T. J. J.</u>	Date <u>4/4/91 0900</u>
---	--	----------------------------

Interpoll Laboratories
(612) 786-6020

SAMPLE CHAIN OF CUSTODY

Job L.P. / Montrose, CO Source Presidential Vent Site Stack
Field Engineer M. Kuebler Date of Test 3-31-94 Test No. 6 No. of Runs 3

# ITEMS	SAMPLE TYPE	ANALYSIS	LOG NUMBER	COMMENTS
3+1	Probe Wash: ☐ Acetone ☒ MeCl ₃	☐ EPA M-5 ☐ EPA M-29	☐ EPA M-201A ☒ EPA M-201	
—	Filter: ☐ 4" Glass ☐ SS Thimble	☐ EPA M-5 ☐ EPA M-29 ☐ EPA M-201A	☐ EPA M-17	
3+1	Impingers: ☐ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☒ 2,4-DNPH	☐ MN Protocol ☐ WI Protocol ☐ EPA M-202 ☐ EPA M-6,8 ☐ Acid Gases	☐ IA Protocol ☒ Formaldehyde ☐ EPA M-29 ☐ EPA M-26 ☐	
—	Integrated Gas: ☐ Tedlar Bag	☐ EPA M-3	☐ EPA M-10	Ambient Air
—	Oxides of Nitrogen:	☐ EPA M-7A		
—	Fuel Lab: ☐ Fuel Sample	☐ Per S-0163		
—	Particle Sizing:	☐ X-Ray Sdgraph ☐	☐ Cascade Imp	
—	Miscellaneous:	☐		

Fuel Type: Coal: ☐ Bituminous ☐ Wood: ☐ Wood Waste ☐ Oil: ☐ Waste Oil
 Anthracite ☐ Natural Gas
 Lignite ☐ RDF
 Misc: ☐

Relinquished by/Affiliation	Accepted by/Affiliation	Date
Mark Gaebler / Interpoll Labs	Bob J. Torp	4/4/94 0900

Interpoll Laboratories

(612) 786-6020

SAMPLE CHAIN OF CUSTODY

Source

Job L.P. MONTROSE

Field Engineer DUT

Date of Test 3/31/94 Test No. 8 No. of Runs

# ITEMS	SAMPLE TYPE	ANALYSIS	LOG NUMBER	COMMENTS
	Probe Wash: ☐ Acetone ☐ MeCl ₂	☐ DI Water ☐		
	Filter: ☐ 4" Glass ☐ SS Thimble	☐ Pallflex ☐ 2.5" Glass		
5	Impingers: ☐ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☐ 2,4-DNPH	☐ H ₂ SO ₄ ☐ HNO ₃ /H ₂ O ₂ ☐ KMnO ₄ /H ₂ SO ₄ ☒ 1-2 PP	1-2 PP	Blank 9 spikes 3 paired impingers (1+2)
	Integrated Gas: ☐ Tedlar Bag	☐ EPA M-3 ☐		
	Oxides of Nitrogen:	☐ EPA M-7A ☐		
	Fuel Lab: ☐ Fuel Sample	☐ Per S-0163		
	Particle Sizing:	☐ X-Ray Sdgraph ☐ Cascade Imp ☐		
	Miscellaneous: ☐	☐		

Fuel Type: Coal: ☐ Bituminous ☐ Wood: ☐ Wood Waste ☐ Oil: ☐ Waste Oil
☐ Anthracite ☐ IDust ☐ No. 2
☐ Lignite ☐ No. 6

Misc: ☐ Natural Gas
☐ RDF
☐

Retinquished by/Affiliation	Accepted by/Affiliation	Date
<u>Dennis Van Horn</u>	<u>Suberg, Ted. sp. 11</u>	<u>4/4/94 0900</u>

Q12ACKWPTFORM35-276-2.LAS

S-278

APPENDIX F

TOTAL HYDROCARBONS AND CO STRIPCHART

CIARI NO. B9565AW/NN

0 20 40 60 80 100

(Base)

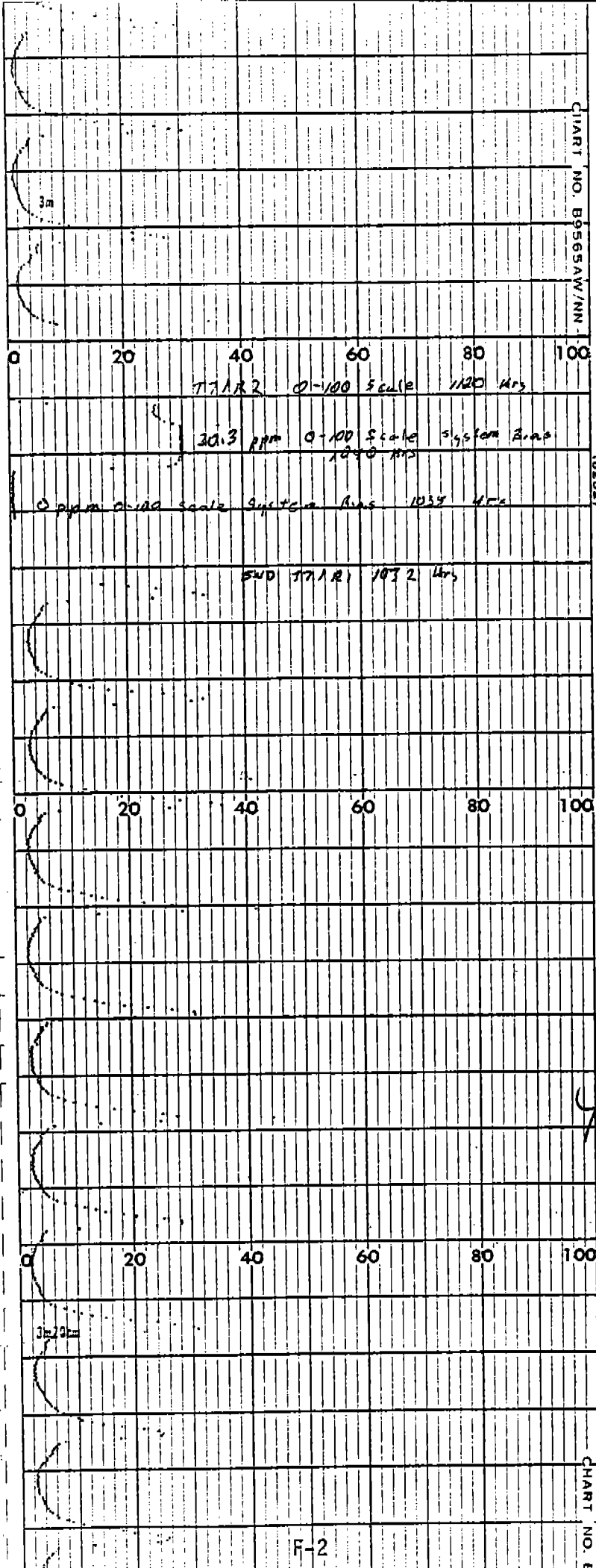
0 20 40 60 80 100

Run 1 →
Start
(0927HRS)

3m40cm
771.01 0.00 Scale 0927 Hrs
Ambient Thru Probe 0921 Hrs
30.3 ppm 0-100 Scale System Bias
0918 Hrs
0 ppm 0-100 Scale System Bias 0915 Hrs Press Vmt 3-11-91

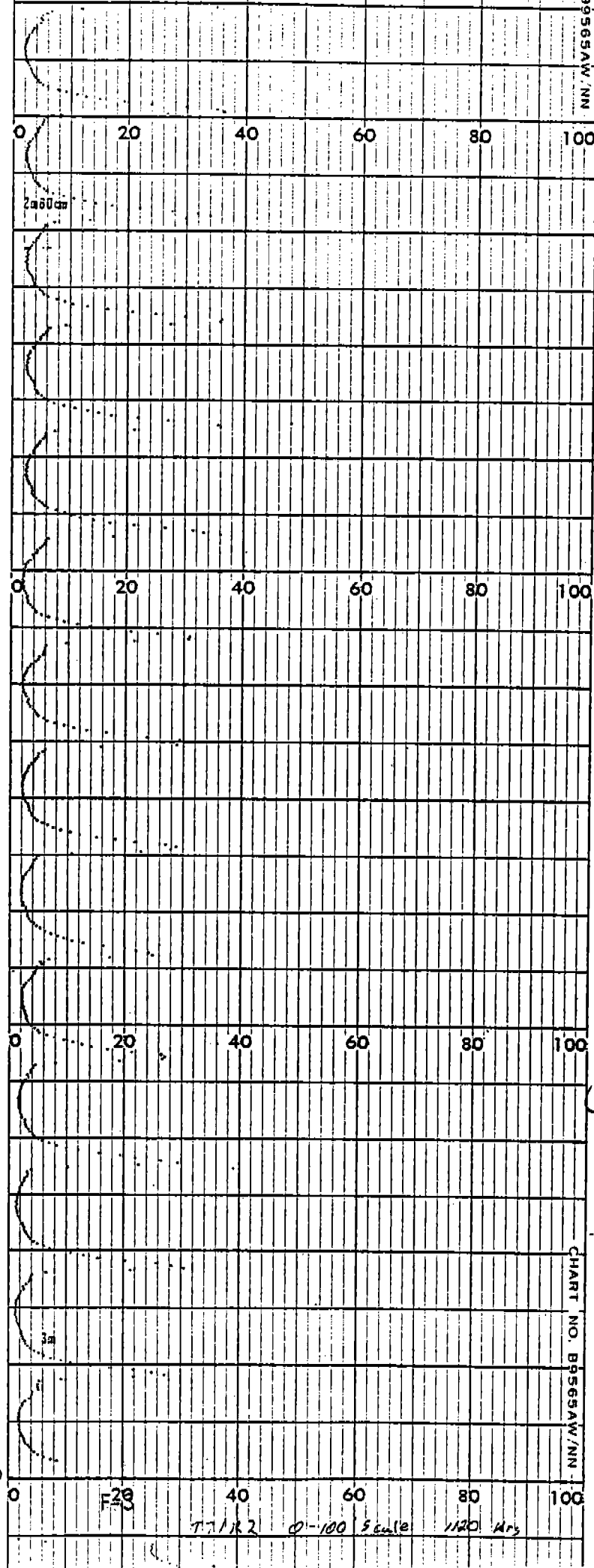
Louisa Pacific
Montrose, CO
THC's

Run 1 →
End
(1032 HRS)



LP
Montrose
THC's

9565AW/NN



10202

LP-
Montrose
TAC'S

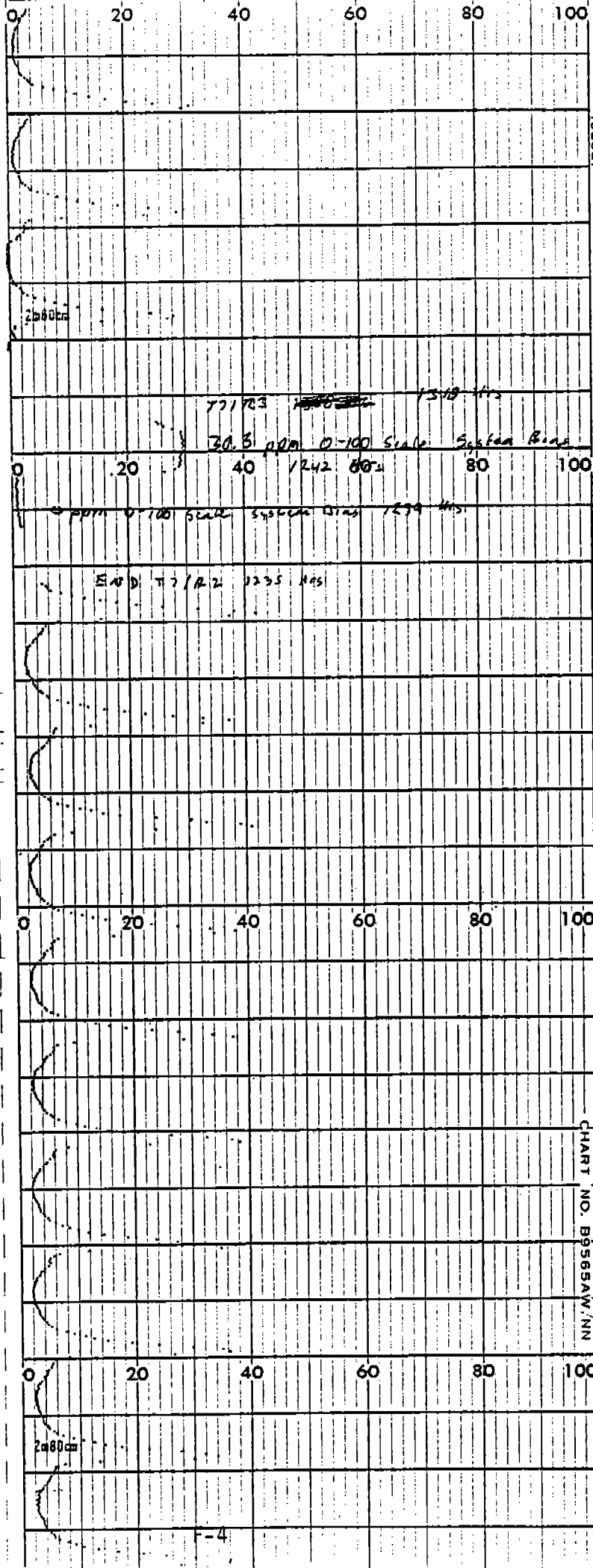
CHART NO. 9565AW/NN

Test 2
Start →
(1120 HRS)

T. 71 R. 2 0-100 Scale 1120 Hrs

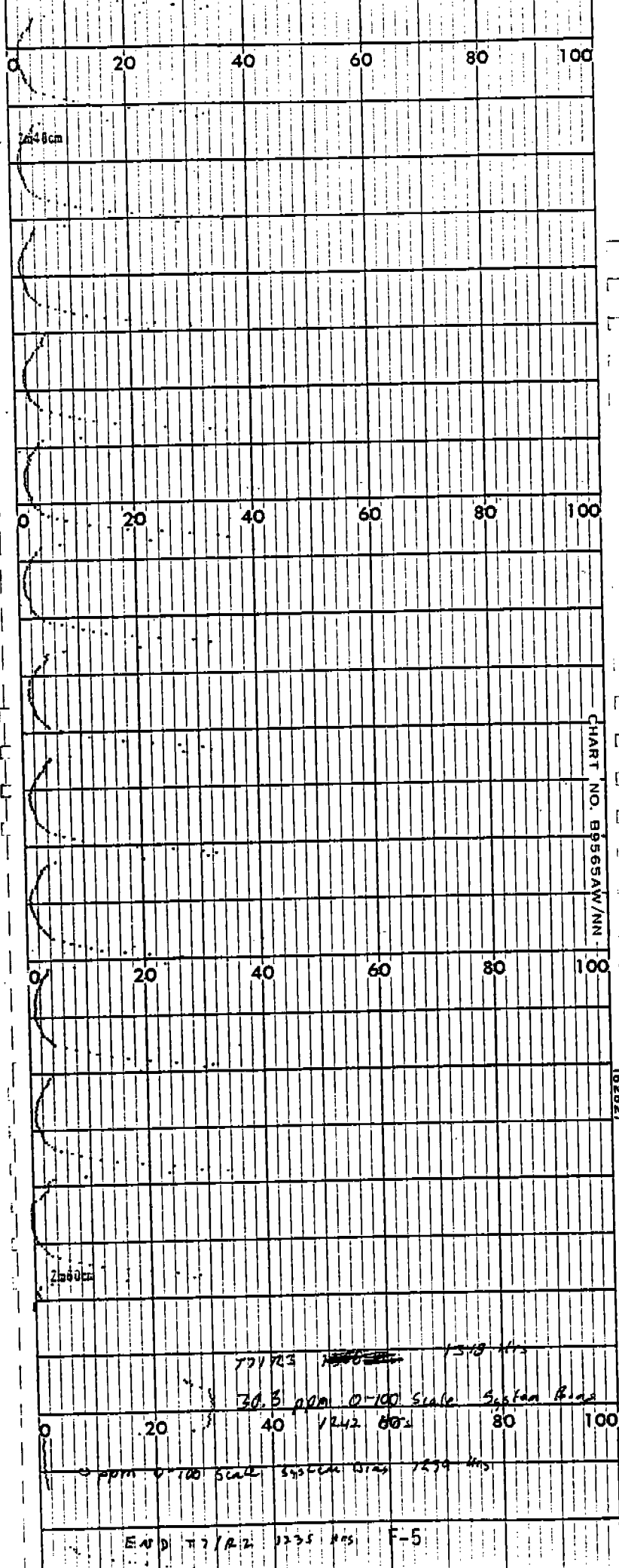
Test 2 →
End
(1235 HRS)

LP-
Montrose
THC's



LP-
Montrose
THC'S

Run 3
Start
(1318 HRS)



Monroze, CO
Press + Unloading Unit
Stack
THe
Method 25A

0 20 Analyze No. 3 60 80 100
3-51-94

2x20cm

30.9 ppm 0-100 Scale
System Bias 1438 Hrs

0 ppm 0-100 Scale System Bias 1436 Hrs

0 20 40 60 80 100
F 1 1431 Hrs

Run 3
End
(1431 HRS)

CHART NO. B9565AW/NN

(02827)

0 20 40 60 80 100

0 20 40 60 80 100

F 6

1	36.3 ppm	0-100 Scale	System Bias	0826 Hrs
1	0.7 ppm	0-100 Scale	System Bias	0753 Hrs
Ambient thru All probes 1103 Hrs				
0	20	40	60	80 100
		30.3 ppm	0-100 Scale	System Bias
				1056 Hrs
5000				
0 ppm	0-100 Scale	System Bias	1052 Hrs	Stack
		610 ppm	0-1,000 Scale	System Bias 1049 Hrs
				Stack
		0 ppm	0-1,000 Scale	System Bias 1043 Hrs
				Stack
		144.8 ppm	0-500 Scale	System Bias 1036 Hrs
				Stack
		0 ppm	0-500 Scale	System Bias 1023 Hrs
				Stack
0	20	40	60	80 100
		2960 ppm	0-10,000 Scale	Linearity Check
				0840 Hrs
		36.3 ppm	0-100 Scale	Linearity Check
				0837 Hrs
		30.3 ppm	0-100 Scale	Linearity Check
				0836 Hrs
		0 ppm	0-100 Scale	Linearity Check
				0820 Hrs
		0 ppm	0-100 Scale	Linearity Check
				0819 Hrs
0	20	40	60	80 100
		610 ppm	0-1,000 Scale	Stack
				0837 Hrs
		312 ppm	0-1,000 Scale	Stack
				0830
		312 ppm	0-500 Scale	Stack
				0830
		144.8 ppm	0-500 Scale	Stack
				0828 Hrs
		5000 ppm	0-500 Scale	Stack
				0818 Hrs
		0-1,000 Scale	Stack	

CHART NO. B9565AW/NN

08021

0 20 40 60 80 100

5m40cm

CHART NO. B9565AW/NN

0 20 40 60 80 100

FO Jula Green
Scale Scale

TAC

Run Simulation only
w/ 44 T1/R3

Run #1 1223 hrs

Test #3 CO Inlet 0-500 Scale Test #4 TAC 0-1000
Scale 0-1000 Scale Scale Scale

1491.8 ppm CO System Bias 0855 hrs
T1/R3

0 20 40 60 80 100

6210 ppm CO
System Bias 0950 hrs
Scale

0 ppm 0-1000 Scale System Bias 0834 hrs
Scale

1363 ppm 0-1000 Scale System Bias
0826 hrs

0 ppm 0-1000 Scale System Bias 0753 hrs

Ambient Flow All probes 1103 hrs

F-8

0 ppm CO 940 cm Bits 1336 Hz Inlet

0.580 Scale

0 20 40 60 80 100

940 cm Bits 1336 Hz

CHART NO. B9565AW/NN

0 20 40 60 80 100

5m20cm

10027

0 20 40 60 80 100

Powr Change Stack

0 20 40 60 80 100

Run Simultaneous
with T2 / R1
Run No. 2 1430 hrs

New O TMC Stack 1414 hrs

30.3 ppm O-1,000 Scale
System Bias 1414 hrs

0 ppm O-1,000 Scale System Bias 1410 hrs

New O Stack CO Stack 1403 hrs
0 20 40 60 80 100

620 ppm CO O-1,000 Scale
System Bias 1402 hrs
Stack

0 ppm CO O-1,000 Scale System Bias 1352 hrs Stack

New O Run 2 Stack 1346 hrs
0 20 40 60 80 100

144.8 ppm CO System Bias
1343 hrs Inlet

0 ppm CO System Bias 1336 hrs Inlet
0-500 Scale

CHART NO. B9565AW/NN

0 20 40 60 80 100

(6252)

0 20 40 60 80 100

4.38 cm

Port Change Stack

0 20 40 60 80 100

Run 5. mu / tanesls
with T2 / R1

Run No. 2 1430 Hz

CHART NO.

NEW 0 JWC Stack 1416 Hz F=11

144.8 ppm CO System Bias
 16110 hrs 0-500 Scale Inlet

0 ppm CO 0-500 Scale System Bias 1603 hr Inlet

0 Base Run No. 2 CO 0-1000 Scale Stack

CHART NO. B9565AW/NN

0 20 40 60 80 100

620 ppm CO 0-1000 Scale
 System Bias 1543 hrs

(6252)

512 ppm CO 0-1000 Scale
 System Bias 1544 hrs

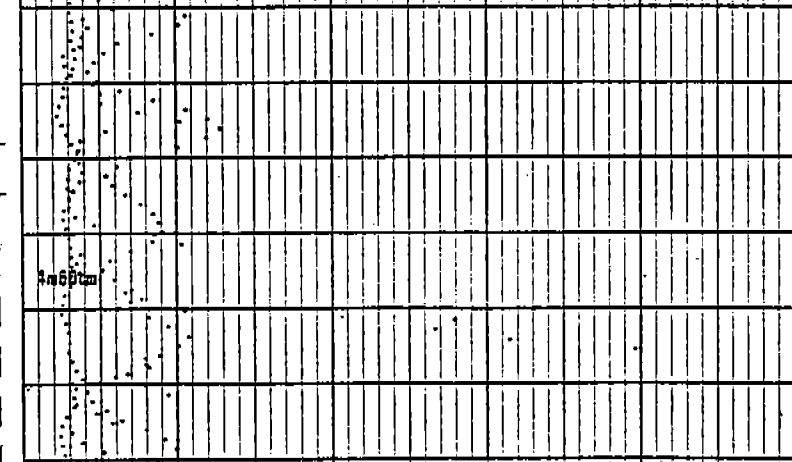
304 ppm CO 0-1000 Scale
 System Bias 1545 hrs

30.3 ppm CO 0-1000 Scale 34-Hr Bias 1543 hrs

0 ppm CO RTHC 1541 hrs CO 0-1000 Scale
 System Bias 40 1540 0-1000 Scale

0 20 40 60 80 100

END Run No. 2 1535 hrs



0 20 40 60 80 100

F-12

CHART NO.

0 20 40 60 80 100

CHART NO. B9565AW/NN

0 20 40 60 80 100

(6252)

0 20 40 60 80 100

Run Simultaneous only
LH 11/12 T 2 1/2

0 20 40 60 80 100

0 Base Run Nav 3 CO 11/13 0-500 Simult

Run Simultaneous with T2/1000

Run No. 4 CO Only Inlet 0-500 Scale
Scale 0-1200 Scale

312 ppm CO 0-1000 Scale
System Bias 1749 hrs

CHART NO. B9565AW/NN

50.3 ppm CO 0-1000 Scale System Bias 1733 hrs

54 ppm CO 0-1000 Scale System Bias 1710 hrs

0 Base Run No. 4 CO Inlet 0-500 Scale 80
1730 hrs

4m

144.4 ppm CO 0-500 Scale
System Bias 1730 hrs Inlet

0 ppm CO 0-500 Scale System Bias 1729 hrs Inlet

End Run No. 3 1732 hrs

0 20 40 60 80 100

0 20 40 60 80 100

END R.H. No. 9 1900 Hrs

0 20 40 60 80 100

3m60cm

0 20 40 60 80 100

CHART NO. B9563AW/NN

0 20 40 60 80 100

(6252)

3m60cm

0 20 40 60 80 100

F-15

A.P.
 Montrose, CO
 Dryer
 Stack
 3-30-94
 Methods 10 & 25 A

HART NO. B9565AW/NN

0 20 40 60 80 100

312 ppm 0-1000 Scale System Bars 1925 hrs Stack

(BASE)

0 ppm 0-1000 Scale System Bars 1920 hrs Stack

144.8 ppm 0-500 Scale System Bars 1914 hrs Smiled

0 ppm 0-500 Scale System Bars 1900 hrs

END Run No. 4 1900 Hrs

0 20 40 60 80 100

3m60cm

0 20 40 60 80 100

F-16

CHART

APPENDIX G

ANALYZER SPECIFICATIONS

SPECIFICATIONS FOR ACS MODEL 3300 CO NDIR

Measuring principle	NDIR single beam method
Operating ranges	0 - 500 ppm 0 - 1000 ppm
Reproducibility	$\pm 0.5\%$ of full scale
Stability	Zero drift; $\pm\%$ of full scale/24H Span drift; $\pm\%$ 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 500 Ω max.)
Linearity	Better than $\pm 2\%$ of full scale (when linearizer is used)
Power supply	AC 115 V $\pm$ 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.



TOTAL HYDROCARBON ANALYZER (FLAME IONIZATION)
Model RS 55

TECHNICAL DATA

MAINS : 115V/60H

RECORDER OUTPUT : 0 - 5 V / 4-20mA

MODEL: ☒ Manual switching
☐ Solenoid valves

HOUSING: ☐ Case, ☐ 19"-Rack

MEASURING RANGES:	1 = 0 - 10	C ₁ -
	2 = 0 - 100	C ₁
	3 = 0 - 1,000	C ₁
	4 = 0 - 10,000	C ₁

SPECIAL OPTIONS :

Flame out alarm
1 Alarm
Sample line
.....

ANALYZER CONDITIONS :

Temperature : 160.°C

Zero Point : 3,90

Gain : 7,70

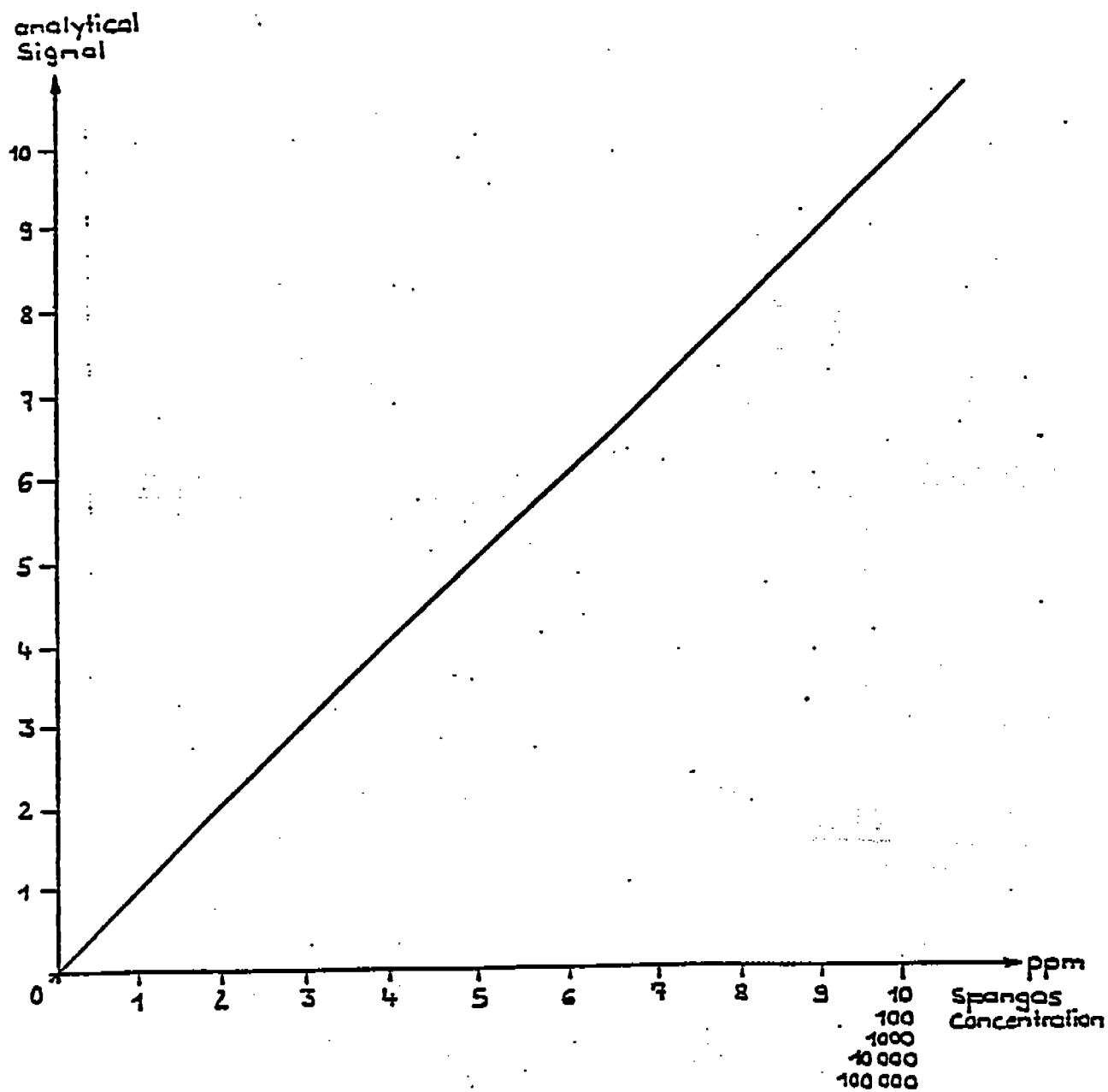
Pressure Setting : Sample/Spangas/Zerogas : 200 mbar

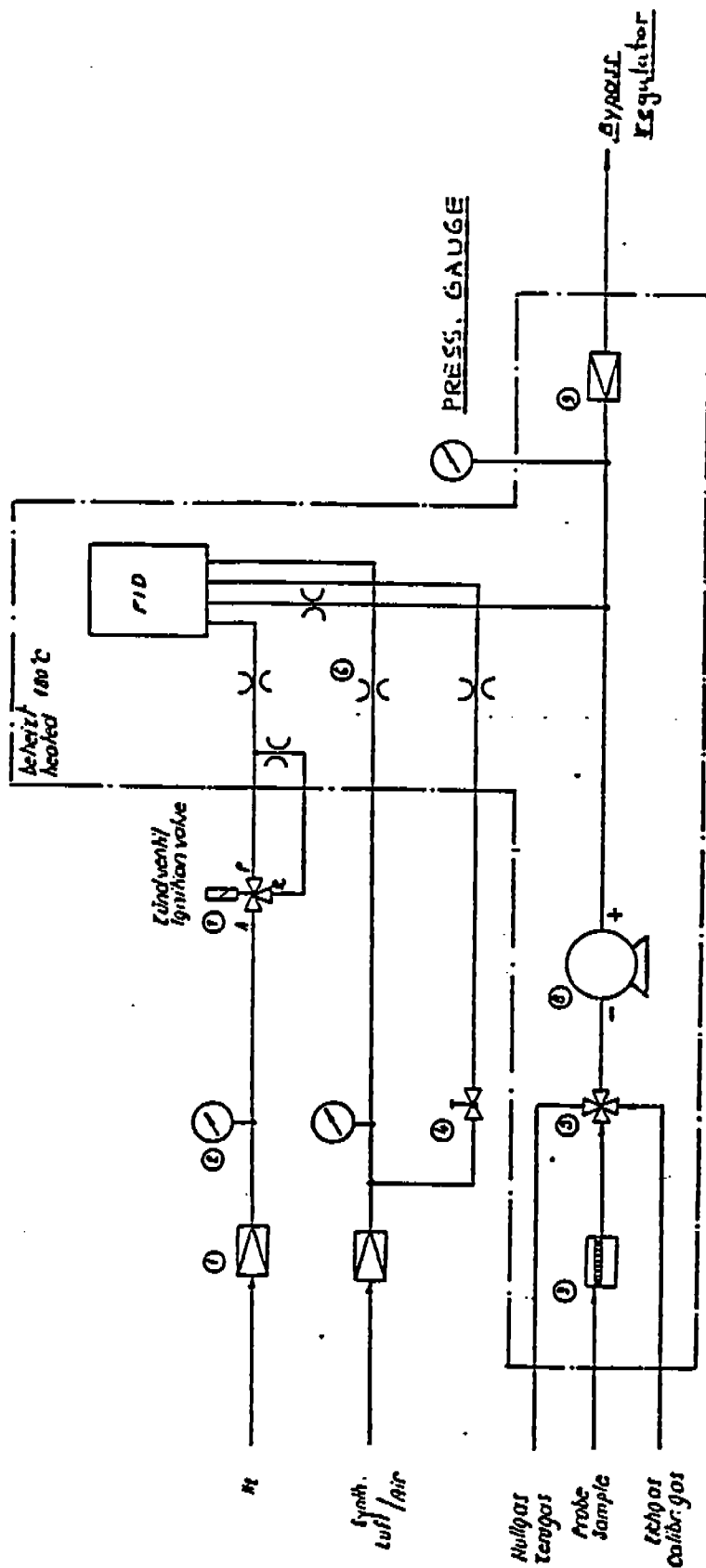
Fuel: Hydrogen : 0,35 bar

Combustion Air : 0,80 bar

Span Gases : 300. ppm C₁
24.000. ppm C₁

CALIBRATION DIAGRAMM

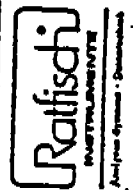




Zündventil
Ignition valve

P-A angezogen
energised
P-A abgezogen
at rest

- 1 Druckregler
pressure regulator
- 2 Manometer
- 3 Zündventil
Gauge
- 4 Nadelventil
Needle valve
- 5 3 Wege Ventil
3 way valve
- 6 Kapillare
capillary
- 7 Magnet Ventil
magnet vent
- 8 Solenoid Ventil
solenoid valve
- 9 Druckregler
pump
back pressure regulator



FLAMMEN IONISATIONS DETEKTOR
Flame Ionisation Detector

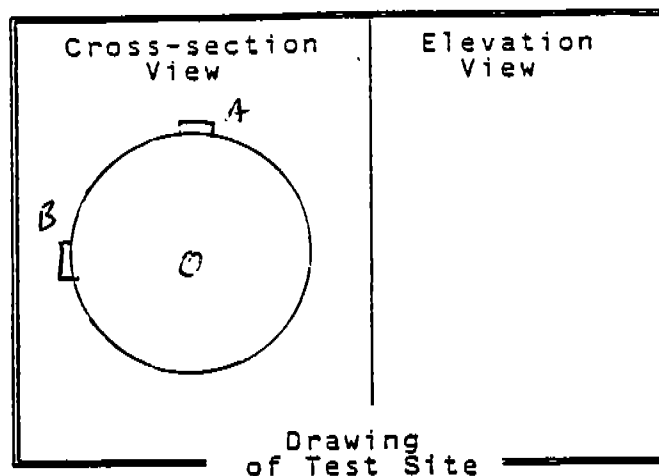
Handumschaltung
Manual switching

RS 55
13.04.88

APPENDIX H

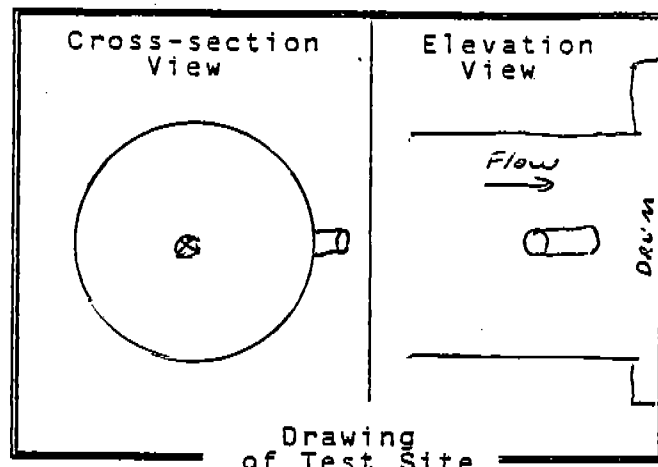
MEASUREMENT SYSTEMS PERFORMANCE SPECIFICATIONS

Job L.P. / Martins 60
Source Dryer / Stacks
Test 3 Run 0 Date 3-30-94
Stack dimen. 47.75 IN.
Dry bulb °F Wet bulb °F
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
Barometric pressure 25.30 in Hg
Static pressure in WC
Operators McKue / Jent K. L. Smith
Pitot No. INST Cp NA

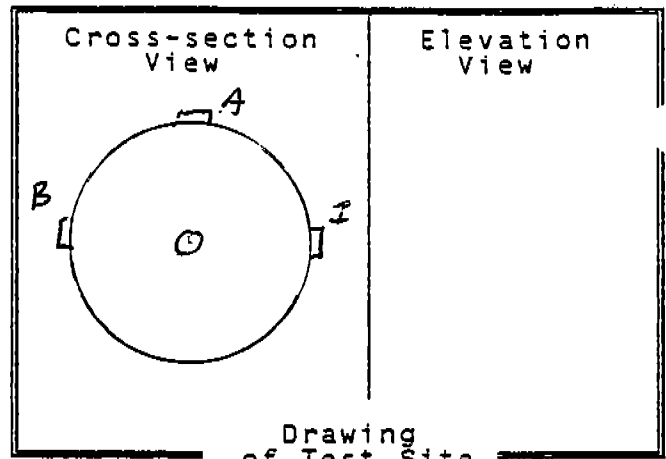


Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length:	6 in.	Time start:	hrs
	1/6	2.96	13.96		
	3/6	23.88	29.88		
	5/6	39.79	45.79		
Temp. meas. device & S/N:				Time end:	hrs

Job L.P. / Montrose, CO
Source Dryer / Inlet
Test 3 Run 0 Date 3-30-44
Stack dimen. NA IN.
Dry bulb °F Wet bulb °F
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
Barometric pressure in Hg
Static pressure in WC
Operators M. Kuehler
Pitot Ng. NA C_p NA

[illegible]

Job L.P. / Montrose, CO
Source Press & Natural Gas Vent / Stack
Test 7 Run 0 Date 3 31-94
Stack dimen. 60 IN.
Dry bulb 23 °F Wet bulb °F
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
Barometric pressure 25.13 in Hg
Static pressure NA in WC
Operators M. K. Winkler & K. Rosecrantz
Pitot No. JUST C_p NA



THC's

[illegible]

INTERPOL LABORATORIES
EPA Method 25A
Calibration Error Check

Job L.P. / Almonte, CO

Test 3 Run 0 Date 3-29-94

Operator M. Kuohler

THC Calibration (Low Range):

Time (HRS) _____

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	0			
Low level					
Mid level					
High level					

THC Calibration (High Range):

Time (HRS) _____

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0				
Span					

O₂ Calibration:

Time (HRS) _____

***	Cylinder Value (%)	Analyzer Response (%)	Difference (%)	Span Value (%)	Percent of Span
Zero gas	0				
Mid level					
High level					

CO Calibration:

Inlet (Green)

Time (HRS) 0918

***	Cylinder Value (%)	Analyzer Response (%)	Difference (%)	Span Value (%)	Percent of Span
Zero gas	0	1	1	500	.20
Mid level	144.9	145	.2	500	.04
High level	312	322	10	500	2.00

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

S-420-14

INTERPOL LABORATORIES
EPA Method 25A
Calibration Error Check

Job L.P. / Montrose, CO

Test 3 Run 0 Date 3-29-94

Operator M. Kuebler

THC Calibration (Low Range):

Time (HRS) _____

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0				
Low level					
Mid level					
High level					

THC Calibration (High Range):

Time (HRS) _____

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0				
Span					

O₂ Calibration:

Time (HRS) _____

***	Cylinder Value (%)	Analyzer Response (%)	Difference (%)	Span Value (%)	Percent of Span
Zero gas	0				
Mid level					
High level					

CO Calibration:

Stack (Blue)

Time (HRS) 0818

***	Cylinder Value (%)	Analyzer Response (%)	Difference (%)	Span Value (%)	Percent of Span
Zero gas	0	0	0	1,000	0
Mid level	312	314	2	1,000	.20
High level	620	623	3	1,000	.30

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

S-420-14

Calibration Error Check & Drift Determination

Job L.P. / Montrose, COTest 7 Run 0 Date 3-29-94Operator M. Kuebler

THC Calibration (Low Range):

Time (HRS) 0929

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	0	0	100	0
Low level	30.3	29	1.3	100	1.3
Mid level	303	315	12	1,000	1.2
High level	2960	3025	65	10,000	1.65

THC Calibration (High Range):

Time (HRS) _____

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0				
Span					

O₂ Calibration:

Time (HRS) _____

***	Cylinder Value (%)	Analyzer Response (%)	Difference (%)	Span Value (%)	Percent of Span
Zero gas	0				
Mid level					
High level					

CO₂ Calibration:

Time (HRS) _____

***	Cylinder Value (%)	Analyzer Response (%)	Difference (%)	Span Value (%)	Percent of Span
Zero gas	0				
Mid level					
High level					

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

S-420-14

Calibration Error Check & Drift Determination

Job L.P. / Montrose, COTest 4 Run 10 Date 3-29-94Operator M. Kuebler

0929

Time (HRS) 0929

THC Calibration (Low Range):

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	0	0	100	0
Low level	30.3	29	1.3	100	1.3
Mid level	303	315	12	1,000	1.2
High level	2960	3025	65	10,000	65

Time (HRS) _____

THC Calibration (High Range):

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0				
Span					

Time (HRS) _____

O₂ Calibration:

***	Cylinder Value (%)	Analyzer Response (%)	Difference (%)	Span Value (%)	Percent of Span
Zero gas	0				
Mid level					
High level					

Time (HRS) _____

CO₂ Calibration:

***	Cylinder Value (%)	Analyzer Response (%)	Difference (%)	Span Value (%)	Percent of Span
Zero gas	0				
Mid level					
High level					

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

S-420-14

INTERPOLL LABORATORIES
(612) 786-6020

CO System Bias Check

Job J.P. / Montrose, CO
Test 3 Run 1, 2, 3, 4 Date 3-30-94
Operator M. Kuchler

Source Dryer
Site Inlet

Inlet (green) CO

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Cal Err	Resp (ppm) Sys Bias	Diff. CE-SB (ppm)	Span Val (PPM)	% of span
1	3-24-94 1022	Zero gas	0	1	0	1	500	.20
		Upscale	144.8	145	143	2	500	.40
2	3-30-94 0855	Zero gas	0	1	0.9	.1	500	.02
		Upscale	144.8	145	143.0	2	500	.40
3	1336	Zero gas	0	1	3.7	4.9	500	.94
		Upscale	144.8	145	146.8	1.8	500	.36
4	1601	Zero gas	0	1	-2	3	500	.60
		Upscale	144.8	145	135.2	9.8	500	1.96
5	1727	Zero gas	0	1	-4	5	500	1.00
		Upscale	144.8	145	143.7	1.3	500	.26
6	1907	Zero gas	0	1	-2	3	500	.60
		Upscale	144.8	145	151	6	500	1.20
7		Zero gas	0					
		Upscale						
8		Zero gas	0					
		Upscale						
9		Zero gas	0					
		Upscale						
10		Zero gas	0					
		Upscale						
11		Zero gas	0					
		Upscale						
12		Zero gas	0					
		Upscale						

Must be within 5% of the span for the zero or upscale cal. gas.

S420-11R

INTERPOLL LABORATORIES
(612) 786-6020

CO System Bias Check

Job L.P. / Markham CO
Test 3 Run 1,2,3,4 Date 3-30-94
Operator M. Kuebler

Source Dryer
Site Stack

Stack (Blue) CO

1223
1326
1430
1535

1617
1722

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm)		Diff. CE-SB (ppm)	Span Val (PPM)	% of span
				Cal Err	Sys Bias			
1	3-29-94 1042	Zero gas	0	0	2	2	1,000	.2
		Upscale	620	623	622	1	1,000	.1
2	3-30-94 0934	Zero gas	0	0	0	0	1,000	0
		Upscale	620	623	621	2	1,000	.2
3	1350	Zero gas	0	0	-2	2	1,000	.2
		Upscale	620	623	564	59	1,000	5.9
4	1539	Zero gas	0	0	-3	3	1,000	.3
		Upscale	312	314	290	34	1,000	3.4
5		Zero gas	0					
		Upscale	620	623	600	23	1,000	2.3
6	1740	Zero gas	0	0	4	4	1,000	.4
		Upscale	312	314	314	0	1,000	0
7	1920	Zero gas	0	0	2	2	1,000	.20
		Upscale	312	314	323	9	1,000	.9
8		Zero gas	0					
		Upscale						
9		Zero gas	0					
		Upscale						
10		Zero gas	0					
		Upscale						
11		Zero gas	0					
		Upscale						
12		Zero gas	0					
		Upscale						

Must be within 5% of the span for the zero or upscale cal. gas.

S420-11R

INTERPOLL LABORATORIES, INC

(612) 786-6020

TIC System Bias Check

Job L.P. / Montrose, CO
 Test 4 Run 1, 2, 3 Date 3-30-94
 Operator M. Kusel

Source Dryer
 Site Stack

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm)		Diff. CE-SB (ppm)	Span Val (ppm)	% of Span
				Cal Err	Sys Bias			
1	3-29-94 1052	Zero Gas	0	0	0	0	100	0
		Upscale	36.3	29	30	1	100	1
2	3-30-94 0752	Zero Gas	0	0	0.1	.1	100	.1
		Upscale	30.3	29	30.3	1.3	100	1.3
3	1410	Zero Gas	0	0	0	7	1,000	.7
		Upscale	303	315	312	3	1,000	.3
4	1539	Zero Gas	0	0	2	2	1,000	.2
		Upscale	30.3	29	29	0	1,000	0
5		Zero Gas	0					
		Upscale	303	315	310	5	1,000	.5
6	1740	Zero Gas	0	0	3	3	1,000	.3
		Upscale	30.3	29	30	1	1,000	.1
7		Zero Gas	0					
		Upscale						
8		Zero Gas	0					
		Upscale						
9		Zero Gas	0					
		Upscale						
10		Zero Gas	0					
		Upscale						
11		Zero Gas	0					
		Upscale						
12		Zero Gas	0					
		Upscale						

Must be within 5% of the span for the zero or upscale cal. gas.

G:\STACK\WP\FORMS\S420-11R

INTERPOLL LABORATORIES, INC

(612) 786-6020

TIC System Bias Check

Job

L.P. / Montross, CO

Test

7

Run

1, 2, 3

Date

3-31-94

Operator

Source

Press + Unloading Vent / Stack

Site

Stack

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm)		Diff. CE-SB (ppm)	Span Val (ppm)	% of Span
				Cal Err	Sys Bias			
1	0915	Zero Gas	0	0	0.4	.4	1100	.4
		Upscale	30.3	29	29.7	.7	100	.7
2	1035	Zero Gas	0	0	0.6	.6	100	.6
		Upscale	30-3	29	29.8	.8	100	.8
3	1239	Zero Gas	0	0	.08	.8	100	.8
		Upscale	30.3	29	29.6	.6	100	.6
4	1435	Zero Gas	0	0	1.0	1.0	100	1
		Upscale	30.3	29	31.6	2.6	100	2.6
5		Zero Gas	0					
		Upscale						
6		Zero Gas	0					
		Upscale						
7		Zero Gas	0					
		Upscale						
8		Zero Gas	0					
		Upscale						
9		Zero Gas	0					
		Upscale						
10		Zero Gas	0					
		Upscale						
11		Zero Gas	0					
		Upscale						
12		Zero Gas	0					
		Upscale						

Must be within 5% of the span for the zero or upscale cal. gas.

GASTACKWPAFORMSS420-11R

APPENDIX I

CALIBRATION GAS CERTIFICATION SHEETS

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

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-25248 CYLINDER #:CC114302 CYL PRESSURE: 20PSG

EXPIRATION DATE: 7-7-96 LAST ANALYSIS DATE:7-7-93

CUSTOMER:TWIN CITY OXYGEN

P.O.# 5337

METHOD: EPA PROTOCOL # 13.0.4.G-1

STANDARD:

SRM #:2636A

CYL #:CLM4436

CONC.:241.9PPM

INSTRUMENT:

BECKMAN

COMPONENT: NDIR

MODEL #: 865

SERIAL #: 0103409

LAST CAL: 4-2-93

COMPONENT: CO

MEAN CONC: 144PPM

REPLICATE CONC.

DATE: 6-30-93 DATE: 7-7-93

144PPM 144PPM

145PPM 145PPM

143PPM 144PPM

COMPONENT:

MEAN CONC:

REPLICATE CONC.

DATE: DATE:

COMPONENT:

MEAN CONC:

REPLICATE CONC.

DATE: DATE:

BALANCE GAS:N2

NATIONAL SPECIALTY GASES
630 UNITED DRIVE
DURHAM, N.C. 27713
(919) 544-3772

TO: TWIN CITY OXYGEN

CERTIFICATE OF ANALYSIS

DATE REPORTED: 4-20-93

REFERENCE #: 88-23715

MATERIAL SUBMITTED: CARBON MONOXIDE IN NITROGEN, CERTIFIED
CYLINDER#CC109767

INFORMATION REQUESTED: RATIO ANALYSIS

METHOD OF ANALYSIS: INFRARED

RESULT OF INVESTIGATION:

<u>COMPONENT</u>	<u>SPECIFICATION</u>	<u>CONCENTRATION</u>
CARBON MONOXIDE	300 PPM	312 PPM
NITROGEN		BALANCE

Richard Sykes
AUTHORIZED SIGNATURE

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 ITS RENDERING OF THIS REPORT, NATIONAL SPECIALTY GASES SHALL HAVE NO LIABILITY IN EXCESS OF ITS ESTABLISHED CHARGE FOR THE SERVICE. ANY USE OF THIS REPORT OR THE INFORMATION CONTAINED HEREIN SHALL BE AT THE SOLE RISK OF THE USER.

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

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-25249 CYLINDER #:CC44391 CYL. PRESSURE: 200PSG

EXPIRATION DATE: 7-7-96 LAST ANALYSIS DATE:7-7-93

CUSTOMER:TWIN CITY OXYGEN

P.O.# 5337

METHOD: EPA PROTOCOL # 13.0.4.G-1

STANDARD:

SRM #:1681B

CYL #:CLM4470

CONC.:975PPM

INSTRUMENT:

BECKMAN

COMPONENT: NDIR

MODEL #: 865

SERIAL #: 0103409

LAST CAL.: 4-2-93

COMPONENT: CO

MEAN CONC: 620PPM

REPLICATE CONC.

DATE: 6-30-93	DATE: 7-7-93
623PPM	618PPM
620PPM	616PPM
621PPM	619PPM

COMPONENT:

MEAN CONC:

REPLICATE CONC.

DATE: DATE:

COMPONENT:

MEAN CONC:

REPLICATE CONC.

DATE: DATE:

BALANCE GAS:N2

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

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-29868 CYLINDER #:CC100138 CYL. PRESSURE:2000PSIG
EXPIRATION DATE:3/8/97 LAST ANALYSIS DATE:3/8/94
CUSTOMER:TWIN CITY OXYGEN P.O.# 9082

METHOD: ANALYZED ACCORDING TO EPA TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION
OF GASEOUS CALIBRATION STANDARDS-SEPTEMBER 1993-G-1

STANDARD: INSTRUMENT:BECKMAN THC
SRM #: 1667B MODEL #:400
CYL #: CLM5293 SERIAL #:1003052
CONC.: 47.3PPM LAST CAL.:3/1/94

COMPONENT:PROPANE	COMPONENT:	COMPONENT:
MEAN CONC:30.3PPM	MEAN CONC:	MEAN CONC:
REPLICATE CONC.	REPLICATE CONC.	REPLICATE CONC.
DATE:3/8/94 DATE:	DATE: DATE:	DATE: DATE:
30.2PPM		
30.3PPM		
30.3PPM		

BALANCE GAS:AIR

REPLICATE DATA

DATE: 3/8/94					
Z 0 R	286.3	C	182.8		
R 286.3 Z	0	C	183.4		
Z 0 C	183.4	R	286.3		

REPLICATE DATA

DATE:			
Z R C			
R Z C			
Z C R			

REPLICATE DATA

DATE:			
Z R C			
R Z C			
Z C R			

COMPONENT:PROPANE

DATE:			
Z R C			
R Z C			
Z C R			

COMPONENT:

DATE:			
Z R C			
R Z C			
Z C R			

COMPONENT:

DATE:			
Z R C			
R Z C			
Z C R			

Z=ZERO C=CANDIDATE R=REFERENCE

ANALYST:

Richard Sykes

APPROVED BY:

[Signature]

"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 ITS RENDERING OF THIS REPORT, NATIONAL SPECIALTY GASES SHALL HAVE NO LIABILITY IN EXCESS OF ITS ESTABLISHED CHARGE FOR THE SERVICE."

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

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-26689 CYLINDER #:CC109652 CYL. PRESSURE:2000PSIG

EXPIRATION DATE: 9/15/96

LAST ANALYSIS DATE:9/15/93

CUSTOMER:TWIN CITY OXYGEN

P.O.# 6422

METHOD: EPA PROTOCOL # 13.0.4. G-1

STANDARD:

SRM #:1669B

CYL #:CLM812

CONC.:464PPM

INSTRUMENT:

COMPONENT: BECKMAN THC

MODEL #: 400

SERIAL #: 1003052

LAST CAL.: 9/1/93

COMPONENT: PROPANE
MEAN CONC: 303PPM

<u>REPLICATE CONC.</u>	
DATE: 9/15/93	DATE:
303PPM	
303PPM	
304PPM	

COMPONENT:
MEAN CONC:

<u>REPLICATE CONC.</u>	
DATE:	DATE:

COMPONENT:
MEAN CONC:

<u>REPLICATE CONC.</u>	
DATE:	DATE:

BALANCE GAS:AIR

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

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-29869 CYLINDER #:CC112117 CYL. PRESSURE:2000PSIG
EXPIRATION DATE:3/8/97 LAST ANALYSIS DATE:3/8/94
CUSTOMER:TWIN CITY OXYGEN P.O.# 9082

METHOD: ANALYZED ACCORDING TO EPA TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION
OF GASEOUS CALIBRATION STANDARDS-SEPTEMBER 1993:G-1

STANDARD: INSTRUMENT:BECKMAN THC
SRM #: 1669B MODEL #:400
CYL #: CLM789 SERIAL #:1003052
CONC.: 464PPM LAST CAL.:3/1/94

COMPONENT:PROPANE	COMPONENT:	COMPONENT:
MEAN CONC:2960PPM	MEAN CONC:	MEAN CONC:
REPLICATE CONC.	REPLICATE CONC.	REPLICATE CONC.
DATE:3/8/94 DATE:	DATE: DATE:	DATE: DATE:
2964PPM		
2964PPM		
2962PPM		

BALANCE GAS:AIR

REPLICATE DATA

DATE: 3/8/94

Z	0	R	96.3	C	615.2
R	96.2	Z	0	C	614.5
Z	0	C	614.1	R	96.2

REPLICATE DATA

DATE:

Z		R		C
R		Z		C
Z		C		R

REPLICATE DATA

DATE:

Z		R		C
R		Z		C
Z		C		R

COMPONENT:PROPANE

DATE:

Z		R		C
R		Z		C
Z		C		R

COMPONENT:

DATE:

Z		R		C
R		Z		C
Z		C		R

COMPONENT:

DATE:

Z		R		C
R		Z		C
Z		C		R

Z=ZERO C=CANDIDATE R=REFERENCE

ANALYST: *Richard Sykes*

APPROVED BY: *[Signature]*

"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 ITS RENDERING OF THIS REPORT, NATIONAL SPECIALTY GASES SHALL HAVE NO LIABILITY IN EXCESS OF ITS ESTABLISHED CHARGE FOR THE SERVICE."

APPENDIX J

PROCESS RATE INFORMATION

Louisiana-Pacific Corporation

TRANSMITTAL

Engineering Department
Rt. 8 Box 8263
Hayward WI 54483

phone 715-634-3454
fax 715-634-5963

to: Interpoll Laboratories **date:** April 15, 1994
4500 Ball Road NE
Circle Pines, MN 55014-1819

Att: Dan Despen

from: Sue Somers

subject: Montrose March 1994 test

enclosed please find:

1 copy of process data for Montrose (30 pages)

RECEIVED

APR 18 1994

INTERPOLL LABORATORIES

MONTROSE TESTING 3-29-94 THROUGH 3-31-94

PROCESS DATA

20% SOFTWOOD

<u>CONTENTS</u>	<u>PAGE</u>
<u>TEST SCHEDULE</u>	<u>2</u>
<u>PROCESS DATA SUMMARY</u>	<u>3</u>

MONTROSE DRYER TESTING 3-29-94, formaldehyde

BOARD WEIGHTS / PRODUCTION	4
FUEL BURNING RATE	5
DRYER DATA SHEETS	6
DRYER CHARTS	7
PRESS CHARTS	8
PRESS REPORTS	9
E-TUBE READINGS	10

MONTROSE DRYER TESTING 3-30-94, TSP, CO, VOC, formaldehyde

BOARD WEIGHTS / PRODUCTION	11
FUEL BURNING RATE	12
DRYER DATA SHEETS	13-15
DRYER CHARTS	16-17
PRESS CHARTS	18
PRESS REPORTS	19
E-TUBE READINGS	20-22

MONTROSE PRESS VENT TESTING 3-31-93, TSP, VOC, formaldehyde

BOARD WEIGHTS / PRODUCTION	23
RESIN AND WAX USAGE	24
PRESS CHARTS	25
PRESS REPORTS	26

MONTROSE PRESS VENT TESTING 3-31-93, MDI

BOARD WEIGHTS / PRODUCTION	27
RESIN AND WAX USAGE	28
PRESS CHARTS	29
PRESS REPORTS	30
DAILY INVENTORY SHEET	31

MONTROSE TESTING 3-29-94 THROUGH 3-31-94
TEST SCHEDULE

MONTROSE DRYER TESTING 3-29-94. formaldehyde

<u>DATE</u>	<u>POLLUTANT</u>	<u>RUN #1</u>
3-29	HCHO	0953-1107

MONTROSE DRYER TESTING 3-30-94. TSP. CO. VOC. formaldehyde

<u>DATE</u>	<u>POLLUTANT</u>	<u>RUN #1</u>	<u>RUN #2</u>	<u>RUN #3</u>	<u>RUN #4</u>
3-30	HCHO	(DONE 3-29)	0912-0954 1110-1139	1211-1325	
3-30	TSP	1402-1514	1617-1721	1755-1858	
3-30	VOC	1223-1326	1430-1534	1617-1722	
3-30	CO	1223-1326	1430-1535	1617-1722	1756-1900

MONTROSE PRESS VENT TESTING 3-31-93. MDI. TSP. VOC. formaldehyde

<u>DATE</u>	<u>POLLUTANT</u>	<u>RUN #1</u>	<u>RUN #2</u>	<u>RUN #3</u>
3-31	HCHO	0923-1027	1121-1223	1317-1422
3-31	VOC	0927-1032	1120-1235	1318-1431
3-31	TSP	0922-1025	1119-1227	1317-1425
3-31	MDI	1726-1831	1919-2023	2106-2208

MONTROSE TESTING 3-29-94 THROUGH 3-31-94
PROCESS DATA SUMMARY

20% SOFTWOOD

MONTROSE DRYER TESTING 3-29-94 AND 3-30-94 formaldehyde

- 10.92 =Plant production rate in TONS per HOUR
- 1.69 =estimated TONS of dry fuel burned based on fuel measurement
- 21837 =LB per HOUR of furnish produced by the dryer
- 1066 =average dryer inlet temperature in deg. f.
- 43.1% =moisture content of incoming wood
- 4.2% =moisture content of wood after drying

MONTROSE DRYER TESTING 3-30-94, TSP, CO, VOC,

- 10.56 ~~10.45~~
- =Plant production rate in TONS per HOUR
 - 1.50 =estimated TONS of dry fuel burned based on fuel measurement
 - 24892 =LB per HOUR of furnish produced by the dryer
 - 1180 =average dryer inlet temperature in deg. f.
 - 40.0% =moisture content of incoming wood
 - 4.2% =moisture content of wood after drying

MONTROSE PRESS VENT TESTING 3-31-93, MDI, TSP, VOC, formaldehyde

- 11.43 =Plant production rate in TONS per HOUR
- 281 =MDI resin usage in LBS per hour
- 1.23% =MDI resin usage as % of finished product
- 390 =Phenolic resin usage in LBS per hour
- 1.71% =Phenolic resin usage as % of finished product

MONTROSE PRESS VENT TESTING 3-31-93, MDI, TSP, VOC, formaldehyde

- 11.27 =Plant production rate in TONS per HOUR
- 281 =MDI resin usage in LBS per hour
- 1.25% =MDI resin usage as % of finished product
- 390 =Phenolic resin usage in LBS per hour
- 1.73% =Phenolic resin usage as % of finished product

MONTROSE DRYER TESTING 3-29-94 AND 3-30-94 formaldehyde

DATA TIME: START= 09:50 END= 11:10 HOURS= 1.33
 09:10 10:00 0.83
 11:10 13:40 2.50
 TOTAL HOURS = 4.67

BOARD WEIGHTS - LBS

weight of approximately every 25th untrimmed board

182	194
175	193
183	185
194	186
197	192
198	185
191	187
177	193
179	189
188	184
192	189
194	184
181	
183	
181	
183	

187.11 lb = average
untrimmed
mat weight

172.14 lb = average
finished board
weight
(untrimmed mat
weight-weight of trim)

8.0% = TRIM

PLANT PRODUCTION RATE

4.67 =hours during testing
 74 =pressloads
 592 =No. of (8' X 16') boards produced (no. of pressloads x 8 boards per load)
 101907 =Lbs. finished product (no. of boards x weight of finished board)
 21837 =Lbs. finished product produced per hour (lbs. of finished product / testing hours)
 10.92 =Tons finished product per hour (lbs. of finished product per hour / 2000 lb)

DRYER PRODUCTION RATE:

25997 = lbs of dryer production per hour (lb. of finished product / (1-%trim + % fines))

8.0% =%FINES
 8.0% =%TRIM

43.1% =moisture content of incoming wood
 4.2% =moisture content of wood after drying

MONTROSE DRYER TESTING 3-29-94 AND 3-30-94 formaldehyde

DATA TIME:	START=	09:50	END=	11:10	HOURS=	1.33
		09:10		10:00		0.83
		11:10		13:40		2.50
			TOTAL HOURS =			4.67

DRYER FUEL BURNING RATE

3.7266 =fuel calibration on lbs. per count
4236 =total counts during testing
4.67 =hours during testing
15786 =total lbs. of fuel burned during testing (calibration x total counts)
3383 =lbs of fuel burned per hour (total lbs fuel burned / testing hours)
1.69 = Tons of fuel burned per hour (lbs of fuel burned per hour / 2000 lbs.)
8600 =estimated BTU content per lb. of wood fuel
29.1 =estimated mmbtu input per hour (BTU content per lb. x lb. per hour)

Page #1

DRYER DATA SHEET

DATE 3-29-94

BY Darla Shipley

PLANT: Montrose

READINGS EVERY 10 MIN.

FUEL CALIBRATION:

TIME	OUTLET SET POINT	FEED RATE	DRYER INLET TEMP	DRYER OUTLET TEMP	FUEL COUNT	WET BIN LEVEL	DRY BIN LEVEL		EVERY HOUR FLAKE MOISTURE	
							SUR.	CORE	IN	OUT
7:35	242.9	690	1106	244.5	296877	3/4	1/2	1/2	—	7.2
7:45	241.0	690	1085	244.6	296988	3/4	1/2	1/2	—	—
7:55	239.0	760	1105	242.2	297118	Full	2/3	2/3	24.2	—
8:05	239.0	810	1159	241.2	297270	3/4	2/3	2/3	—	—
8:15	239.0	—	367	244.4	297300	Full	1/2	1/2	—	5.0
8:25	239.0	350	302	245.2	297313	Full	1/2	1/2	—	—
8:35	239.0	450	939	245.9	297422	3/4	1/2+	1/2-	—	—
8:45	238.8	650	979	235.6	297540	3/4	1/2	1/2	39.8	—
8:55	230.0	750	1128	233.0	297684	3/4	1/2	3/4	—	—
9:05	230.0	800	1133	229.6	297846	3/4	3/4	3/4	—	—
9:15	230.0	850	1231	235.6	297993	3/4	3/4	3/4	—	4.2
9:25	230.0	880	1180	231.6	298146	Full	3/4	3/4	—	—
9:35	230.0	890	1152	229.2	298291	Full	3/4	3/4	46.6	—
9:45	230.0	900	1238	231.5	298443	3/4	1/2+	1/2-	—	—
9:55	230.0	900	1167	230.7	298596	3/4	1/2-	1/2+	—	—
10:05	230.0	900	1205	231.0	298750	3/4	1/2+	1/2-	—	3.5
10:15	230.0	900	1223	230.0	298927	3/4	1/2-	1/2-	—	—
10:25	230.0	900	1227	229.8	299068	3/4	1/2	1/2	39.5	—
10:35	230.0	900	1242	229.8	299235	3/4	3/4	3/4	—	—
10:45	230.0	900	1196	230.3	299385	Full	3/4	3/4	—	—
10:55	230.0	900	1194	228.6	299548	Full	1/2	3/2	—	—
11:05	230.0	900	1258	227.9	299711	Full	1/2-	3/4	—	4.0
11:15	230.0	900	1271	231.6	299890	Full	1/2-	2/3	—	—
11:25	230.0	900	1265	230.4	300053	Full	3/4	3/4	48.2	—
11:35	230.0	—	785↓	257.0↑	300161	Full	3/4	3/4	—	—
11:45	230.0	—	316	219.3	300161	Full	1/2-	1/2+	—	—
11:55	230.0	—	224	201.7	300161	Full	1/2-	1/2+	—	—
12:05	230.0	—	258	201.8	300161	Full	1/2-	1/2+	—	—
12:15	230.0	—	315	204.6	300161	Full	1/2-	1/2+	—	—
12:25	230.0	—	305	202.8	300161	Full	1/2-	1/2+	—	—

DRYER CHART
3-29-99

0700-1500

1400

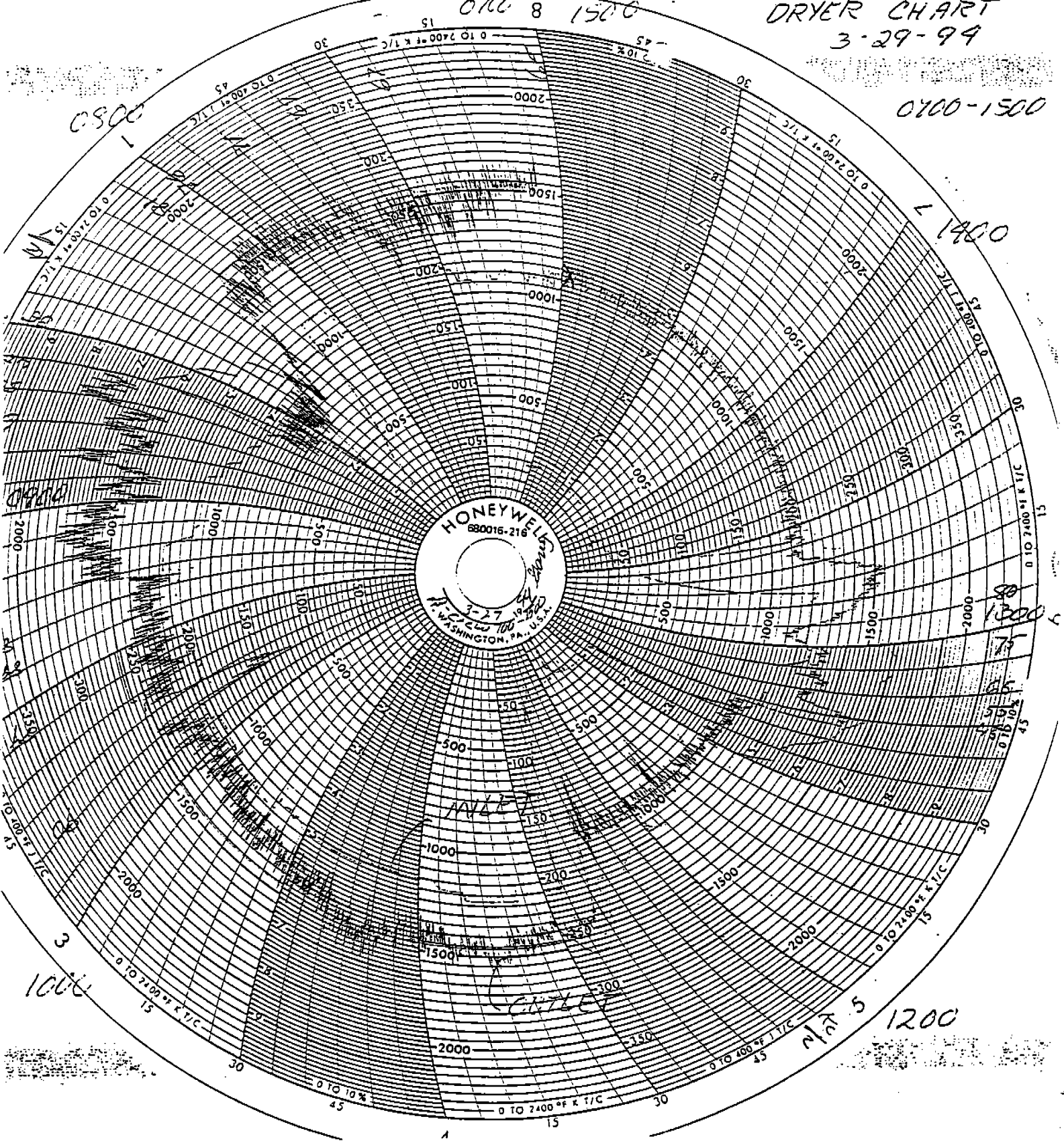
1300

1200

1100

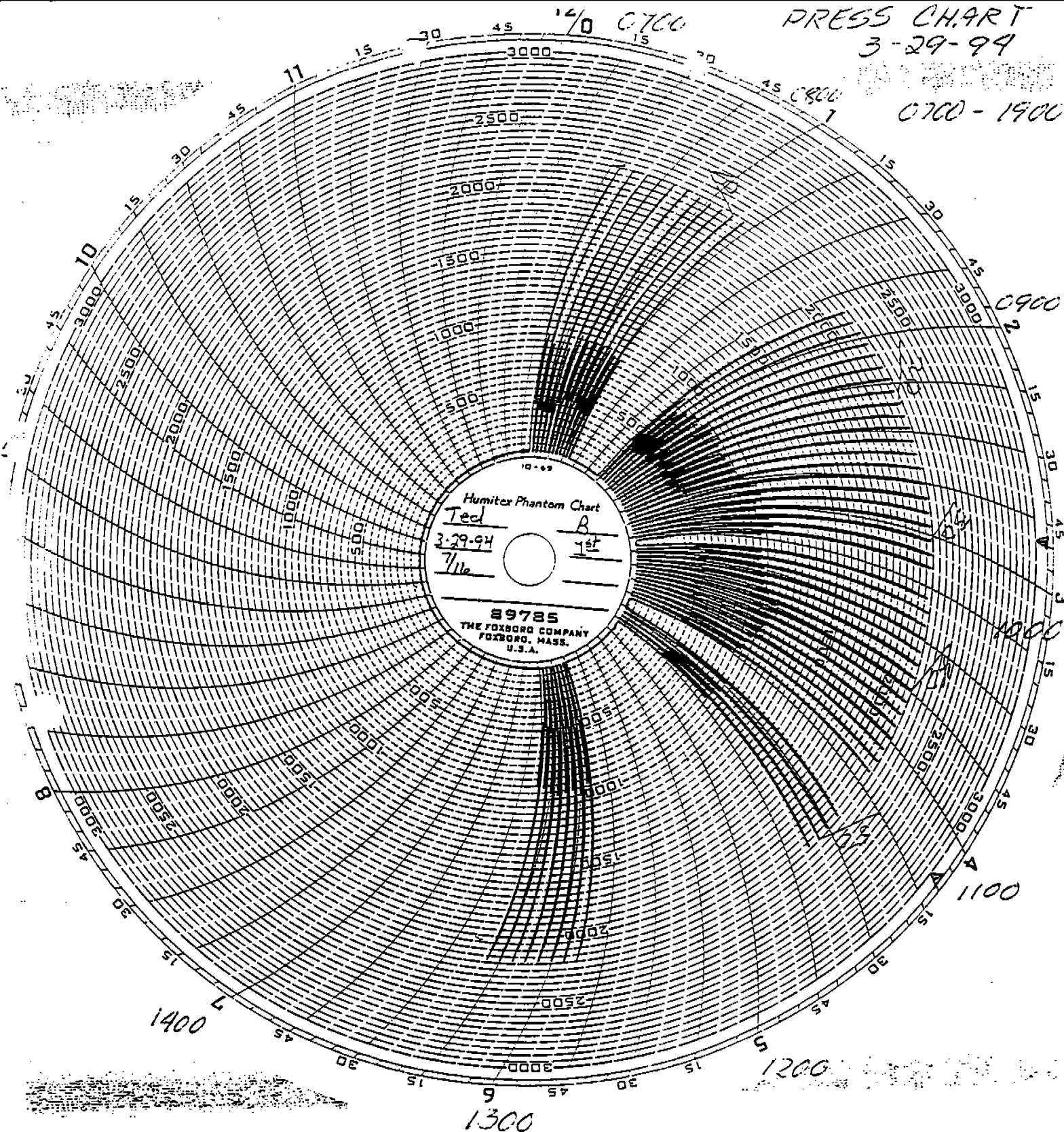
0800

0700 8 1500



PRESS CHART
3-29-94

0700 - 1900



PRESS LOADS
0950-1110 = 21

CONTRASE, COLOREAZA

OPERATOR Ted

SHIFT 1st

CREW B

DATE 3-29-94

hubwheel-setting

Thickness

7/16

surface

Core

Resin

Press Temp

213°

Flowmeters

surface

1b

Care

1b

Pressloads

59

Highest Board Wt

Footage

70,487

Lowest Board Wt

Total Downtime minutes 693

Former Setting

ISL

Code

BSL

Dry Bin Turnwheel Setting

Contents

Surface

Total Footage

DOORTIME		DOORTIME (LINE)				REASONS FOR DOORTIME
FROM	TO	H	E	O	OC	
7:00	7:35			35		LOP - DRYER FIRE FROM PREV. SHIFT
8:17	8:53			33		LOP - FLAKE BREAKER PLUG
10:15	10:20	5				#1 BAG HOUSE PLUG
11:17	11:30	13				PUTTING 8X16'S BACK ON LINE
11:44	12:56	72				FLAKE BREAKER PLUG + PRIMARY FIRE
1:25	7:00	335				WORKING ON PRIMARY

READINGS EVERY 10 MIN.

E-TUBE DATA SHEET

DATE 3-29-94

BY Mike Kennedy

PLANT: MONTROSE

TIME	QUENCH CHAMBER TEMP	SOUTH TR SET			NORTH TR SET			INDICATE TIME OF FLUSH CYCLE
		KV	MA	SPARK RATE	KV	MA	SPARK RATE	
8:10	104.7	38	230	28.1	40	210	25.4	
8:20	92.9	35	260	20.3	40	230	26.7	
8:30	114.3	39	180	27.6	39	110	27.2	
8:40	120.2	34	70	28.2	41	150	26.5	
8:50	123.7	36	100	27.5	42	210	26.8	
9:00	124.6	36	110	27.8	42	230	26.7	
9:10	126.4	38	140	27.6	42	200	26.8	
9:20	125.7	38	210	27.5	40	250	26.8	
9:30	125.3	38	180	27.6	40	270	26.8	
9:40	128.2	38	190	27.9	40	240	27.2	
9:50	127.2	38	170	27.9	40	210	26.1	
10:00	127.4	40	90	28.0	42	250	26.8	10:04
10:10	130.0	40	120	27.8	40	240	26.9	
10:20	127.4	40	170	27.8	42	260	26.7	
10:30	127.7	40	140	27.8	40	210	26.8	
10:40	127.3	40	140	27.9	42	300	26.8	
10:50	127.4	40	160	27.9	40	300	26.7	
11:00	128.8	40	150	27.8	40	300	27.0	
11:10	130.3	40	160	28.0	42	300	26.5	
11:20	130.2	40	120	28.6	42	330	26.8	N 11:28
11:30	130.3	38	60	28.1	32	50	27.2	
11:40	96.9	40	220	27.7	40	200	25.5	
11:50	93.0	38	210	27.9	42	180	26.8	
12:00	88.5	36	180	27.4	40	160	26.9	
12:10	84.3	36	150	27.9	40	170	26.7	
12:20	81.5	36	140	28.1	40	170	26.8	
12:33	83.8	39	100	28.0	42	110	26.7	
12:40	119.2	40	140	27.8	42	160	26.5	
12:50	122.0	40	80	28.3	44	140	26.9	
13:00	126.8	40	170	28.5	44	210	26.5	

MONTROSE DRYER TESTING 3-30-94, TSP, CO, VOC,

DATA TIME: START= 12:00 END= 19:00 HOURS= 7.00

BOARD WEIGHTS - LBS

weight of approximately every 25th untrimmed board

186	180	188
192	191	185
185	196	189
187	180	
193	180	
189	185	
184	190	
189	193	
184	192	
191	193	
195	196	
189	197	
191	180	
191	183	
177	174	
185	189	

187.69 lb = average
untrimmed
mat weight

172.67 lb = average
finished board
weight
(untrimmed mat
weight-weight of trim)

8.0% = TRIM

PLANT PRODUCTION RATE

7 =hours during testing

107 =pressloads

856 =No. of (8' X 16') boards produced (no. of pressloads x 8 boards per load)

147806 =Lbs. finished product (no. of boards x weight of finished board)

21115 =Lbs. finished product produced per hour (lbs. of finished product / testing hours)

10.56 =Tons finished product per hour (lbs. of finished product per hour / 2000 lb)

DRYER PRODUCTION RATE:

25137 = lbs of dryer production per hour (lb. of finished product / (1-%trim + % fines))

8.0% =%FINES

8.0% =%TRIM

40.0% =moisture content of incoming wood

4.2% =moisture content of wood after drying

MONTROSE DRYER TESTING 3-30-94, TSP, CO, VOC.

DATA TIME: START= 12:00 END= 19:00 HOURS= 7.00

DRYER FUEL BURNING RATE

3.7266 =fuel calibration on lbs. per count
5647 =total counts during testing
7.00 =hours during testing
21044 =total lbs. of fuel burned during testing (calibration x total counts)
3006 =lbs of fuel burned per hour (total lbs fuel burned / testing hours)
1.50 = Tons of fuel burned per hour (lbs of fuel burned per hour / 2000 lbs.)
8600 =estimated BTU content per lb. of wood fuel
25.9 =estimated mmbtu input per hour (BTU content per lb. x lb. per hour)

Page #1

DRYER DATA SHEET

DATE

3-30-94

BY

Daria Shipley

PLANT: Montrose

READINGS EVERY 10 MIN.

FUEL CALIBRATION:

TIME	OUTLET SET POINT	FEED RATE	DRYER INLET TEMP	DRYER OUTLET TEMP	FUEL COUNT	WET BIN LEVEL	DRY BIN LEVEL		EVERY HOUR FLAKE MOISTURE	
							SUR.	CORE	IN	OUT
AM 7:30	230.0	900	1157	230.2	310202	3/4	1/2+	1/2+	—	6.2
7:40	230.0	900	1128	229.5	310310	Full	3/4+	1/2+	—	—
7:50	230.0	900	1139	231.4	310455	3/4+	3/4	2/3	39.4	—
8:00	230.0	900	1065	230.9	310592	Full	3/4	3/4	—	—
8:10	230.0	920	1166	229.6	310748	3/4+	3/4-	3/4-	—	—
8:20	230.0	920	1194	229.1	310896	3/4+	2/3	2/3	—	4.0
8:30	230.0	920	1343	228.8	311045	Full	2/3	2/3+	40.2	—
8:40	230.0	920	1347	229.6	311213	Full	2/3	Full	—	—
8:50	230.0	920	1302	232.1	311372	Full	3/4	3/4	—	4.2
9:00	230.0	920	1328	230.0	311517	3/4+	3/4	3/4	—	—
9:10	230.0	920	1298	231.0	311674	3/4+	3/4	3/4	—	4.5
9:20	230.0	920	1324	229.5	311815	Full	3/4	3/4	—	—
9:30	230.0	920	1360	228.7	311974	Full	3/4	3/4	45.0	—
9:40	230.0	920	1375	228.5	312130	3/4+	2/3	2/3	—	—
9:50	230.0	920	1345	230.9	312277	3/4+	2/3	2/3	—	—
Flake Breaker 10:00	230.0	0	692	272.6	312379	Full	3/4	Full	—	—
10:10	230.0	450	806	255.9	312450	Full	3/4-	3/4-	—	4.5
10:20	230.0	550	923	250.4	312515	3/4-	3/4	3/4	—	—
10:30	230.0	750	1034	236.8	312642	2/3	3/4+	2/3+	36.0	—
10:40	230.0	800	1193	229.1	312780	1/2+	3/4	3/4	—	—
10:50	230.0	830	1248	228.2	312917	1/2+	3/4	3/4	—	—
11:00	230.0	880	1245	234.4	313076	3/4+	2/3+	2/3+	—	—
11:10	230.0	900	1232	235.7	313237	Full	2/3+	2/3+	—	4.0
11:20	230.0	910	1243	231.0	313390	3/4	3/4	1/2-	—	—
11:30	230.0	920	1189	231.9	313505	3/4	2/3+	1/2-	44.6	—
11:40	230.0	920	1224	230.4	313702	3/4	1/2+	1/2-	—	—
11:50	230.0	920	1229	229.7	313822	3/4	1/2-	1/2-	—	—
12:00	230.0	920	1328	228.3	313970	Full	1/2-	1/2-	—	—
12:10	230.0	920	1301	232.5	313128	3/4	1/2-	1/2+	—	4.5
12:20	230.0	920	1286	230.1	313285	3/4+	1/2-	1/2-	—	—

DATE 3-30-94

BY *Danla Shipley*
*Kerry Eason*PLANT: *Montrose*

READINGS EVERY 10 MIN.

FUEL CALIBRATION:

TIME	OUTLET SET POINT	FEED RATE	DRYER INLET TEMP	DRYER OUTLET TEMP	FUEL COUNT	WET BIN LEVEL	DRY BIN LEVEL		EVERY HOUR FLAKE MOISTURE	
							SUR.	CORE	IN	OUT
12:30	230.0	920	1314	230.8	314422	Full	1/2+	1/2-	43.0	—
12:40	230.0	920	1322	229.1	314600	3/4+	1/2-	1/2-	—	—
12:50	230.0	920	1325	229.4	314743	Full	1/2-	1/2+	—	—
13:00	230.0	920	1324	229.0	314870	3/4	1/2-	1/2+	—	—
13:10	230.0	920	1285	231.4	315046	Full	1/2-	1/2+	—	4.8
13:20	230.0	920	1259	230.5	315180	3/4	1/2-	1/2-	—	—
13:30	230.0	920	1279	230.0	315320	3/4	1/2-	1/2-	43.6	—
13:40	230.0	920	1205	232.1	315474	2/3	1/2-	1/2-	—	—
13:50	230.0	920	1134	231.2	315654	1/3	1/2-	1/2+	—	—
14:00	230.0	920	1052	233.1	315733	1/3	1/3+	1/3+	—	—
14:10	230.0	920	994	232.2	315842	1/4	1/3-	1/3-	—	3.9
14:20	230.0	920	951	231.1	315944	1/3	1/2+	1/3	—	—
14:30	230.0	920	1001	230.4	316067	1/2-	1/2+	1/3	31.8	—
14:40	230.0	920	1066	230.5	316193	1/2+	1/2-	1/3+	—	—
14:50	230.0	920	1065	231.0	316315	1/3+	1/2-	1/3+	—	—
15:00	230.0	920	1106	229.6	316423	1/3+	1/2-	1/3+	—	—
15:10	230.1	920	1109	228.6	316557	1/2	1/2-	1/2-	—	4.0
15:20	230.1	920	1143	230.0	316684	1/2+	1/2-	1/2-	—	—
15:30	230.1	920	1176	229.1	316818	2/3	1/2-	1/2-	42.6	—
15:40	230.1	920	1146	230.4	316956	3/4	1/2-	1/2-	—	—
15:50	230.1	920	1152	229.2	317082	1/2+	1/3+	1/3+	—	—
16:00	230.1	920	1150	230.4	317228	1/4+	1/3+	1/3+	—	—
16:10	230.1	920	1145	230.1	317339	1/2	1/3+	1/3+	—	4.6
16:20	230.1	920	1094	231.7	317471	1/2-	1/3+	1/3+	—	—
16:30	230.1	920	1082	230.8	317604	1/2-	1/3+	1/3+	38.8	—
16:40	230.1	920	1135	230.2	317736	1/2	1/3+	1/3+	—	—
16:50	230.1	920	1158	229.5	317867	Full	1/3+	1/3+	—	—
17:00	230.1	920	1171	229.5	317999	Full	1/3+	1/3+	—	—
17:10	230.1	920	1172	231.5	318129	Full	1/2-	1/2-	—	3.6
17:20	230.1	920	1141	230.4	318256	Full	1/2-	1/2-	—	—

DATE 3-30-94
BY Sherry L. Eber

PLANT: Montrose

READINGS EVERY 10 MIN.

FUEL CALIBRATION:

[illegible]

0700/1500

L 1400

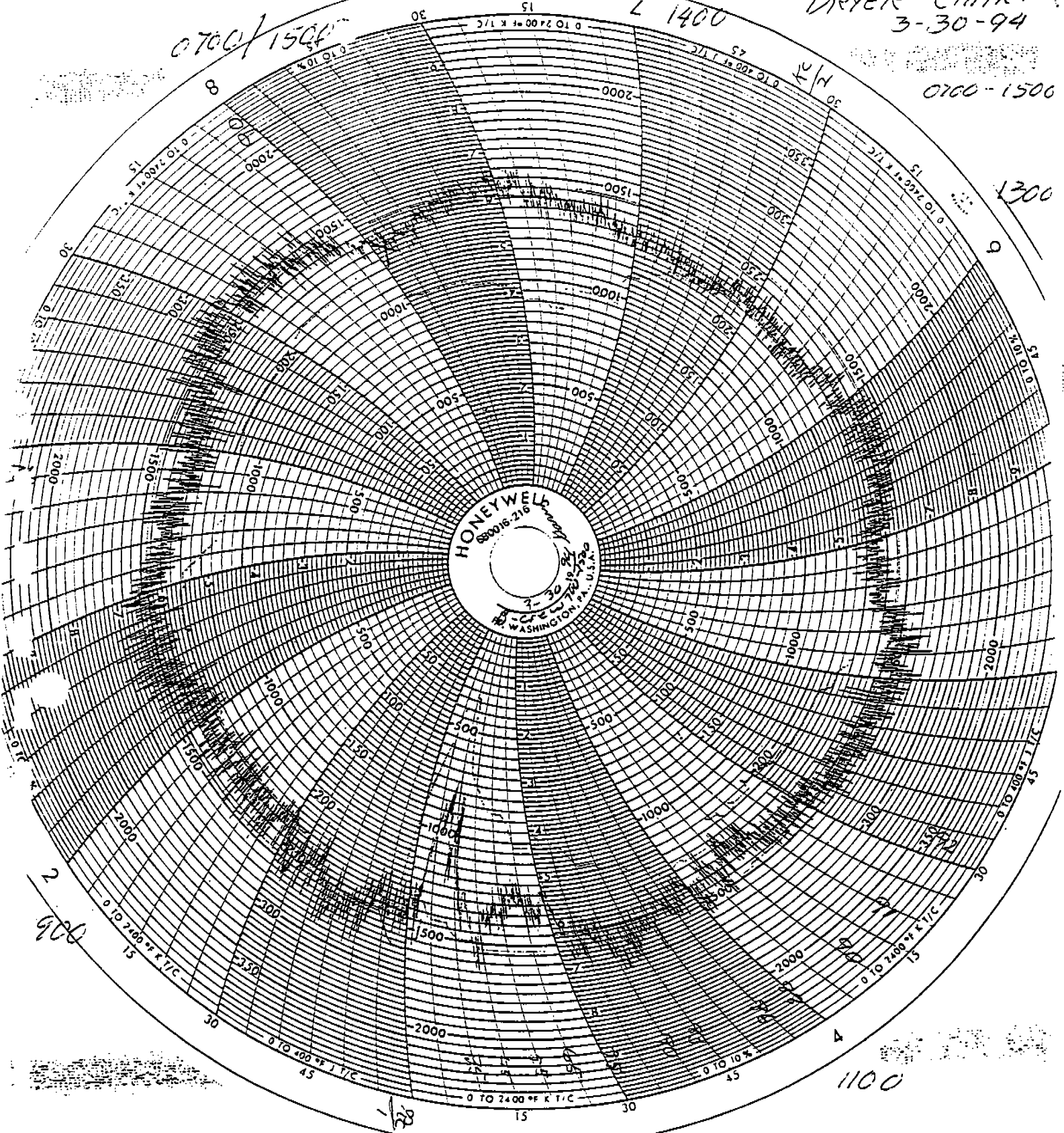
DRYER CHART
3-30-94

0700-1500

1300

1100

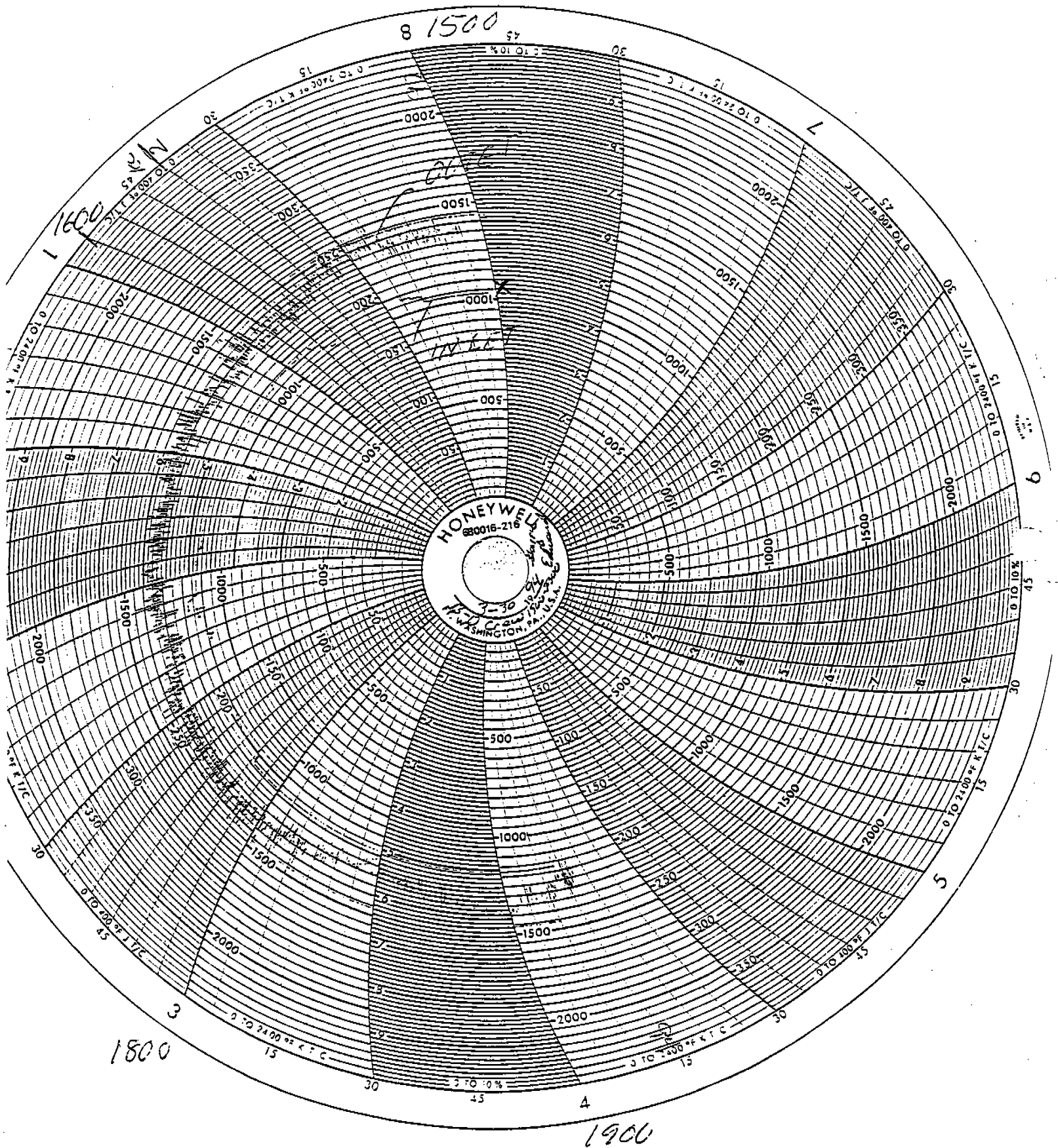
1000



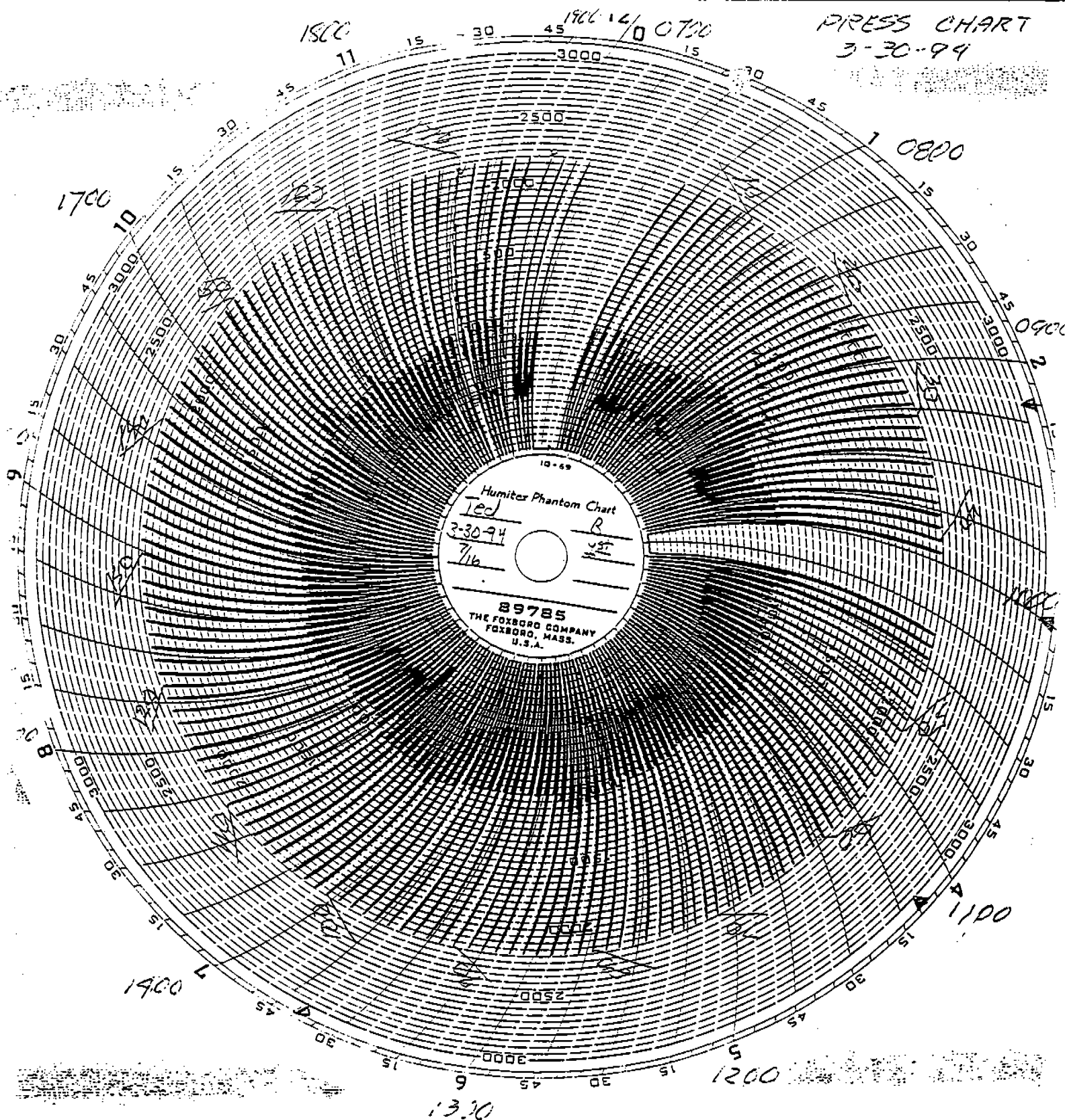
DRYER CHART

3-30-94

1500 - 1900



PRESS CHART
3-30-94



PRESSLOADS

$$0910 - 1000 = 14$$

$$1110 - 1340 = 39$$

$$1200 - 1900 = 107$$

0700-1900

ENTRÉE, VOLGARE

hubwheel-setting

Thickness

7/16

Surface Core Resin

Press Temp

213'

Flowmeters

Surface lb Core lb

Pressloads

175

Lightest Board Wt

Footage

209,073

Lowest Board Wt

Total Downtime minutes

45

Total Footage

Former-Setting

ISI

Game

BSL

Big Bin Trunk Wheel Setting

Conde

• Surface

19 J-20

READINGS EVERY 10 MIN.

E-TUBE DATA SHEET

PLANT: Montrose

DATE 3-30-94

BY Mike Kennedy

TIME	QUENCH CHAMBER TEMP	SOUTH TR SET			NORTH TR SET			INDICATE TIME OF FLUSH CYCLE
		KV	MA	SPARK RATE	KV	MA	SPARK RATE	
810	124.4	40	190	27.9	38	280	26.7	
820	126.2	40	170	27.8	40	140	26.7	
830	129.4	34	170	27.7	42	200	26.5	
840	128.5	38	250	28.0	44	280	26.4	
850	127.4	38	200	28.2	44	180	26.9	
900	128.7	38	280	28.1	42	300	26.7	
910	128.2	38	240	28.1	42	280	26.8	
920	127.2	36	280	27.9	42	230	26.9	
930	129.6	38	200	28.0	40	270	26.8	5 930
940	130.1	42	140	27.8	44	440	26.7	
950	129.8	40	170	27.9	42	380	26.7	
10:00	96.9	40	180	28.0	36	210	27.0	
1010	115.0	40	160	27.8	40	190	26.5	
1020	119.8	40	180	27.7	40	280	26.8	
1030	122.5	40	180	27.9	40	260	26.6	
1040	123.6	40	150	27.8	42	320	26.7	
1050	129.2	40	210	28.0	42	270	26.7	
1100	127.8	40	120	28.1	40	130	26.8	11055
1110	126.4	40	150	27.9	44	220	26.4	
1120	127.0	40	210	28.1	42	170	26.6	
1130	126.8	40	200	27.8	44	220	26.7	
1140	126.1	40	230	28.0	44	270	26.7	
1150	126.6	38	220	28.1	44	220	26.8	
1200	130.8	40	300	27.9	42	250	26.7	
1210	127.5	38	0	29.2	42	160	26.7	5 1280
1220	128.7	42	140	26.5	38	120	27.0	
1230	129.8	42	210	27.8	38	200	26.9	
1240	129.9	40	210	27.8	38	150	26.7	
1250	130.2	40	220	27.8	38	180	26.7	
1300	130.8	40	210	28.2	38	200	26.8	

READINGS EVERY 10 MIN.

E-TUBE DATA SHEET

DATE 3-30-94

BY W. Kennedy

PLANT: Montrose

TIME	QUENCH CHAMBER TEMP	SOUTH TR SET			NORTH TR SET			INDICATE TIME OF FLUSH CYCLE
		KV	MA	SPARK RATE	KV	MA	SPARK RATE	
1310	128.8	39	220	28.0	38	190	26.8	
1320	128.4	40	280	27.9	38	180	26.6	1325 Right
1330	128.4	40	160	27.9	40	160	26.7	
1340	127.4	40	220	28.0	44	150	26.5	
1350	125.6	38	150	27.9	46	230	26.9	
1400	123.7	40	220	28.1	44	240	27.0	
1410	121.4	38	170	28.0	42	220	26.9	
1420	121.8	38	200	27.4	42	180	26.8	
1430	123.8	38	130	27.9	42	230	26.9	N 1440
1440	123.5	16	0	29.1	42	200	26.6	
1450	123.8	40	100	26.1	42	320	26.7	
1500	124.1	40	130	27.6	44	250	26.7	
1510	124.8	40	170	27.7	42	240	26.9	
1520	125.4	40	80	27.8	42	260	26.6	
1530	124.8	40	150	28.2	42	200	26.8	
1540	125.8	38	170	27.9	42	240	26.8	
1550	126.7	40	220	28.0	42	260	26.8	355 N
1600	126.1	40	150	27.8	42	150	26.9	
1610	125.1	41	200	27.8	44	200	26.5	
1620	124.0	40	200	28.0	44	180	26.8	
1630	125.7	40	210	28.0	44	170	26.6	
1640	125.6	40	200	28.0	44	190	28.0	
1650	127.2	40	220	27.8	44	240	26.8	
1700	127.3	40	220	27.6	44	260	26.9	
1710	127.1	40	230	28.1	42	270	26.6	
1720	127.1	42	170	27.7	44	210	26.6	
1730	126.1	40	170	27.7	42	270	26.6	
1740	127.1	42	190	27.7	42	270	26.6	
1750	128.6	40	230	28.0	44	280	26.8	
1800	127.0	40	200	27.9	44	320	26.8	

E-TUBE DATA SHEET

READINGS EVERY 10 MIN.

DATE 3-30-94

BY W. Kennedy

PLANT: Mentha

[illegible]

MONTROSE PRESS VENT TESTING 3-31-93, TSP, VOC, formaldehyde

DATA TIME: START= 09:00 END= 10:30 HOURS= 1.50
 DATA TIME: START= 11:00 END= 15:00 HOURS= 4.00

TOTAL TIME = 5.5

BOARD WEIGHTS - LBS

weight of approximately every 25th untrimmed board

191	186
191	188
198	184
188	186
192	189
186	193
185	191
190	192
200	195
192	189
192	191
191	187
191	186
185	193
181	190
192	

189.84 lb = average
untrimmed
mat weight

174.65 lb = average
finished board
weight
(untrimmed mat
weight-weight of trim)

8.0% = TRIM

PLANT PRODUCTION RATE

5.5 =hours during testing
 90 =pressloads
 720 =No. of (8' X 16') boards produced (no. of pressloads x 8 boards per load)
 125748 =Lbs. finished product (no. of boards x weight of finished board)
 22863 =Lbs. finished product produced per hour (lbs. of finished product / testing hours)
 11.43 =Tons finished product per hour (lbs. of finished product per hour / 2000 lb)

MONTROSE PRESS VENT TESTING 3-31-93, ~~MDI~~, TSP, VOC, formaldehyde

DATA TIME:	START=	09:00	END=	10:30	HOURS=	1.5
DATA TIME:	START=	11:00	END=	15:00	HOURS=	4
			TOTAL TIME =			5.5

RESIN USAGE FROM FLOW CHARTS *DAILY INVENTORY*

281.4 =MDI resin usage in LBS per hour
22863 =lbs of finished product per hour
1.23% =MDI resin usage as % of finished product

736.2 =Phenolic resin usage in LBS per hour (53% solids)
390 =Phenolic resin usage in LBS per hour (100% solids)
1.71% =Phenolic resin usage as % of finished product

WAX USAGE FROM DAILY INVENTORY SHEET

3043 = lbs of wax used for the day
270002 = production footage for the day (3/8" basis)
231430 = production footage for the day (7/16" basis) $((3/8" \text{ ft.}) / 7/16" / 3/8")$
1808 =no. of 8'x16' boards produced (7/16" FOOTAGE / (8'X16"))
174.65 =weight of finished 8'x16'x7/16" board
315767 =total lbs. of board produced (no. of boards x board weight)
0.96% =wax as % of finished product
22863 =lbs of finished product produced per hour during testing
220 =lbs of wax used per hour during testing $(\% \text{ wax} \times \text{lbs board per hour})$

PRESS CHARTS

1 CSCU 3-31-94

0700-1900

2 0900

1800

1100

5 1200

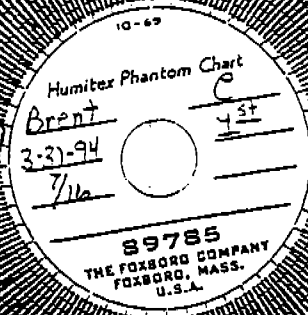
1300

1400 4

1500

1700

1800 11



PRESSLOADS

0900-1030 = 25

1100-1500 = 65

1720-1900 = 26

PRESS REPORT
0700-1900

KONTROSE, COLORADO

OPERATOR Brent SHIFT 1st CREW C DATE 3-31-94

Thrustwheel setting

Thickness

Surface	Core	Resin
---------	------	-------

Press Temp

Flowmeters

Surface	lb	Core	lb
1	10	10	10
2	10	10	10
3	10	10	10
4	10	10	10
5	10	10	10
6	10	10	10
7	10	10	10
8	10	10	10
9	10	10	10
10	10	10	10
11	10	10	10
12	10	10	10
13	10	10	10
14	10	10	10
15	10	10	10
16	10	10	10
17	10	10	10
18	10	10	10
19	10	10	10
20	10	10	10
21	10	10	10
22	10	10	10
23	10	10	10
24	10	10	10
25	10	10	10
26	10	10	10
27	10	10	10
28	10	10	10
29	10	10	10
30	10	10	10
31	10	10	10
32	10	10	10
33	10	10	10
34	10	10	10
35	10	10	10
36	10	10	10
37	10	10	10
38	10	10	10
39	10	10	10
40	10	10	10
41	10	10	10
42	10	10	10
43	10	10	10
44	10	10	10
45	10	10	10
46	10	10	10
47	10	10	10
48	10	10	10
49	10	10	10
50	10	10	10
51	10	10	10
52	10	10	10
53	10	10	10
54	10	10	10
55	10	10	10
56	10	10	10
57	10	10	10
58	10	10	10
59	10	10	10
60	10	10	10
61	10	10	10
62	10	10	10
63	10	10	10
64	10	10	10
65	10	10	10
66	10	10	10
67	10	10	10
68	10	10	10
69	10	10	10
70	10	10	10
71	10	10	10
72	10	10	10
73	10	10	10
74	10	10	10
75	10	10	10
76	10	10	10
77	10	10	10
78	10	10	10
79	10	10	10
80	10	10	10
81	10	10	10
82	10	10	10
83	10	10	10
84	10	10	10
85	10	10	10
86	10	10	10
87	10	10	10
88	10	10	10
89	10	10	10
90	10	10	10
91	10	10	10
92	10	10	10
93	10	10	10
94	10	10	10
95	10	10	10
96	10	10	10
97	10	10	10
98	10	10	10
99	10	10	10
100	10	10	10

Press loads

Highest Board Wt

Footage

Lowest Board Wt

Total Downtime minutes

Total Footage

Former-Setting

ISI

Core

BSL

Dry Bin Turnwheel Setting

Core

Surface

[illegible]

MONTROSE PRESS VENT TESTING 3-31-93, MDI

DATA TIME	START=	17:20	END=	20:30	HOURS=	3.17
DATA TIME	START=	21:00	END=	22:20	HOURS=	1.33

TOTAL TIME = 4.5

BOARD WEIGHTS - LBS

weight of approximately every 25th untrimmed board

189	182
180	187
189	195
187	187
194	193
189	189
190	186
197	
195	
182	
190	
198	
189	
188	
180	
187	

188.83 lb = average
untrimmed
mat weight

173.72 lb = average
finished board
weight
(untrimmed mat
weight-weight of trim)

8.0% = TRIM

PLANT PRODUCTION RATE

4.5 =hours during testing

73 =pressloads

584 =No. of (8' X 16') boards produced (no. of pressloads x 8 boards per load)

101452 =Lbs. finished product (no. of boards x weight of finished board)

22545 =Lbs. finished product produced per hour (lbs. of finished product / testing hours)

11.27 =Tons finished product per hour (lbs. of finished product per hour / 2000 lb)

MONTROSE PRESS VENT TESTING 3-31-93, MDI

DATA TIME START=	17:20	END=	20:30	HOURS=	3.166667
DATA TIME START=	21:00	END=	22:20	HOURS=	1.333333
TOTAL TIME =					4.5

RESIN USAGE FROM FLOW CHARTS *DAILY INVENTORY*

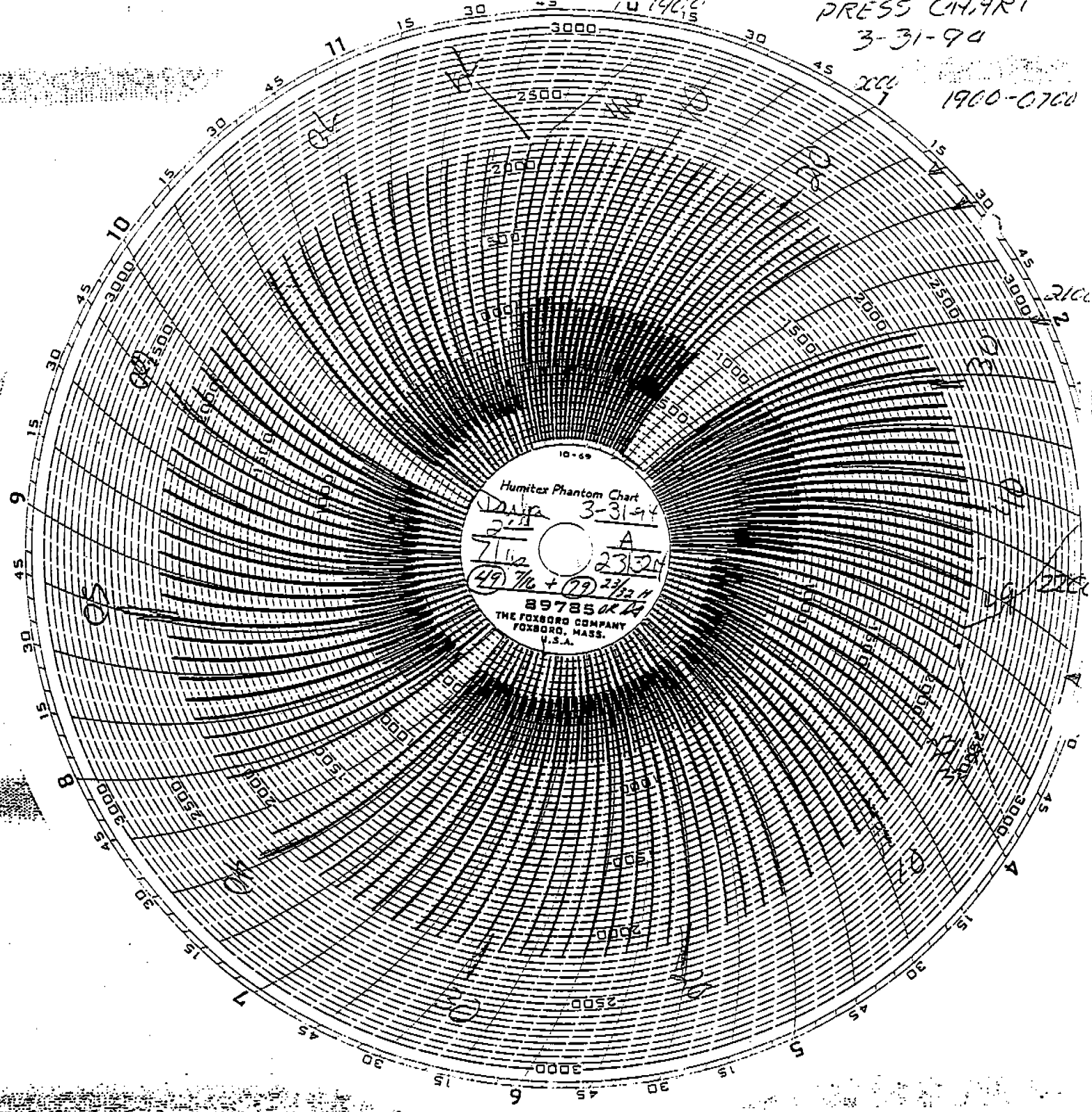
281.4 =MDI resin usage in LBS per hour
22545 =lbs of finshed product per hour
1.25% =MDI resin usage as % of finshed product

736.2 =Phenolic resin usage in LBS per hour (53% solids)
390 =Phenolic resin usage in LBS per hour (100% solids)
1.73% =Phenolic resin usage as % of finshed product

WAX USAGE FROM DAILY INVENTORY SHEET

3043 = lbs of wax used for the day
270002 = production footage for the day (3/8" basis)
231430.3 = production footage for the day (7/16" basis) $((3/8" \text{ ft.}) / 7/16" \times 3/8")$
1808 =no. of 8'x16' boards produced $(7/16" \text{ FOOTAGE} / (8' \times 16'))$
173.72 =weight of finished 8'x16'x7/16" board
314085.8 =total lbs. of board produced (no. of boards x board weight)
0.97% =wax as % of finished product
22545 =lbs of finshed product produced per hour during testing
218 =lbs of wax used per hour during testing $(\% \text{ wax} \times \text{lbs board per hour})$

PRESS CHART
 3-31-94
 1900-0700



PRESS LOADS
 1900 - 2030 = 25
 2100 - 2200 = 22

KONTROSE, COLORADO

OPERATOR Darla SHIFT 2 CREW A DATE 3-31-94

Throttlewheel-setting

Thickness

Surface _____ Core _____ Resin _____

Press Temp

Flowmeters

Surface	lb	Core	lb
1	100	100	100
2	100	100	100
3	100	100	100
4	100	100	100
5	100	100	100
6	100	100	100
7	100	100	100
8	100	100	100
9	100	100	100
10	100	100	100
11	100	100	100
12	100	100	100
13	100	100	100
14	100	100	100
15	100	100	100
16	100	100	100
17	100	100	100
18	100	100	100
19	100	100	100
20	100	100	100
21	100	100	100
22	100	100	100
23	100	100	100
24	100	100	100
25	100	100	100
26	100	100	100
27	100	100	100
28	100	100	100
29	100	100	100
30	100	100	100
31	100	100	100
32	100	100	100
33	100	100	100
34	100	100	100
35	100	100	100
36	100	100	100
37	100	100	100
38	100	100	100
39	100	100	100
40	100	100	100
41	100	100	100
42	100	100	100
43	100	100	100
44	100	100	100
45	100	100	100
46	100	100	100
47	100	100	100
48	100	100	100
49	100	100	100
50	100	100	100
51	100	100	100
52	100	100	100
53	100	100	100
54	100	100	100
55	100	100	100
56	100	100	100
57	100	100	100
58	100	100	100
59	100	100	100
60	100	100	100
61	100	100	100
62	100	100	100
63	100	100	100
64	100	100	100
65	100	100	100
66	100	100	100
67	100	100	100
68	100	100	100
69	100	100	100
70	100	100	100
71	100	100	100
72	100	100	100
73	100	100	100
74	100	100	100
75	100	100	100
76	100	100	100
77	100	100	100
78	100	100	100
79	100	100	100
80	100	100	100
81	100	100	100
82	100	100	100
83	100	100	100
84	100	100	100
85	100	100	100
86	100	100	100
87	100	100	100
88	100	100	100
89	100	100	100
90	100	100	100
91	100	100	100
92	100	100	100
93	100	100	100
94	100	100	100
95	100	100	100
96	100	100	100
97	100		

Press loads

Highest Board Wt.

Footage

Lowest Board Wt

Total Downtime minutes

Total Footage . 213,593

Former-Setting

TSL

Core

ESL

Dry Bin Thumwheel Setting

Core

Surface

[illegible]

DAILY INVENTORY SHEET

DATE 3-31-94

MTD 9054607

SHIFT 1
***SHIFT 2
***DAILY
TOTAL 270002

0 3/8	0 38.70	0 3/8	0
182 7/16	217436 36.90	44 7/16	52567
0 15/32	0 37.66	0 15/32	0
0 19/32 SE	0 37.87	0 19/32 SE	0
0 19/32 TG	0 38.53	0 19/32 TG	0
0 23/32 SE	0 37.01	0 23/32 SE	0
0 23/32 TG	0 37.90	0 23/32 TG	0
0 7/8 TG	0 36.50	0 1 SE	0
0 1 TG	0 36.50	0 1 TG	0
0 1-1/8 TG	0 36.50	0 1-1/8 TG	0
TOTAL	217436	TOTAL	52567

MDI RESIN	COST	INSIDE	8.92	69519
DAY B/4	282276			
+INCOMING	0			
TODAY	278607			
USAGE	3669			
DAILY COST	2.36%	OUTSIDE	23.66	206694
MONTH USE	127587			
MONTH COST	2.41%			

PHENOLIC	COST	SOUTH	15.42	86690
DAY B/4	178244			
+INCOMING	0			
TODAY	169015	NORTH	13.33	76206
USAGE	9229			
DAILY COST	3.44%	WEST	0	0
MONTH USE	335793	DAY	2.08	3502
MONTH COST	3.68%			

WAX	COST	TANK	14.71	82900
DAY B/4	85943			
+INCOMING	0			
TODAY	82900			
USAGE	3043			
DAILY COST	0.98%			
MONTH USE	108920			
MONTH COST	1.03%			

# OF BRDS USED FOR TESTS	2 7/16	LBS. PROD DAILY	311346	(Based on avg density)
		LBS. PROD MTD	10593982	
		PH % TOTAL #'S	1.72	
MDI % TOTAL #'S	1.18	DENSITY:	36.9	
MDI % MTD	1.20	TOTAL	972.5	
LPH % MTD	1.84	DAY#	26	
		MTD DENSITY	37.4	

APPENDIX K

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.

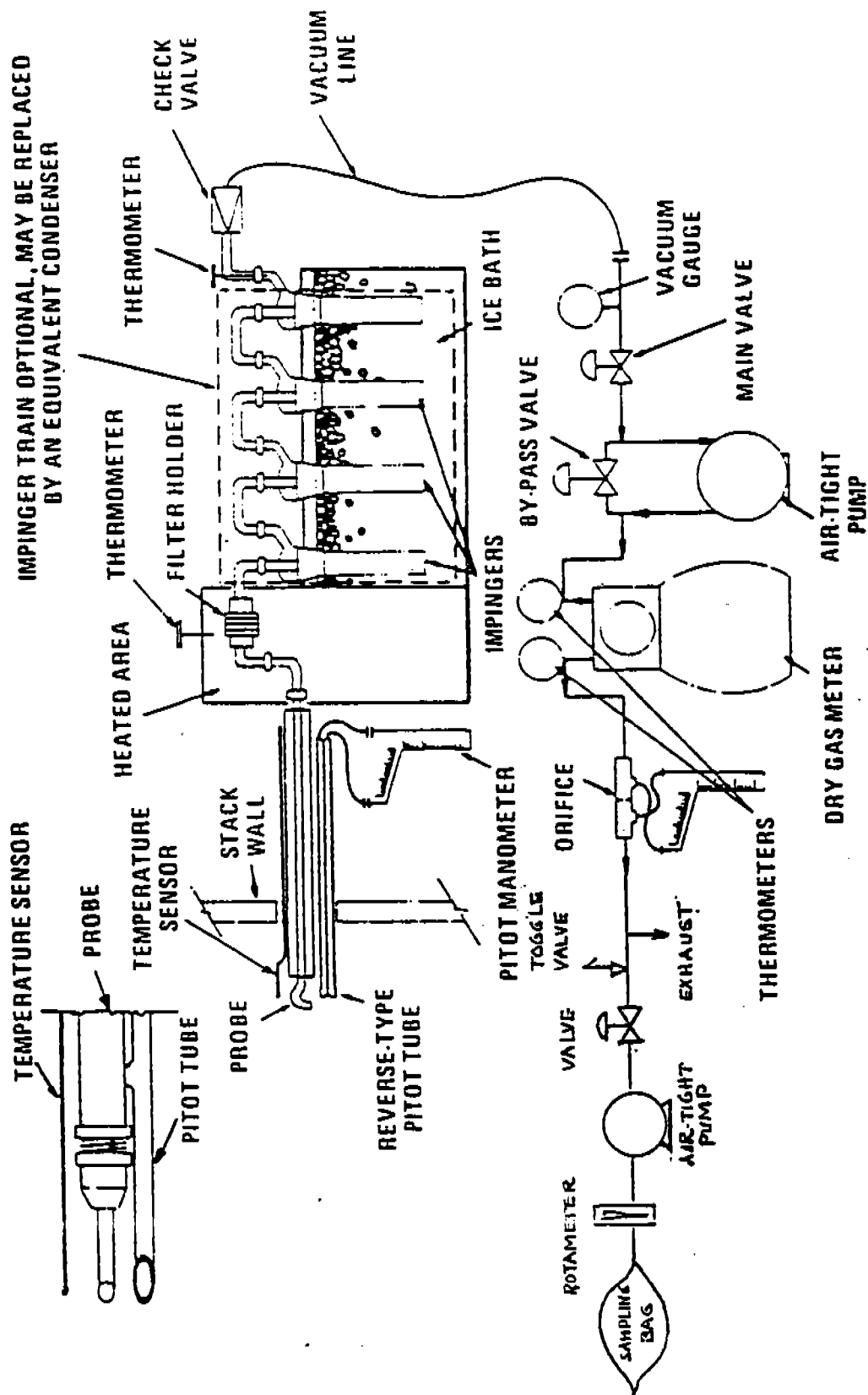
Particulate samples are collected as follows: The sample gas is drawn through the sampling probe isokinetically and passed through a 4-inch diameter Gelman Type A/E glass fiber filter where particulates are removed. The sample gas is then passed through an ice-cooled impinger train and a desiccant-packed 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

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

Integrated flue gas samples for Orsat analysis were collected simultaneously with each pollutant sample. The samples were collected in 15-liter gas sampling bags at a constant flow rate throughout each particulate run. The bags were at a constant flow rate throughout each particulate run. The bags were then returned to the laboratory and analyzed by Orsat analysis. Standard commercially prepared solutions were used in the Orsat analyzer (sat. KOH for carbon dioxide and reduced methylene blue for oxygen).



Particulate sampling train.

**ENVIRONMENTAL PROTECTION
AGENCY**

40 CFR Part 51

[AD-FRL-3977-4]

**Preparation, Adoption, and Submittal
of State Implementation Plans, Method
for Measurement of Condensible
Particulate Emissions From Stationary
Sources**

AGENCY: Environmental Protection
Agency (EPA).

ACTION: Final rule.

SUMMARY: Method 202 for the measurement of condensible particulate matter (CPM) was proposed in the Federal Register on October 12, 1990, at (55 FR 41546). This action promulgates this method. On April 17, 1990 at (55 FR 14246) EPA promulgated two methods for measuring particulate matter (PM) with an aerodynamic diameter of 10 μ m or less (PM₁₀). Since CPM emissions form very fine particles in the PM₁₀ size range and are considered PM₁₀ emissions, the Agency is adding a method for measuring CPM emissions from stationary sources to appendix M in 40 CFR part 51. The purpose of this

rule is to provide the States with a method for measuring CPM.

EFFECTIVE DATE: December 17, 1991.

ADDRESSES: Background Information Document. The Background Information Document for the promulgated test methods may be obtained from Candace Sorrell or Peter Westlin, MD-19, U.S. EPA, Research Triangle Park, North Carolina 27711, telephone number (919) 541-1064. Please refer to "Summary of Comments and Responses for Method 202."

Docket. Docket No. A-60-03, containing materials relevant to this rulemaking, is available for public inspection and copying between 8:30 a.m. to 12 Noon and 1:30 to 3:30 p.m., Monday through Friday, at EPA's Air Docket Section, Waterside Mall, room M1500, 1st Floor, Gallery 1, 401 M Street SW., Washington, DC 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: Candace Sorrell or Peter Westlin, Emission Measurement Branch (MD-19), Technical Support Division, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number (919) 541-1064.

SUPPLEMENTARY INFORMATION:

I. The Rulemaking

The EPA is proposing to add a method for measuring CPM emissions to appendix M in 40 CFR part 51 to provide a method that States can use in their State implementation plans.

II. Public Participation

The opportunity to hold a public hearing on November 2, 1990 at 10 a.m. was presented in the proposal notice, but no one desired to make an oral presentation. The public comment period was from October 12, 1990 to December 17, 1990.

III. Significant Comments and Changes to the Proposed Rulemaking

Six comment letters were received from the proposal rulemaking. A detailed discussion of these comments is contained in the background document entitled "Summary of Comments and Responses for Method 202" which is referred to in the ADDRESSES section of this preamble. The major comments raised in these letters and the Agency's responses follow.

One commenter suggests that EPA determine the chemical composition of the material collected in the sampling train to verify that it will form ambient condensibles.

The EPA believes that material will collect in the impingers only by

condensation or dissolution. Dissolved gases will evaporate during analysis and will not be measured unless the gases react to form a solid or liquid while they are in solution. The EPA has designed Method 202 to prevent the formation of reaction materials from dissolved gases. The EPA believes that any remaining material collected and measured by Method 202 represents the material that would condense in the ambient air. Additional analysis of chemical composition is not necessary.

Another comment raises the concern that the method may collect some portion of the sulfur dioxide (SO_2) as condensible.

The dissolution of SO_2 in water does not lead immediately to the formation of sulfuric acid (H_2SO_4), but tends to lower the solution pH, which further inhibits sulfate or H_2SO_4 formation. The method includes a purging procedure which effectively removes SO_2 before significant oxidation occurs. No additional revisions are necessary.

The commenter feels that if EPA is allowing Method 202 to be used in conjunction with Method 201 or 201A or another dry catch procedure to determine the total PM_{10} measurement, the combined methods should be tested for precision.

The imprecision associated with combining Method 202 with Method 201 or 201A or any other dry catch procedure is not additive because each train provides a separate measurement. Since the total precision associated with the combined methods cannot be larger than the least precise sampling method, a precision evaluation of a combined sampling system is unnecessary.

A commenter suggests that EPA add specific language to the applicability section of the method stating that Method 202 cannot be used on wet sources. He notes that Method 17 is excluded from use on wet sources, and Methods 201 and 201A are not recommended for wet sources.

The EPA agrees that Method 202 with an in-stack filter is not recommended for wet sources, and such a statement has been added to the applicability. However, a heated Method 5 filter could be used in Method 202 instead of the in-stack filter which would allow application to wet sources.

One commenter requests that EPA clearly state that Method 202 should not be used for assessing compliance with emission limits set on the basis of data derived from a different measurement approach.

The EPA agrees that a violation must be shown, in the first instance, by means of measurements made with the

applicable test method. Once such a showing is made, however, section 113(e) of the Clean Air Act allows the Agency to rely on any credible evidence, including evidence other than the applicable test method, to establish the duration of the period of noncompliance for the purposes of assessing a penalty.

A commenter believes that the sample collection efficiency and method precision may be affected by the sampling conditions such as impinger temperature and sampling flow rate and the method should address this possibility.

The EPA agrees that the nature of the material in the sample gas may affect collection efficiency. For example, a field demonstration of Method 202 at an oil-fired boiler resulted in about 75 percent impinger collection efficiency. This collection efficiency can be improved with the addition of a second filter place between the second and third impinger. This option has been included in the method with a discussion of applicability.

The commenter feels the 1-hour nitrogen (N_2) purge is too long. He believes the majority of the SO_2 is removed in the first few minutes. He suggests the method be revised to reduce the purge time in conjunction with maintaining the sample under cold conditions and analyzing it within 48 hours.

The EPA does not agree with reducing the purge time. Laboratory tests have shown that a 1-hour purge time is necessary to ensure the adequate removal of SO_2 from the impinger solution.

Another commenter suggests that the method should be revised to give credit for ammonium sulfate ($(\text{NH}_4)_2\text{SO}_4$) dihydrate and other condensible particulate matter formed in the gas stream due to ammonia (NH_3) injection used to enhance the efficiency of a control device.

The EPA does not agree. The condensible particulate matter formed in the gas stream due to NH_3 injection is emitted to the atmosphere. The EPA believes that condensible particulate matter emitted from the source should be counted as such even if it is a product of a pollution-control technique.

The commenter suggests that EPA consider an alternative to MeCl_2 consistent with the Montreal Protocol.

The EPA investigated the effectiveness of a chloroform-ether extraction during the method development phase. The chloroform-ether was not as effective as the MeCl_2 in removing organic materials; however, the chloroform-ether procedure was

found to be acceptable for organic extraction. The method has been revised to allow a chloroform-ether extraction.

The commenter supports the exclusion of ammonium chloride as a condensible; however, he expresses concern about $(\text{NH}_4)_2\text{SO}_4$ forming in the impingers.

The N_2 purge removes SO_2 before significant oxidation occurs. If NH_3 is present in the flue gas, the $(\text{NH}_4)_2\text{SO}_4$ formed in the impingers would not be counted as a condensible, although the H_2SO_4 , which reacted with NH_3 , would be counted as a condensible. Method 202 corrects for the NH_3 by measuring the sulfate using an IC analysis and subtracting out the ammonium ion (NH_4^+) mass.

The commenter agrees that the NH_3 added during the titration should be subtracted from the final weight. However, he does not agree with adding back in the water removed by the acid-base reaction.

Because H_2SO_4 is hygroscopic, the H_2SO_4 mass found in the atmosphere would have the water attached to it. The method has been revised to allow the source to correct for only the NH_4^+ or for both NH_4^+ and water as an option depending on the basis for the regulation.

A. Docket

The docket is an organized and complete file of all the information submitted to or otherwise considered by EPA in the development of this proposed rulemaking. The principle purposes of the docket are to: (1) Allow interested parties to identify and locate documents so that they can effectively participate in the rulemaking process, and (2) serve as the record in case of judicial review except for interagency review materials (Section 307(d)(7)(A)).

B. Office of Management and Budget Review

Under Executive Order 12291, EPA must judge whether a regulation is "major" and, therefore, subject to the requirement of a regulatory impact analysis. This rulemaking would not result in any of the adverse economic effects set forth in Section 1 of the Order as grounds for finding a "major rule." It will neither have an annual effect on the economy of \$100 million or more, nor will it result in a major increase in costs or prices. There will be no significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of U.S.-based enterprises to compete with foreign-based enterprises in domestic or export markets. This rulemaking was submitted to the Office of Management

and Budget (OMB) for review as required by Executive Order 12291.

C. Regulatory Flexibility Act Compliance

Pursuant to the provisions of 5 U.S.C. 605(b), I hereby certify that this attached rule, if promulgated, will not have any economic impact on small entities because no additional costs will be incurred.

This rule does not contain any information collection requirements subject to OMB review under the Paperwork Reduction Act of 1980, 44 U.S.C. 3501 *et seq.*

Dated: December 8, 1991.

F. Henry Habicht II,
Acting Administrator.

List of Subjects in 40 CFR Part 51

Administrative practice and procedure.

Air pollution control.
Carbon Monoxide.
Inter-governmental relations.
Lead.
Nitrogen dioxide.
Ozone.
Particulate matter.
Reporting and recordkeeping requirements.
Sulfur Oxides.
Volatile Organic Compounds.

The EPA amends title 40, chapter I, part 51 of the Code of Federal Regulations as follows:

PART 51—[AMENDED]

1. The authority citation for part 51 continues to read as follows:

Authority: Section 110 of the Clean Air Act as amended (42 U.S.C. 7410).

2. Appendix M, to part 51 Table of Contents is amended by adding an entry to read as follows:

Method 202—Determination of Condensible Particulate Emissions From Stationary Sources

3. By adding Method 202 to Appendix M to part 51 to read as follows:

Method 202—Determination of Condensible Particulate Emissions From Stationary Sources

1. Applicability and Principle

1.1 Applicability. 1.1.1 This method applies to the determination of condensible particulate matter (CPM) emissions from stationary sources. It is intended to represent condensible matter as material that condenses after passing through a filter and as measured by this method (Note: The filter catch can be analyzed according to the appropriate method).

1.1.2 This method may be used in conjunction with Method 201 or 201A if the

probes are glass-lined. Using Method 202 in conjunction with Method 201 or 201A, only the impinger train configuration and analysis is addressed by this method. The sample train operation and front end recovery and analysis shall be conducted according to Method 201 or 201A.

1.1.3 This method may also be modified to measure material that condenses at other temperatures by specifying the filter and probe temperature. A heated Method 5 out-of-stack filter may be used instead of the in-stack filter to determine condensible emissions at wet sources.

1.2 Principle. 1.2.1 The CPM is collected in the impinger portion of a Method 17 (appendix A, 40 CFR part 60) type sampling train. The impinger contents are immediately purged after the run with nitrogen (N_2) to remove dissolved sulfur dioxide (SO_2) gases from the impinger contents. The impinger solution is then extracted with methylene chloride (MeCl_2). The organic and aqueous fractions are then taken to dryness and the residues weighed. The total of both fractions represents the CPM.

1.2.2 The potential for low collection efficiency exist at oil-fired boilers. To improve the collection efficiency at these type of sources, an additional filter placed between the second and third impinger is recommended.

2. Precision and Interference

2.1 Precision. The precision based on method development tests at an oil-fired boiler and a catalytic cracker were 11.7 and 4.8 percent, respectively.

2.2 Interference. Ammonia. In sources that use ammonia injection as a control technique for hydrogen chloride (HCl), the ammonia interferes by reacting with HCl in the gas stream to form ammonium chloride (NH_4Cl) which would be measured as CPM. The sample may be analyzed for chloride and the equivalent amount of NH_4Cl can be subtracted from the CPM weight. However, if NH_4Cl is to be counted as CPM, the inorganic fraction should be taken to near dryness (less than 1 ml liquid) in the oven and then allowed to air dry at ambient temperature to prevent any NH_4Cl from vaporizing.

3. Apparatus

3.1 Sampling Train. Same as in Method 17, section 2.1, with the following exceptions noted below (see Figure 202-1). Note: Mention of trade names or specific products does not constitute endorsement by EPA.

3.1.1 The probe extension shall be glass-lined or Teflon.

3.1.2 Both the first and second impingers shall be of the Greenburg-Smith design with the standard tip.

3.1.3 All sampling train glassware shall be cleaned prior to the test with soap and tap water, water, and rinsed using tap water, water, acetone, and finally, MeCl_2 . It is important to completely remove all silicone grease from areas that will be exposed to the MeCl_2 during sample recovery.

3.2 Sample Recovery. Same as in Method 17, section 2.2, with the following additions:

3.2.1 N_2 Purge Line. Inert tubing and fittings capable of delivering 0 to 25 liters/min of N_2 gas to the impinger train from a

standard gas cylinder (see Figure 202-2). Standard 0.95 cm (3/8-inch) plastic tubing and compression fittings in conjunction with an adjustable pressure regulator and needle valve may be used.

3.2.2 Rotameter. Capable of measuring gas flow at 20 liters/min.

3.3 Analysis. The following equipment is necessary in addition to that listed in Method 17, section 2.3:

3.3.1 Separatory Funnel. Glass, 1-liter.

3.3.2 Weighing Tins. 350-ml.

3.3.3 Dry Equipment. Hot plate and oven with temperature control.

3.3.4 Pipets. 5-ml.

3.3.5 Ion Chromatograph. Same as in Method 5F, Section 2.1.8.

4. Reagents

Unless otherwise indicated, all reagents must conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society. Where such specifications are not available, use the best available grade.

4.1 Sampling. Same as in Method 17, section 3.1, with the addition of deionized distilled water to conform to the American Society for Testing and Materials Specification D 1193-74, Type II and the omission of section 3.1.4.

4.2 Sample Recovery. Same as in Method 17, section 3.2, with the following additions:

4.2.1 N_2 Gas. Zero N_2 gas at delivery pressures high enough to provide a flow of 20 liters/min for 1 hour through the sampling train.

4.2.2 Methylene Chloride. ACS grade. Blanks shall be run prior to use and only methylene chloride with low blank values (0.001 percent) shall be used.

4.2.3 Water. Same as in section 4.1.

4.3 Analysis. Same as in Method 17, section 3.3, with the following additions:

4.3.1 Methylene Chloride. Same as section 4.2.2.

4.3.2 Ammonium Hydroxide. Concentrated (14.8 M) NH_4OH .

4.3.3 Water. Same as in section 4.1.

4.3.4 Phenolphthalein. The pH indicator solution, 0.05 percent in 50 percent alcohol.

5. Procedure

5.1 Sampling. Same as in Method 17, section 4.1, with the following exceptions:

5.1.1 Place 100 ml of water in the first three impingers.

5.1.2 The use of silicone grease in train assembly is not recommended because it is very soluble in $MeCl_2$, which may result in sample contamination. Teflon tape or similar means may be used to provide leak-free connections between glassware.

5.2 Sample Recovery. Same as in Method 17, section 4.2 with the addition of a post-test N_2 purge and specific changes in handling of individual samples as described below.

5.2.1 Post-test N_2 Purge for Sources Emitting SO_2 . (Note: This step is recommended, but is optional. With little or no SO_2 is present in the gas stream, i.e., the pH of the impinger solution is greater than 4.5, purging has been found to be unnecessary.) As soon as possible after the post-test leak check, detach the probe and filter from the impinger train. Leave the ice in

the impinger box to prevent removal of moisture during the purge. If necessary, add more ice during the purge to maintain the gas temperature below 20 °C. With no flow of gas through the clean purge line and fittings, attach it to the input of the impinger train (see Figure 202-2). To avoid over- or under-pressurizing the impinger array, slowly commence the N_2 gas flow through the line while simultaneously opening the meter box pump valve(s). When using the gas cylinder pressure to push the purge gas through the sample train, adjust the flow rate to 20 liters/min through the rotameter. When pulling the purge gas through the sample train using the meter box vacuum pump, set the orifice pressure differential to ΔH_2 and maintain an overflow rate through the rotameter of less than 2 liters/min. This will guarantee that the N_2 delivery system is operating at greater than ambient pressure and prevents the possibility of passing ambient air (rather than N_2) through the impingers. Continue the purge under these conditions for 1 hour, checking the rotameter and ΔH value(s) periodically. After 1 hour, simultaneously turn off the delivery and pumping systems.

5.2.2 Sample Handling.

5.2.2.1 Container Nos. 1, 2, and 3. If filter catch is to be determined, as detailed in Method 17, section 4.2.

5.2.2.2 Container No. 4 (Impinger Contents). Measure the liquid in the first three impingers to within 1 ml using a clean graduated cylinder or by weighing it to within 0.5 g using a balance. Record the volume or weight of liquid present to be used to calculate the moisture content of the effluent gas. Quantitatively transfer this liquid into a clean sample bottle (glass or plastic); rinse each impinger and the connecting glassware, including probe extension, twice with water, recover the rinse water, and add it to the same sample bottle. Mark the liquid level on the bottle.

5.2.2.3 Container No. 5 ($MeCl_2$ Rinse). Follow the water rinses of each impinger and the connecting glassware, including the probe extension with two rinses of $MeCl_2$; save the rinse products in a clean, glass sample jar. Mark the liquid level on the jar.

5.2.2.4 Container No. 6 (Water Blank). Once during each field test, place 500 ml of water in a separate sample container.

5.2.2.5 Container No. 7 ($MeCl_2$ Blank). Once during each field test, place in a separate glass sample jar a volume of $MeCl_2$ approximately equivalent to the volume used to conduct the $MeCl_2$ rinse of the impingers.

5.3 Analysis. Record the data required on a sheet such as the one shown in Figure 202-3. Handle each sample container as follows:

5.3.1 Container Nos. 1, 2, and 3. If filter catch is analyzed, as detailed in Method 17, section 4.3.

5.3.2 Container Nos. 4 and 5. Note the level of liquid in the containers and confirm on the analytical data sheet whether leakage occurred during transport. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results. Measure the liquid in Container No. 4 either volumetrically to ± 1 ml or gravimetrically to ± 0.5 g. Remove a 5-ml aliquot and set aside for later ion

chromatographic (IC) analysis of sulfates. (Note: Do not use this aliquot to determine chlorides since the HCl will be evaporated during the first drying step; Section 8.2 details a procedure for this analysis.)

5.3.2.1 Extraction. Separate the organic fraction of the sample by adding the contents of Container No. 4 ($MeCl_2$) to the contents of Container No. 4 in a 1000-ml separatory funnel. After mixing, allow the aqueous and organic phases to fully separate, and drain off most of the organic/ $MeCl_2$ phase. Then add 75 ml of $MeCl_2$ to the funnel, mix well, and drain off the lower organic phase. Repeat with another 75 ml of $MeCl_2$. This extraction should yield about 250 ml of organic extract. Each time, leave a small amount of the organic/ $MeCl_2$ phase in the separatory funnel ensuring that no water is collected in the organic phase. Place the organic extract in a tared 350-ml weighing tin.

5.3.2.2 Organic Fraction Weight Determination (Organic Phase from Container Nos. 4 and 5). Evaporate the organic extract at room temperature and pressure in a laboratory hood. Following evaporation, desiccate the organic fraction for 24 hours in a desiccator containing anhydrous calcium sulfate. Weigh to a constant weight and report the results to the nearest 0.1 mg.

5.3.2.3 Inorganic Fraction Weight Determination. (Note: If NH_4Cl is to be counted as CPM, the inorganic fraction should be taken to near dryness (less than 1 ml liquid) in the oven and then allow to air dry at ambient temperature. If multiple acid emissions are suspected, the ammonia titration procedure in section 8.1 may be preferred.) Using a hot plate, or equivalent, evaporate the aqueous phase to approximately 50 ml; then, evaporate to dryness in a 105 °C oven. Redissolve the residue in 100 ml of water. Add five drops of phenolphthalein to this solution; then, add concentrated (14.8 M) NH_4OH until the sample turns pink. Any excess NH_4OH will be evaporated during the drying step. Evaporate the sample to dryness in a 105 °C oven, desiccate the sample for 24 hours, weigh to a constant weight, and record the results to the nearest 0.1 mg. (Note: The addition of NH_4OH is recommended, but is optional when little or no SO_2 is present in the impinger solution is greater than 4.5, the addition of NH_4OH is not necessary.)

5.3.2.4 Analysis of Sulfate by IC to Determine Ammonium Ion (NH_4^+) Retained in the Sample. (Note: If NH_4OH is not added, omit this step.) Determine the amount of sulfate in the aliquot taken from Container No. 4 earlier as described in Method 5F (appendix A, 40 CFR part 80). Based on the IC SO_4^{2-} analysis of the aliquot, calculate the correction factor to subtract the NH_4^+ retained in the sample and to add the combined water removed by the acid-base reaction (see section 7.2).

5.3.3 Analysis of Water and $MeCl_2$ Blanks (Container Nos. 6 and 7). Analyze these sample blanks as described above in sections 5.3.2.3 and 5.3.2.2, respectively.

5.3.4 Analysis of Acetone Blank (Container No. 8). Same as in Method 17, section 4.3.

6. Calibration

Same as in Method 17, section 5, except for the following:

6.1 IC Calibration. Same as Method 5F, section 5.

6.2 Audit Procedure. Concurrently, analyze the audit sample and a set of compliance samples in the same manner to evaluate the technique of the analyst and the standards preparation. The same analyst, analytical reagents, and analytical system shall be used both for compliance samples and the EPA audit sample. If this condition is met, auditing of subsequent compliance analyses for the same enforcement agency within 30 days is not required. An audit sample set may not be used to validate different sets of compliance samples under the jurisdiction of different enforcement agencies, unless prior arrangements are made with both enforcement agencies.

6.3 Audit Samples. Audit Sample Availability. Audit samples will be supplied only to enforcement agencies for compliance tests. The availability of audit samples may be obtained by writing:

Source Test Audit Coordinator (MD-778),

Quality Assurance Division, Atmospheric Research and Exposure Assessment Laboratory, U.S. Environmental Protection Agency, Research Triangle, Park, NC 27711

or by calling the Source Test Audit Coordinator (STAC) at (919) 541-7834. The request for the audit sample must be made at least 30 days prior to the scheduled compliance sample analysis.

6.4 Audit Results. Calculate the audit sample concentration according to the calculation procedure described in the audit instructions included with the audit sample. Fill in the audit sample concentration and the analyst's name on the audit response form included with the audit instructions. Send one copy to the EPA Regional Office or the appropriate enforcement agency and a second copy to the STAC. The EPA Regional Office or the appropriate enforcement agency will report the results of the audit to the laboratory being audited. Include this response with the results of the compliance samples in relevant reports to the EPA Regional Office or the appropriate enforcement agency.

7. Calculations

Same as in Method 17, section 6, with the following additions:

7.1 Nomenclature. Same as in Method 17, section 6.1 with the following additions.

C_{gas} = Concentration of the CPM in the stack gas, dry basis, corrected to standard conditions, g/dscm (g/dscf).

C_{org} = Concentration of SO_4^{--} in the sample, mg/ml.

m_w = Sum of the mass of the water and MeCl_2 blanks, mg.

m_s = Mass of the NH_4^+ added to sample to form ammonium sulfate, mg.

m_i = Mass of inorganic CPM matter, mg.

m_o = Mass of organic CPM, mg.

m_{org} = Mass of dried sample from inorganic fraction, mg.

V_a = Volume of aliquot taken for IC analysis, ml.

V_{imp} = Volume of impinger contents sample, ml.

7.2 Correction for NH_4^+ and H_2O .

Calculate the correction factor to subtract the NH_4^+ retained in the sample based on the IC SO_4^{--} and if desired, add the combined water removed by the acid-base reaction.

$$m_c = K C_{\text{org}} V_a \quad \text{Eq. 202-1}$$

where:

$K = 0.0205$, when correcting for NH_4^+ and H_2O .

$= 0.1840$, when only correcting for NH_4^+ .

7.3 Mass of Inorganic CPM.

$$m_i = m_{\text{org}} \frac{V_a}{V_{\text{imp}} - V_a} - m_c \quad \text{Eq. 202-2}$$

7.4 Concentration of CPM.

$$C_{\text{org}} = \frac{m_i + m_o - m_c}{V m_{\text{org}}} \quad \text{Eq. 202-3}$$

8. Alternative Procedures

8.1 Determination of NH_4^+ Retained in Sample by Titration.

8.1.1 An alternative procedure to determine the amount of NH_4^+ added to the inorganic fraction by titration may be used. After dissolving the inorganic residue in 100 ml of water, titrate the solution with 0.1 N NH_4OH to a pH of 7.0, as indicated by a pH meter. The 0.1 N NH_4OH is made as follows: Add 7 ml of concentrated (14.8 M) NH_4OH to 1 liter of water. Standardize against standardized 0.1 N H_2SO_4 and calculate the exact normality using a procedure parallel to that described in section 5.5 of Method 6 (appendix A, 40 CFR part 60). Alternatively, purchase 0.1 N NH_4OH that has been standardized against a National Institute of Standards and Technology reference material.

8.1.2 Calculate the concentration of SO_4^{--} in the sample using the following equation.

$$C_{\text{SO}_4} = \frac{48.03 V_t N}{100} \quad \text{Eq. 202-4}$$

where

N = Normality of the NH_4OH , mg/ml.

V_t = Volume of NH_4OH titrant, ml.

48.03 = mg/meq.

100 = Volume of solution, ml.

8.3.1 Calculate the CPM as described in section 7.

8.2 Analysis of Chlorides by IC. At the conclusion of the final weighing as described in section 5.3.2.3, redissolve the inorganic fraction in 100 ml of water. Analyze an aliquot of the redissolved sample for chlorides by IC using techniques similar to those described in Method 5F for sulfates. Previous drying of the sample should have

removed all HCl. Therefore, the remaining chlorides measured by IC can be assumed to be NH_4Cl , and this weight can be subtracted from the weight determined for CPM.

8.3 Air Purge to Remove SO_4 from Impinger Contents. As an alternative to the post-test N_2 purge described in section 5.2.1, the tester may opt to conduct the post-test purge with air at 20 liter/min. Note: The use of an air purge is not as effective as a N_2 purge.

8.4 Chloroform-ether Extraction. As an alternative to the methylene chloride extraction described in section 5.3.2.1, the tester may opt to conduct a chloroform-ether extraction. Note: The Chloroform-ether was not as effective as the MeCl_2 in removing the organics, but it was found to be an acceptable organic extractant. Chloroform and diethylether of ACS grade, with low blank values (0.001 percent), shall be used. Analysis of the chloroform and diethylether blanks shall be conducted according to Section 5.3.3 for MeCl_2 .

8.4.1 Add the contents of Container No. 4 to a 1000-ml separatory funnel. Then add 75 ml of chloroform to the funnel, mix well, and drain off the lower organic phase. Repeat two more times with 75 ml of chloroform. Then perform three extractions with 75 ml of diethylether. This extraction should yield approximately 450 ml of organic extraction. Each time, leave a small amount of the organic/ MeCl_2 phase in the separatory funnel ensuring that no water is collected in the organic phase.

8.4.2 Add the contents of Container No. 5 to the organic extraction. Place approximately 300 ml of the organic extract in a tared 350-ml weighing tin while storing the remaining organic extract in a sample container. As the organic extract evaporates, add the remaining extract to the weighing tin.

8.4.3 Determine the weight of the organic phase as described in Section 5.3.2.2.

8.5 Improving Collection Efficiency. If low impinger collection efficiency is suspected, the following procedure may be used.

8.5.1 Place an out-of-stock filter as described in Method 8 between the second and third impingers.

8.5.2 Recover and analyze the filter according to Method 17, Section 4.2. Include the filter holder as part of the connecting glassware and handle as described in sections 5.2.2.2 and 5.2.2.3.

8.5.3 Calculate the Concentration of CPM as follows:

$$C_{\text{org}} = \frac{m_o + m_i + m_{\text{org}} - m_c}{V m_{\text{org}}} \quad \text{Eq. 202-5}$$

where:

m_i = amount of CPM collected on out-of-stock filter, mg.

8.6 Wet Source Testing. When testing at a wet source, use a heated out-of-stock filter as described in Method 5.

9. Bibliography

1. DeWees, W.D., S.C. Steinsberger, G.M. Plummer, L.T. Lay, C.D. McAlister, and R.T.

Shigenara. "Laboratory and Field Evaluation of the EPA Method 5 Impinger Catch for Measuring Condensible Matter from Stationary Sources." Paper presented at the 1989 EPA/AWMA International Symposium on Measurement of Toxic and Related Air Pollutants. Raleigh, North Carolina. May 1-5, 1989.

2. DeWees, W.D. and K.C. Steinsberger. "Method Development and Evaluation of Draft Protocol for Measurement of Condensible Particulate Emissions." Draft Report. November 17, 1989.

3. Texas Air Control Board. Laboratory Division. "Determination of Particulate in Stack Gases Containing Sulfuric Acid and/or Sulfur Dioxide." *Laboratory Methods for Determination of Air Pollutants*. Modified December 3, 1978.

4. Nothstein, Greg. Masters Thesis. University of Washington. Department of Environmental Health. Seattle, Washington.

5. "Particulate Source Test Procedures Adopted by Puget Sound Air Pollution Control Agency Board of Directors." Puget Sound Air Pollution Control Agency.

Engineering Division. Seattle, Washington. August 11, 1983.

6. Commonwealth of Pennsylvania. Department of Environmental Resources. Chapter 139. Sampling and Testing (Title 25. Rules and Regulations. Part I. Department of Environmental Resources. Subpart C. Protection of Natural Resources. Article III. Air Resources). January 8, 1980.

7. Wisconsin Department of Natural Resources. *Air Management Operations Handbook, Revision 3*. January 11, 1988.

BILLING CODE 6560-50-M

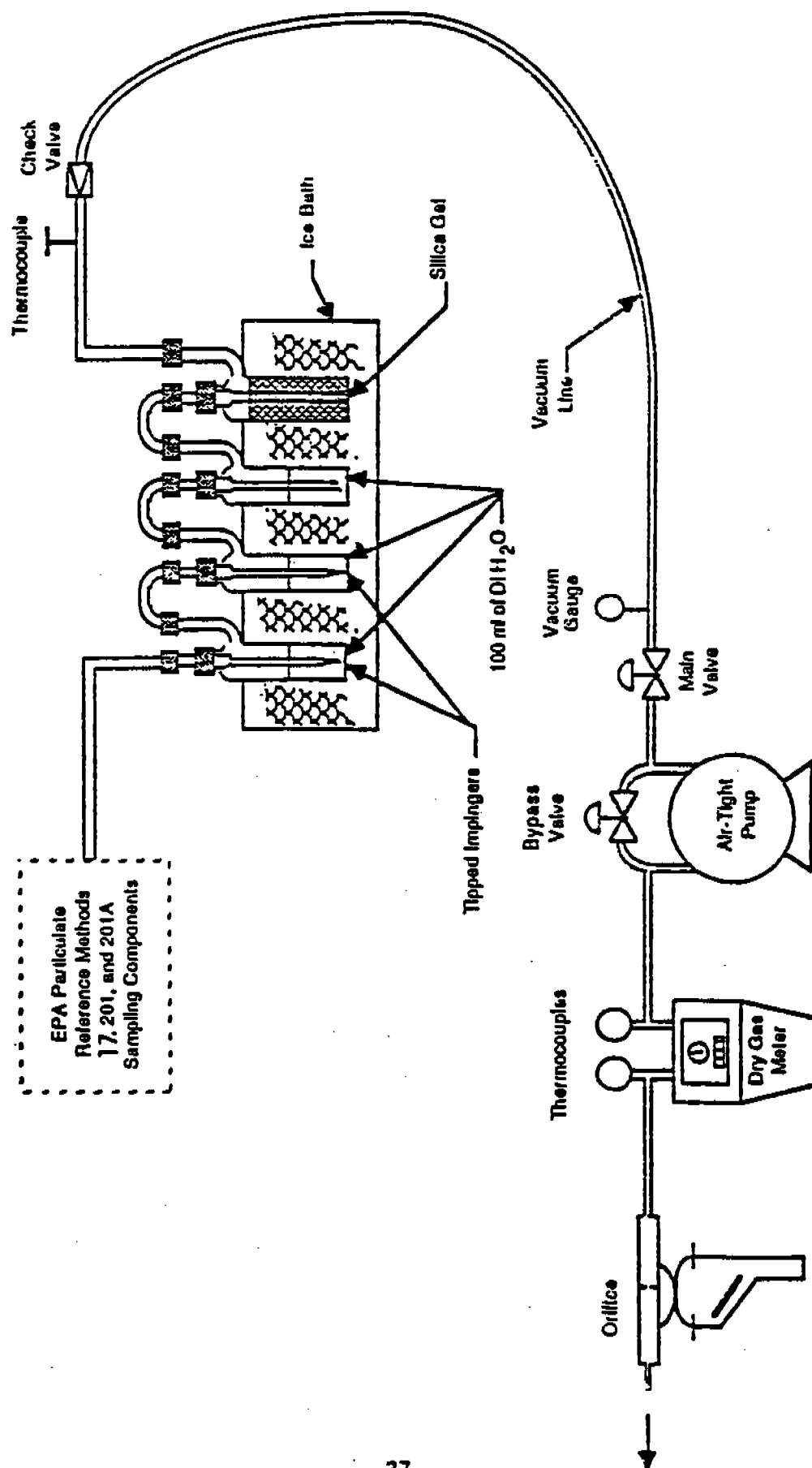


Figure 202-1. Schematic of condensible particulate sampling train.

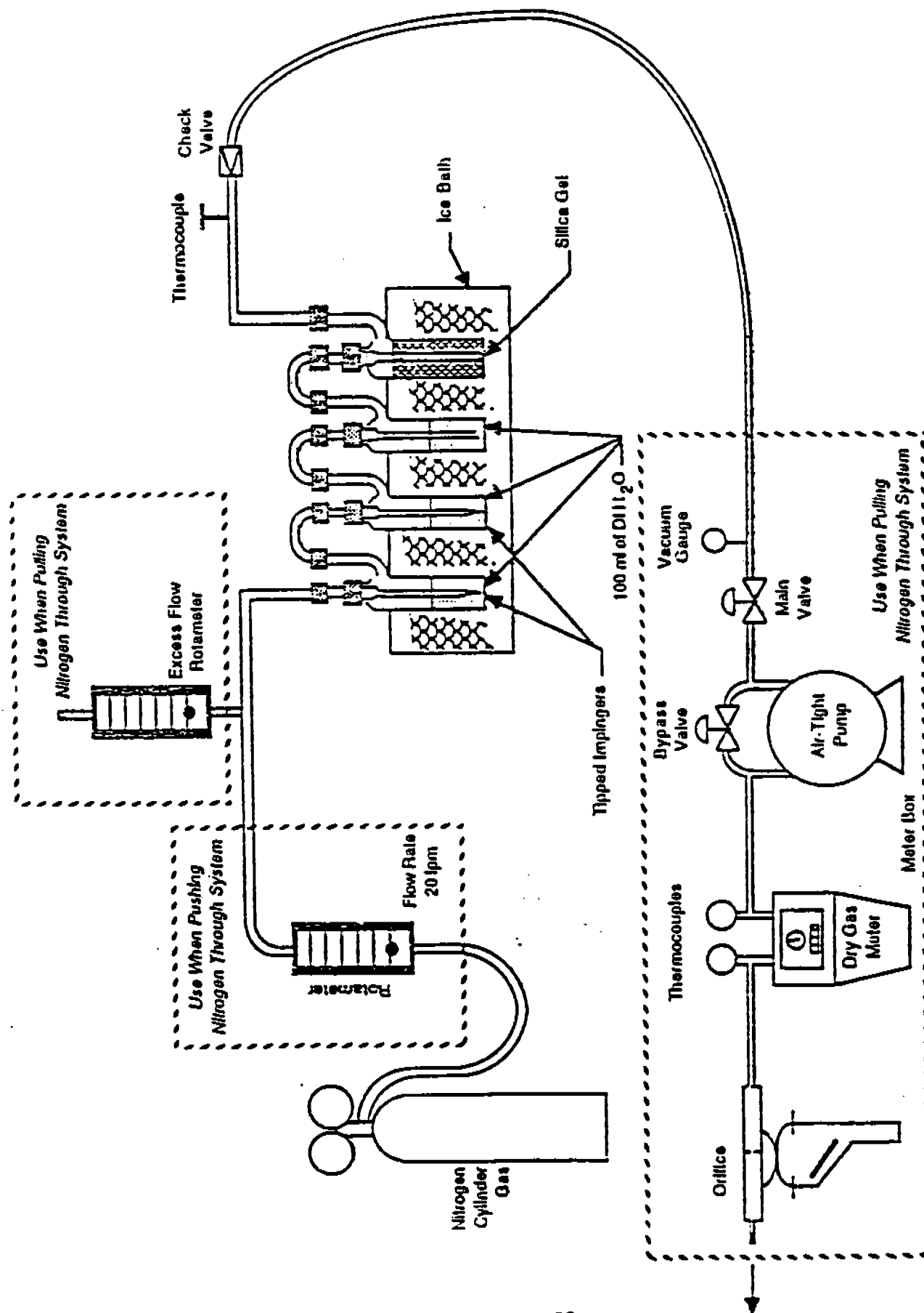


Figure 202-2. Schematic of post-test nitrogen purge system.

Moisture Determination

Volume or weight of liquid in impingers: _____ ml or g

Weight of moisture in silica gel: _____ g

Sample Preparation (Container No. 4)

Amount of liquid lost during transport: _____ ml

Final volume: _____ ml

pH of sample prior to analysis: _____

Addition of Nrl.OH required: _____

Sample extracted 2X with 75 ml MeCl_2 : _____

For Titration of Sulfate

Normality of NH_4OH : _____ N

Volume of sample titrated: _____ ml

Volume of titrant: _____ ml

Sample Analysis

Container number	Weight of condensible particulate, mg		
	Final weight	Tare weight	Weight gain
4 (Inorganic) _____			
4 & 5 (Organic) _____			

Total: _____

Less Blank: _____

Weight of Condensable Particulate: _____

Figure 202-3. Analytical data sheet.

[FR Doc. 91-29957 Filed 12-16-91; 8:45 am]

BILLING CODE 6550-50-4

4.2 Performance Evaluation Tests. The owner of a lidar system shall subject such a lidar system to the performance verification tests described in Section 3, prior to first use of this method. The annual calibration shall be performed for three separate, complete runs and the results of each should be recorded. The requirements of Section 3.3.1 must be fulfilled for each of the three runs.

Once the conditions of the annual calibration are fulfilled the lidar shall be subjected to the routine verification for three separate complete runs. The requirements of Section 3.3.2 must be fulfilled for each of the three runs and the results should be recorded. The Administrator may request that the results of the performance evaluation be submitted for review.

5. References

5.1 The Use of Lidar for Emissions Source Opacity Determination. U.S. Environmental Protection Agency, National Enforcement Investigations Center, Denver, CO. EPA-330/1-79-003-R. Arthur W. Dybdahl, current edition [NTIS No. PB81-246662].

5.2 Field Evaluation of Mobile Lidar for the Measurement of Smoke Plume Opacity, U.S. Environmental Protection Agency, National Enforcement Investigations Center, Denver, CO. EPA/NEIC-TS-128, February 1976.

5.3 Remote Measurement of Smoke Plume Transmittance Using Lidar, C. S. Cook, G. W. Bethke, W. D. Conner (EPA/RTP). Applied Optics 11, pg 1742. August 1972.

5.4 Lidar Studies of Stack Plumes in Rural and Urban Environments, EPA-650/4-73-002, October 1973.

5.5 American National Standard for the Safe Use of Lasers ANSI Z 136.1-176, March 8, 1976.

5.6 U.S. Army Technical Manual TB MED 279, Control of Hazards to Health from Laser Radiation, February 1969.

5.7 Laser Institute of America Laser Safety Manual, 4th Edition.

5.8 U.S. Department of Health, Education and Welfare, Regulations for the Administration and Enforcement of the Radiation Control for Health and Safety Act of 1968, January 1976.

5.9 Laser Safety Handbook, Alex Mallow, Leon Chabot, Van Nostrand Reinhold Co., 1978.

METHOD 10—DETERMINATION OF CARBON MONOXIDE EMISSIONS FROM STATIONARY SOURCES

1. Principle and Applicability

1.1 Principle. An integrated or continuous gas sample is extracted from a sampling point and analyzed for carbon monoxide

(CO) content using a Luft-type nondispersive infrared analyzer (NDIR) or equivalent.

1.2 Applicability. This method is applicable for the determination of carbon monoxide emissions from stationary sources only when specified by the test procedures for determining compliance with new source performance standards. The test procedure will indicate whether a continuous or an integrated sample is to be used.

2. Range and Sensitivity

2.1 Range. 0 to 1,000 ppm.

2.2 Sensitivity. Minimum detectable concentration is 20 ppm for a 0 to 1,000 ppm span.

3. Interferences

Any substance having a strong absorption of infrared energy will interfere to some extent. For example, discrimination ratios for water (H₂O) and carbon dioxide (CO₂) are 3.5 percent H₂O per 7 ppm CO and 10 percent CO₂ per 10 ppm CO, respectively, for devices measuring in the 1,500 to 3,000 ppm range. For devices measuring in the 0 to 100 ppm range, interference ratios can be as high as 3.5 percent H₂O per 25 ppm CO and 10 percent CO₂ per 50 ppm CO. The use of silica gel and ascarite traps will alleviate the major interference problems. The measured gas volume must be corrected if these traps are used.

4. Precision and Accuracy

4.1 Precision. The precision of most NDIR analyzers is approximately ± 2 percent of span.

4.2 Accuracy. The accuracy of most NDIR analyzers is approximately ± 5 percent of span after calibration.

5. Apparatus

5.1 Continuous Sample (Figure 10-1).

5.1.1 Probe. Stainless steel or sheathed Pyrex¹ glass, equipped with a filter to remove particulate matter.

5.1.2 Air-Cooled Condenser or Equivalent. To remove any excess moisture.

5.2 Integrated Sample (Figure 10-2).

5.2.1 Probe. Stainless steel or sheathed Pyrex glass, equipped with a filter to remove particulate matter.

5.2.2 Air-Cooled Condenser or Equivalent. To remove any excess moisture.

5.2.3 Valve. Needle valve, or equivalent, to adjust flow rate.

5.2.4 Pump. Leak-free diaphragm type, or equivalent, to transport gas.

5.2.5 Rate Meter. Rotameter, or equivalent, to measure a flow range from 0 to 1.0 liter per min (0.035 cfm).

¹ Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

5.2.6 Flexible Bag. Tedlar, or equivalent, with a capacity of 60 to 90 liters (2 to 3 ft³). Leak-test the bag in the laboratory before using by evacuating bag with a pump followed by a dry gas meter. When evacuation is complete, there should be no flow through the meter.

5.2.7 Pitot Tube. Type S, or equivalent, attached to the probe so that the sampling rate can be regulated proportional to the stack gas velocity when velocity is varying with the time or a sample traverse is conducted.

5.3 Analysis (Figure 10-3).

5.3.1 Carbon Monoxide Analyzer. Nondispersive infrared spectrometer, or equivalent. This instrument should be demonstrated, preferably by the manufacturer, to meet or exceed manufacturer's specifications and those described in this method.

5.3.2 Drying Tube. To contain approximately 200 g of silica gel.

5.3.3 Calibration Gas. Refer to section 6.1.

5.3.4 Filter. As recommended by NDIR manufacturer.

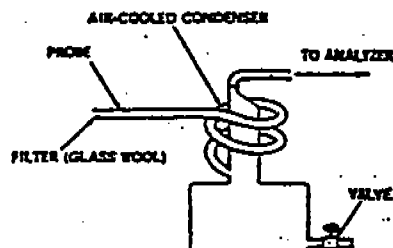


Figure 10-1. Continuous sampling train.

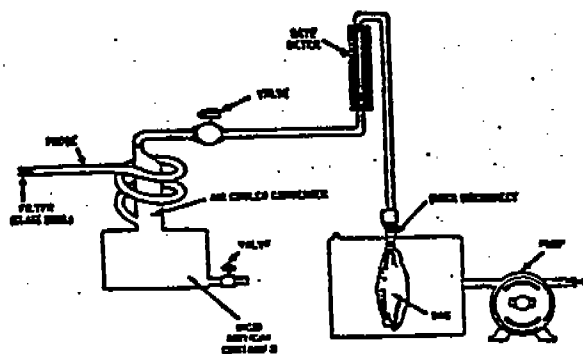


Figure 10-2. Integrated gas sampling train.

5.3.5 CO₂ Removal Tube. To contain approximately 500 g of ascarite.

5.3.6 Ice Water Bath. For ascarite and silica gel tubes.

5.3.7 Valve. Needle valve, or equivalent, to adjust flow rate

5.3.8 Rate Meter. Rotameter or equivalent to measure gas flow rate of 0 to 1.0 liter per min (0.035 cfm) through NDIR.

5.3.9 Recorder (optional). To provide permanent record of NDIR readings.

6. Reagents

6.1 Calibration Gases. Known concentration of CO in nitrogen (N₂) for instrument span, prepurified grade of N₂ for zero, and two additional concentrations corresponding approximately to 60 percent and 30 percent span. The span concentration shall not exceed 1.5 times the applicable source performance standard. The calibration gases shall be certified by the manufacturer to be within ± 2 percent of the specified concentration.

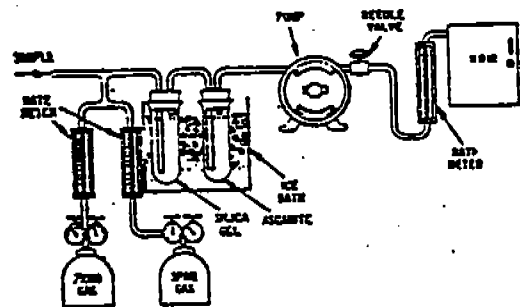


Figure 10-3. Analytical equipment.

6.2 Silica Gel. Indicating type, 6 to 16 mesh, dried at 175° C (347° F) for 2 hours.

6.3 Ascarite. Commercially available.

7. Procedure

7.1 Sampling.

7.1.1 Continuous Sampling. Set up the equipment as shown in Figure 10-1 making sure all connections are leak free. Place the probe in the stack at a sampling point and purge the sampling line. Connect the analyzer and begin drawing sample into the analyzer. Allow 5 minutes for the system to stabilize, then record the analyzer reading as required by the test procedure. (See section 7.2 and 8). CO₂ content of the gas may be determined by using the Method 3 integrated sample procedure, or by weighing the ascarite CO₂ removal tube and computing CO₂ concentration from the gas volume sampled and the weight gain of the tube.

7.1.2 Integrated Sampling. Evacuate the flexible bag. Set up the equipment as shown in Figure 10-2 with the bag disconnected. Place the probe in the stack and purge the sampling line. Connect the bag, making sure that all connections are leak free. Sample at a rate proportional to the stack velocity. CO₂ content of the gas may be determined by using the Method 3 integrated sample procedures, or by weighing the ascarite CO₂ removal tube and computing CO₂ concentra-

tion from the gas volume sampled and the weight gain of the tube.

7.2 CO Analysis. Assemble the apparatus as shown in Figure 10-3, calibrate the instrument, and perform other required operations as described in section 8. Purge analyzer with N₂ prior to introduction of each sample. Direct the sample stream through the instrument for the test period, recording the readings. Check the zero and span again after the test to assure that any drift or malfunction is detected. Record the sample data on Table 10-1.

3. Calibration

Assemble the apparatus according to Figure 10-3. Generally an instrument requires a warm-up period before stability is obtained. Follow the manufacturer's instructions for specific procedure. Allow a minimum time of 1 hour for warm-up. During this time check the sample conditioning apparatus, i.e., filter, condenser, drying tube, and CO₂ removal tube, to ensure that each component is in good operating condition. Zero and calibrate the instrument according to the manufacturer's procedures using, respectively, nitrogen and the calibration gases.

TABLE 10-1—FIELD DATA

Comments	
Location.....	
Test.....	
Date.....	
Operator.....	
Clock time	Rotameter setting, liters per minute (cubic feet per minute)

3. Calculation

Calculate the concentration of carbon monoxide in the stack using Equation 10-1.

$$C_{CO \text{ stack}} = C_{CO \text{ NDIR}}(1 - F_{CO_2}) \quad \text{Eq. 10-1}$$

Where:

$C_{CO \text{ stack}}$ = Concentration of CO in stack, ppm by volume (dry basis).

$C_{CO \text{ NDIR}}$ = Concentration of CO measured by NDIR analyzer, ppm by volume (dry basis).

F_{CO_2} = Volume fraction of CO₂ in sample, i.e., percent CO₂ from Orsat analysis divided by 100.

10. Alternative Procedures

10.1 Interference Trap. The sample conditioning system described in Method 10A sections 2.1.2 and 4.2, may be used as an alternative to the silica gel and ascarite traps.

11. Bibliography

- McElroy, Frank. The Intertech NDIR-CO Analyzer, Presented at 11th Methods Conference on Air Pollution, University of California, Berkeley, CA. April 1, 1970.
- Jacobs, M. B., et al., Continuous Determination of Carbon Monoxide and Hydrocarbons in Air by a Modified Infrared Analyzer, J. Air Pollution Control Association, 9(2): 110-114, August 1959.
- MSA LIRA Infrared Gas and Liquid Analyzer Instruction Book, Mine Safety Appliances Co., Technical Products Division, Pittsburgh, PA.
- Models 215A, 315A, and 415A Infrared Analyzers, Beckman Instruments, Inc., Beckman Instructions 1635-B, Fullerton, CA. October 1967.
- Continuous CO Monitoring System, Model A5611, Intertech Corp., Princeton, NJ.
- UNOR Infrared Gas Analyzers, Bendix Corp., Ronceverte, WV

ADDENDA

A. PERFORMANCE SPECIFICATIONS FOR NDIR CARBON MONOXIDE ANALYZERS

Range (minimum)	0-1000 ppm.
Output (minimum)	0-10mV.
Minimum detectable sensitivity.	20 ppm.
Rise time, 90 percent (maximum).	30 seconds.
Fall time, 90 percent (maximum).	30 seconds.
Zero drift (maximum).....	10% in 8 hours.
Span drift (maximum).....	10% in 8 hours.
Precision (minimum).....	±2% of full scale.
Noise (maximum).....	±1% of full scale.
Linearity (maximum deviation)	2% of full scale.
Interference rejection ratio	CO ₂ —1000 to 1, H ₂ O—500 to 1.

B. Definitions of Performance Specifications.

Range—The minimum and maximum measurement limits.

Output—Electrical signal which is proportional to the measurement; intended for connection to readout or data processing devices. Usually expressed as millivolts or milliamperes full scale at a given impedance.

Full scale—The maximum measuring limit for a given range.

Minimum detectable sensitivity—The smallest amount of input concentration that can be detected as the concentration approaches zero.

Accuracy—The degree of agreement between a measured value and the true value; usually expressed as $\pm$ percent of full scale.

Time to 90 percent response—The time interval from a step change in the input concentration at the instrument inlet to a reading of 90 percent of the ultimate recorded concentration.

Rise Time (90 percent)—The interval between initial response time and time to 90 percent response after a step increase in the inlet concentration.

Fall Time (90 percent)—The interval between initial response time and time to 90 percent response after a step decrease in the inlet concentration.

Zero Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is zero; usually expressed as percent full scale.

Span Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is a stated upscale value; usually expressed as percent full scale.

Precision—The degree of agreement between repeated measurements of the same concentration, expressed as the average deviation of the single results from the mean.

Noise—Spontaneous deviations from a mean output not caused by input concentration changes.

Linearity—The maximum deviation between an actual instrument reading and the reading predicted by a straight line drawn between upper and lower calibration points.

METHOD 10A—DETERMINATION OF CARBON MONOXIDE EMISSIONS IN CERTIFYING CONTINUOUS EMISSION MONITORING SYSTEMS AT PETROLEUM REFINERIES

1. Applicability and Principle

1.1 Applicability. This method applies to the measurement of carbon monoxide (CO) at petroleum refineries. This method serves as the reference method in the relative accuracy test for nondispersive infrared (NDIR) CO continuous emission monitoring systems (CEMS's) that are required to be in-

stalled in petroleum refineries on fluid catalytic cracking unit catalyst regenerators [40 CFR Part 60.105(a)(2)].

1.2 Principle. An integrated gas sample is extracted from the stack, passed through an alkaline permanganate solution to remove sulfur and nitrogen oxides, and collected in a Tedlar bag. The CO concentration in the sample is measured spectrophotometrically using the reaction of CO with p-sulfamino-benzoic acid.

1.3 Range and Sensitivity.

1.3.1 Range. Approximately 3 to 1800 ppm CO. Samples having concentrations below 400 ppm are analyzed at 425 nm, and samples having concentrations above 400 ppm are analyzed at 600 nm.

1.3.2 Sensitivity. The detection limit is 3 ppm based on three times the standard deviation of the mean reagent blank values.

1.4 Interferences. Sulfur oxides, nitric oxide, and other acid gases interfere with the colorimetric reaction. They are removed by passing the sampled gas through an alkaline potassium permanganate scrubbing solution. Carbon dioxide (CO₂) does not interfere, but, because it is removed by the scrubbing solution, its concentration must be measured independently and an appropriate volume correction made to the sampled gas.

1.5 Precision, Accuracy, and Stability.

1.5.1 Precision. The estimated intralaboratory standard deviation of the method is 3 percent of the mean for gas samples analyzed in duplicate in the concentration range of 39 to 412 ppm. The interlaboratory precision has not been established.

1.5.2 Accuracy. The method contains no significant biases when compared to an NDIR analyzer calibrated with National Bureau of Standards (NBS) standards.

1.5.3 Stability. The individual components of the colorimetric reagent are stable for at least 1 month. The colorimetric reagent must be used within 2 days after preparation to avoid excessive blank correction. The samples in the Tedlar¹ bag should be stable for at least 1 week if the bags are leak-free.

2. Apparatus

2.1 Sampling. The sampling train is shown in Figure 10A-1, and component parts are discussed below:

¹ Mention of trade names or commercial products in this publication does not consti-

tute the endorsement or recommendation for use by the Environmental Protection Agency.

METHOD 25A—DETERMINATION OF TOTAL GASEOUS ORGANIC CONCENTRATION USING A FLAME IONIZATION ANALYZER**1. Applicability and Principle**

1.1 **Applicability.** This method applies to the measurement of total gaseous organic concentration of vapors consisting primarily of alkanes, alkenes, and/or arenes (aromatic hydrocarbons). The concentration is expressed in terms of propane (or other appropriate organic calibration gas) or in terms of carbon.

1.2 **Principle.** A gas sample is extracted from the source through a heated sample line, if necessary, and glass fiber filter to a flame ionization analyzer (FLA). Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

2. Definitions

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

2.1.1 **Sample Interface.** That portion of the system that is used for one or more of the following: sample acquisition, sample transportation, sample conditioning, or protection of the analyzer from the effects of the stack effluent.

2.1.2 **Organic Analyzer.** That portion of the system that senses organic concentration and generates an output proportional to the gas concentration.

2.2 **Span Value.** The upper limit of a gas concentration measurement range that is

specified for affected source categories in the applicable part of the regulations. The span value is established in the applicable regulation and is usually 1.5 to 2.5 times the applicable emission limit. If no span value is provided, use a span value equivalent to 1.5 to 2.5 times the expected concentration. For convenience, the span value should correspond to 100 percent of the recorder scale.

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

2.4 **Zero Drift.** The difference in the measurement system response to a zero level calibration gas before and after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

2.5 **Calibration Drift.** The difference in the measurement system response to a mid-level calibration gas before and after a stated period of operation during which no unscheduled maintenance, repair or adjustment took place.

2.6 **Response Time.** The time interval from a step change in pollutant concentration at the inlet to the emission measurement system to the time at which 95 percent of the corresponding final value is reached as displayed on the recorder.

2.7 **Calibration Error.** The difference between the gas concentration indicated by the measurement system and the known concentration of the calibration gas.

3. Apparatus

A schematic of an acceptable measurement system is shown in Figure 25A-1. The essential components of the measurement system are described below:

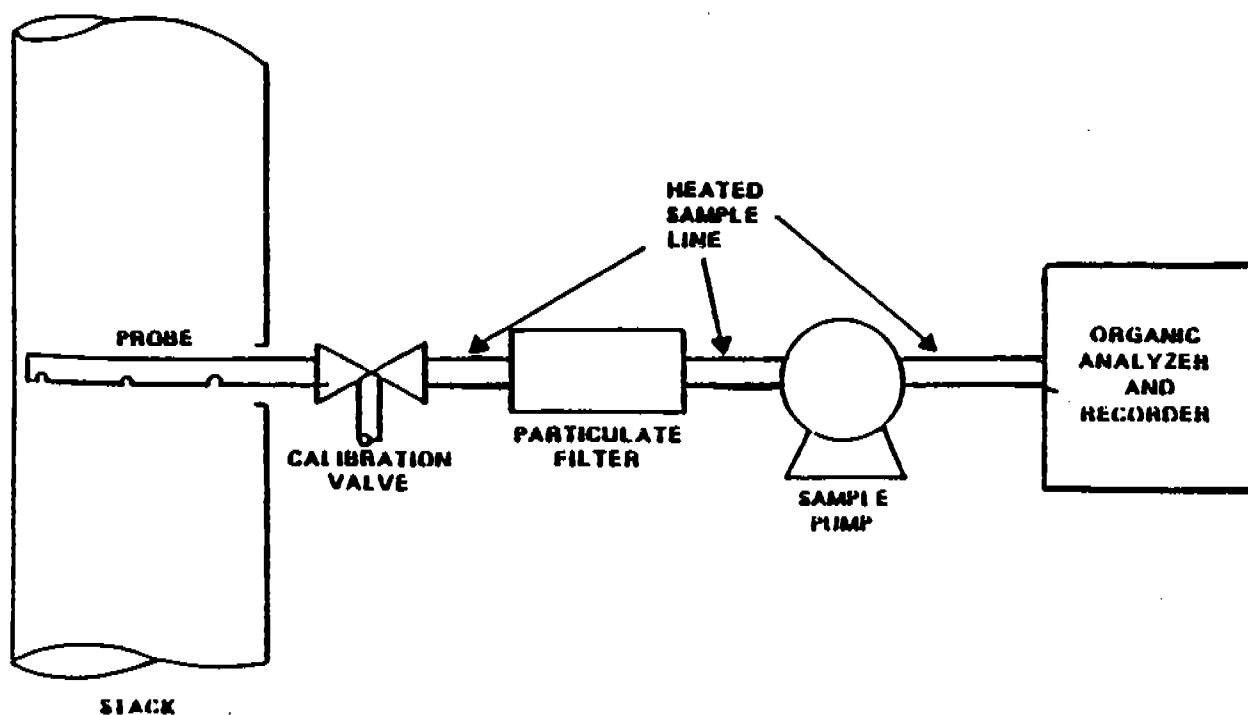


Figure 25A-1. Organic Concentration Measurement System.

3.1 Organic Concentration Analyzer. A flame ionization analyzer (FIA) capable of meeting or exceeding the specifications in this method.

3.2 Sample Probe. Stainless steel, or equivalent, three-hole rake type. Sample holes shall be 4 mm in diameter or smaller and located at 16.7, 50, and 83.3 percent of the equivalent stack diameter. Alternatively, a single opening probe may be used so that a gas sample is collected from the centrally located 10 percent area of the stack cross-section.

3.3 Sample Line. Stainless steel or Teflon^{*} tubing to transport the sample gas to the analyzer. The sample line should be heated, if necessary, to prevent condensation in the line.

3.4 Calibration Valve Assembly. A three-way valve assembly to direct the zero and calibration gases to the analyzers is recommended. Other methods, such as quick-connect lines, to route calibration gas to the analyzers are applicable.

3.5 Particulate Filter. An in-stack or an out-of-stack glass fiber filter is recommended if exhaust gas particulate loading is significant. An out-of-stack filter should be heated to prevent any condensation.

3.6 Recorder. A strip-chart recorder, analog computer, or digital recorder for recording measurement data. The minimum data recording requirement is one measurement value per minute. Note: This method is often applied in highly explosive areas. Caution and care should be exercised in choice of equipment and installation.

4. Calibration and Other Gases

Gases used for calibrations, fuel, and combustion air (if required) are contained in compressed gas cylinders. Preparation of calibration gases shall be done according to the procedure in Protocol No. 1, listed in Reference 9.2. Additionally, the manufacturer of the cylinder should provide a recommended shelf life for each calibration gas cylinder over which the concentration does not change more than ± 2 percent from the certified value. For calibration gas values not generally available (i.e., organics between 1 and 10 percent by volume), alternative methods for preparing calibration gas mixtures, such as dilution systems, may be used with prior approval of the Administrator.

Calibration gases usually consist of propane in air or nitrogen and are determined in terms of the span value. Organic compounds other than propane can be used following the above guidelines and making the appropriate corrections for response factor.

^{*} Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

4.1 Fuel. A 40 percent H₂/60 percent He or 40 percent H₂/60 percent N₂ gas mixture is recommended to avoid an oxygen synergism effect that reportedly occurs when oxygen concentration varies significantly from a mean value.

4.2 Zero Gas. High purity air with less than 0.1 parts per million by volume (ppmv) of organic material (propane or carbon equivalent) or less than 0.1 percent of the span value, whichever is greater.

4.3 Low-level Calibration Gas. An organic calibration gas with a concentration equivalent to 25 to 35 percent of the applicable span value.

4.4 Mid-level Calibration Gas. An organic calibration gas with a concentration equivalent to 45 to 55 percent of the applicable span value.

4.5 High-level Calibration Gas. An organic calibration gas with a concentration equivalent to 80 to 90 percent of the applicable span value.

5. Measurement System Performance Specifications

5.1 Zero Drift. Less than ± 3 percent of the span value.

5.2 Calibration Drift. Less than ± 3 percent of span value.

5.3 Calibration Error. Less than ± 5 percent of the calibration gas value.

6. Pretest Preparations

6.1 Selection of Sampling Site. The location of the sampling site is generally specified by the applicable regulation or purpose of the test; i.e., exhaust stack, inlet line, etc. The sample port shall be located at least 1.5 meters or 2 equivalent diameters upstream of the gas discharge to the atmosphere.

6.2 Location of Sample Probe. Install the sample probe so that the probe is centrally located in the stack, pipe, or duct and is sealed tightly at the stack port connection.

6.3 Measurement System Preparation. Prior to the emission test, assemble the measurement system following the manufacturer's written instructions in preparing the sample interface and the organic analyzer. Make the system operable.

FIA equipment can be calibrated for almost any range of total organics concentrations. For high concentrations of organics (> 1.0 percent by volume as propane) modifications to most commonly available analyzers are necessary. One accepted method of equipment modification is to decrease the size of the sample to the analyzer through the use of a smaller diameter sample capillary. Direct and continuous measurement of organic concentration is a necessary consideration when determining any modification design.

6.4 Calibration Error Test. Immediately prior to the test series, (within 2 hours of the start of the test) introduce zero gas and

high-level calibration gas at the calibration valve assembly. Adjust the analyzer output to the appropriate levels, if necessary. Calculate the predicted response for the low-level and mid-level gases based on a linear response line between the zero and high-level responses. Then introduce low-level and mid-level calibration gases successively to the measurement system. Record the analyzer responses for low-level and mid-level calibration gases and determine the differences between the measurement system responses and the predicted responses. These differences must be less than 5 percent of the respective calibration gas value. If not, the measurement system is not acceptable and must be replaced or repaired prior to testing. No adjustments to the measurement system shall be conducted after the calibration and before the drift check (Section 7.3). If adjustments are necessary before the completion of the test series, perform the drift checks prior to the required adjustments and repeat the calibration following the adjustments. If multiple electronic ranges are to be used, each additional range must be checked with a mid-level calibration gas to verify the multiplication factor.

6.5 Response Time Test. Introduce zero gas into the measurement system at the calibration valve assembly. When the system output has stabilized, switch quickly to the high-level calibration gas. Record the time from the concentration change to the measurement system response equivalent to 95 percent of the step change. Repeat the test three times and average the results.

7. Emission Measurement Test Procedure

7.1 Organic Measurement. Begin sampling at the start of the test period, recording time and any required process information as appropriate. In particular, note on the recording chart periods of process interruption or cyclic operation.

7.2 Drift Determination. Immediately following the completion of the test period and hourly during the test period, reintroduce the zero and mid-level calibration gases, one at a time, to the measurement system at the calibration valve assembly. (Make no adjustments to the measurement system until after both the zero and calibration drift checks are made.) Record the analyzer response. If the drift values exceed the specified limits, invalidate the test results preceding the check and repeat the test following corrections to the measurement system. Alternatively, recalibrate the test measurement system as in Section 6.4 and report the results using both sets of calibration data (i.e., data determined prior to the test period and data determined following the test period).

8. Organic Concentration Calculations

Determine the average organic concentration in terms of ppmv as propane or other

calibration gas. The average shall be determined by the integration of the output recording over the period specified in the applicable regulation.

If results are required in terms of ppmv as carbon, adjust measured concentrations using Equation 25A-1.

$$C_c = K C_{meas} \quad \text{Eq. 25A-1}$$

Where:

C_c = Organic concentration as carbon, ppmv.

C_{meas} = Organic concentration as measured, ppmv.

K = Carbon equivalent correction factor,

$K=2$ for ethane.

$K=3$ for propane.

$K=4$ for butane.

K = Appropriate response factor for other organic calibration gases.

9. Bibliography

9.1 Measurement of Volatile Organic Compounds—Guideline Series. U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA-450/2-78-041. June 1978. p. 46-54.

9.2 Traceability Protocol for Establishing True Concentrations of Gases Used for Calibration and Audits of Continuous Source Emission Monitors (Protocol No. 1). U.S. Environmental Protection Agency. Environmental Monitoring and Support Laboratory. Research Triangle Park, NC. June 1978.

9.3 Gasoline Vapor Emission Laboratory Evaluation—Part 2. U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. Research Triangle Park, NC. EMB Report No. 75-GAS-6. August 1975.

EPA
METHOD 0011

RECEIVED

SAMPLING FOR FORMALDEHYDE EMISSIONS FROM STATIONARY SOURCES JUL 16 1990

INTERPOLL LABORATORIES

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the determination of Destruction and Removal Efficiency (DRE) of formaldehyde, CAS Registry number 50-00-0, and possibly other aldehydes and ketones from stationary sources as specified in the regulations. The methodology has been applied specifically to formaldehyde; however, many laboratories have extended the application to other aldehydes and ketones. Compounds derivatized with 2,4-dinitrophenylhydrazine can be detected as low as 6.4×10^{-8} lbs/cu ft (1.8 ppbv) in stack gas over a 1 h sampling period, sampling approximately 45 cu ft.

2.0 SUMMARY OF METHOD

2.1 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.

3.0 INTERFERENCES

3.1 A decomposition product of 2,4-dinitrophenylhydrazine, 2,4-dinitroaniline, can be an analytical interferent if concentrations are high. 2,4-dinitroaniline can coelute with the 2,4-dinitrophenylhydrazone of formaldehyde under high performance liquid chromatography conditions which may be 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.

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 level of acetone contamination is unavoidable, because acetone is ubiquitous in laboratory and field operations. However, the acetone contamination must be minimized.

4.0 APPARATUS AND MATERIALS

4.1 A schematic of the sampling train is shown in Figure 1. This sampling train configuration is adapted from EPA Method 5 procedures. The sampling train consists of the following components: Probe Nozzle, Pitot Tube, Differential Pressure Gauge, Metering System, Barometer, and Gas Density Determination Equipment.

4.1.1 Probe Nozzle: 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

INTERPOLL LABORATORIES

4500 BALL ROAD N.E.

CIRCLE PINES, MN 55014-1819

(612) 786-0020

K-20

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 1/2 in), or larger if higher volume sampling trains are used. Each nozzle shall be calibrated according to the procedures outlined in Section 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 $120 \pm 14^{\circ}\text{C}$ ($248 \pm 25^{\circ}\text{F}$).

4.1.3 Pitot Tube: The Pitot tube shall be Type S, as described in Section 2.1 of EPA Method 2, or any other appropriate device. 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 EPA Method 2, Figure 2-6b) during sampling. The Type S pitot tube assembly shall have a known coefficient, determined as outlined in Section 4 of EPA Method 2.

4.1.4 Differential Pressure Gauge: The differential pressure gauge shall be an inclined manometer or equivalent device as described in Section 2.2 of EPA 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 four impingers, connected as shown in Figure 1, with ground glass (or equivalent) vacuum-tight fittings. For the first, third, and fourth impingers, use the Greenburg-Smith design, modified by replacing the tip with a 1.3-cm inside diameter (1/2 in) glass tube extending to 1.3 cm (1/2 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 fourth impinger for monitoring purposes.

4.1.6 Metering System: The necessary components 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 sampling rates within 10% of isokinetic collection and of determining 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: Temperature sensor and pressure gauge (as described in Sections 2.3 and 2.4 of EPA Method 2), and gas analyzer, if necessary (as described in EPA Method 3). 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 EPA Method 2, Figure 2-7). 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 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 >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.

5.0 REAGENTS

Reagent grade chemicals or better grades shall be used in all tests. Unless otherwise indicated, all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.

5.1 Water: HPLC-grade water is used in preparation of DNPH reagent and in all other applications in the sampling train.

5.2 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 h before using. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used.

5.3 Crushed Ice: Quantities 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.

5.4 2,4-Dinitrophenylhydrazine Reagent: 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: The glassware must not be rinsed with acetone or unacceptable levels of acetone contamination will be introduced. If field preparation of DNPH is performed, caution must be exercised in avoiding acetone contamination.

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.

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

5.4.1 Preparation of Aqueous Acidic DNPH: The following materials and reagents are required for preparation of the reagent.

5.4.1.1 Bottles/Caps: amber 1- or 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.

5.4.1.2 Large Glass Container: at least one large glass container (8 to 16 L) is required for mixing the aqueous acidic DNPH solution.

5.4.1.3 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.

5.4.1.4 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.

5.4.1.5 Separatory Funnels: at least one large separatory funnel (2 L) is required for cleaning the DNPH prior to use.

5.4.1.6 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.

5.4.1.7 Funnels: at least one large funnel is needed for pouring the aqueous acidic DNPH into the separatory funnel.

5.4.1.8 Graduated Cylinders: at least one large graduated cylinder (1 to 2 L) is required for measuring HPLC-grade water and acid when preparing the DNPH solution.

5.4.1.9 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.

5.4.1.10 Spatulas: spatulas are needed for weighing out DNPH when preparing the aqueous DNPH solution.

5.4.1.11 HPLC-Grade Water: water (HPLC-grade) is required to mix the aqueous DNPH solution.

5.4.1.12 Hydrochloric Acid: reagent grade hydrochloric acid (approximately 12N) is required for acidifying the aqueous DNPH solution.

5.4.1.13 2,4-Dinitrophenylhydrazine: a supply of moist solid 2,4-dinitrophenylhydrazine (DNPH) is required for preparation of aqueous acidic DNPH solution. The quantity of water may vary from 10 to 30%. Reagent grade or equivalent is required.

5.4.1.14 Methylene Chloride: 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.

5.4.1.15 Cyclohexane: 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.

5.4.1.16 Methanol: methanol (HPLC grade or equivalent) is required for rinsing glassware.

5.4.1.17 Acetonitrile: acetonitrile (HPLC grade or equivalent) is required for rinsing glassware.

5.4.1.18 Formaldehyde: Analytical grade or equivalent formaldehyde is required for preparation of standards. If other aldehydes or ketones are used, analytical grade or equivalent is required.

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.

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 HPLC-grade water. Save the empty bottle from HPLC-grade water. Start the stirring bar and adjust the stir rate to be as fast as possible. Using a graduated cylinder, measure 1.4 mL 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 on a one-place balance (see Table 1 for approximate amounts) and add to the stirring acid solution. Fill the 8 L container to the 8 L mark with HPLC 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. 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.

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	31 g
15 weight percent	33 g
30 weight percent	40 g

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 sec). After the layers have separated, discard the lower (organic) layer.

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 Quality Control: 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. To ensure that the background in the reagent is acceptable for field use, analyze one aliquot of the reagent according to the procedure of EPA Draft Method 8315. Save the other aliquot of aqueous acidic DNPH for use as a method blank when the analysis is performed.

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.

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.

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

5.4.5 Calculation of Acceptable Levels of Impurities in DNPH Reagent: The acceptable impurity level (AIL, $\mu\text{g/mL}$) is calculated from the expected analyte level in the sampled gas (EAL, 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):

$$\text{AIL} = 0.1 \times [\text{EAL} \times \text{SVOL} \times \text{FW}/22.4 \times (\text{FW} + 180)/\text{FW}] / (\text{RVOL} \times 1000).$$

where 0.1 is the acceptable contaminant level, 22.4 is a factor relating ppbv to g/L, 180 is a factor relating the underivatized analyte to the derivatized analyte, and 1000 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 4.01 mg/mL, use a 500 μL syringe to transfer 0.5 mL of 37% by weight of formaldehyde (401 mg/mL) to a 50 mL volumetric flask containing approximately 40 mL of methanol. Dilute to 50 mL with methanol.

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, 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 EPA Method 1 or other relevant criteria. Determine the stack pressure, temperature, and range of velocity heads using EPA Method 2. A leak-check of the pitot lines according to EPA Method 2, Section 3.1, must be performed. Determine the stack gas moisture content using EPA Approximation Method 4 or its alternatives to establish estimates of isokinetic sampling-rate settings. Determine the stack gas dry molecular weight, as described in EPA Method 2, Section 3.6. If integrated EPA Method 3 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 Section 2.2 of EPA 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 ft³ of sample volume is required for the determination of the Destruction and Removal Efficiency (DRE) of formaldehyde from incineration systems (45ft³ 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 Section 10.

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 EPA 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.

6.4.2 Place 100 mL of cleaned DNPH solution in each of the first two impingers, and leave the third impinger empty. If additional capacity is required for high expected concentrations of formaldehyde in the stack gas, 200 mL of DNPH per impinger may be used or additional impingers may be used for sampling. Transfer approximately 200 to 300 g of pre-weighed silica gel from its container to the fourth 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 <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 in excess of 4% of the average sampling rate or >0.00057 m³/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 Leak Checks During Sampling Runs:

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 Section 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 m³/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 re-initiated, a leak check similar to a pre-test leak check must also be conducted.

6.5.3 Post-test Leak Check:

6.5.3.1 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 m³/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° ± 14°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 unrepresentative dilution of the gas stream.

6.6.6 Traverse the stack cross section, as required by EPA 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 $<20^{\circ}\text{C}$ (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 EPA Method 2. The lines must pass this leak check in order to validate the velocity-head data.

6.6.11 Calculate percent isokineticity (see Method 2) to determine whether the run was valid or another test should be made.

7.0 SAMPLE RECOVERY

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 solutions (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. Include any condensate in the probe in this determination. 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. Follow 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. With stainless steel or other metal probes, run the brush through in the above prescribed manner at least six times since there may be small crevices in which particulate matter can be entrapped. 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: Two people should clean the probe in order to minimize sample losses. 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, and brush each surface to which sample is exposed with a Teflon® bristle brush to ensure recovery of fine particulate matter. 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 and of the brush, 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 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.

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 Section 4 of EPA 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 systems 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 m³/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 m³/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 >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 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 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 $>1.5\%$.

8.5.1 Impinger and dry-gas meter thermocouples: For the thermocouples used to measure the temperature of the gas leaving the impinger train, 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 $\pm 2^{\circ}\text{C}$ (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 balance: Calibrate the triple-beam balance before each test series, using Class S standard weights. The weights must be within $\pm 0.5\%$ of the standards, or the balance must be adjusted to meet these limits.

9.0 CALCULATIONS

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

9.1 Calculation of Total Formaldehyde:

To determine the total formaldehyde in mg, use the following equation:

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

where:

C_d - measured concentration of DNPH-formaldehyde derivative, $\mu\text{g/mL}$.

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:

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

where:

$K = 35.31 \text{ ft}^3/\text{m}^3$ if $V_{m(\text{std})}$ is expressed in English units

$= 1.00 \text{ m}^3/\text{m}^3$ if $V_{m(\text{std})}$ is expressed in metric units

$V_{m(\text{std})}$ - 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 $V_{m(\text{std})}$ and adjust for leakage, if necessary, using the equation in Section 6.3 of EPA 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 EPA 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:

Max FORM₁ Mass -

$$[(WF) (FORM_1 \text{ conc}) (100 - XDRE)] / 100$$

where:

WF - mass flow rate of waste feed per h, g/h (lb/h)

FORM₁ - 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 source

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 EPA Method 1 - 4 determinations:

$$\text{Max FORM}_1 \text{ conc} = [\text{Max FORM}_1 \text{ Mass}] / DV_{\text{eff(Std)}}$$

where:

DV_{eff(Std)} - volumetric flow rate of exhaust gas, dscm (dscf)

FORM₁ 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.

$$[LDL_{\text{FORM}} \times 10] / [FORM_1 \text{ conc}] = V_{\text{tbc}}$$

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.

Table 2. Instrument Detection Limits and Reagent Capacity for Formaldehyde Analysis¹

Analyte	Detection Limit, ppbv ²	Reagent Capacity, ppmv
formaldehyde	1.8	66
acetaldehyde	1.7	70
acrolein	1.5	75
acetone/propionaldehyde	1.5	75
butyraldehyde	1.5	79
methyl ethyl ketone	1.5	79
valeraldehyde	1.5	84
isovaleraldehyde	1.4	84
hexaldehyde	1.3	88
benzaldehyde	1.4	84
o-/m-/p-tolualdehyde	1.3	89
dimethylbenzaldehyde	1.2	93

¹ Oxygenated compounds in addition to formaldehyde are included for comparison with formaldehyde; extension of the methodology to other compounds is possible.

² Detection limits are determined in solvent. These values therefore represent the optimum capability of the methodology.

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, and analysis of field spikes. 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 must 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. At a minimum, one complete sampling train will be assembled in the field staging area, taken to the sampling area, and leak-checked at the beginning and end of the testing (or for the same total number of times as the actual sampling train). The probe of the blank train must be heated during the sample test. The train will be recovered as if it were an actual test sample. No gaseous sample will be passed through the Blank sampling train.

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 Spike: A field spike is performed by introducing 200 μ L 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.

12.0 METHOD PERFORMANCE

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

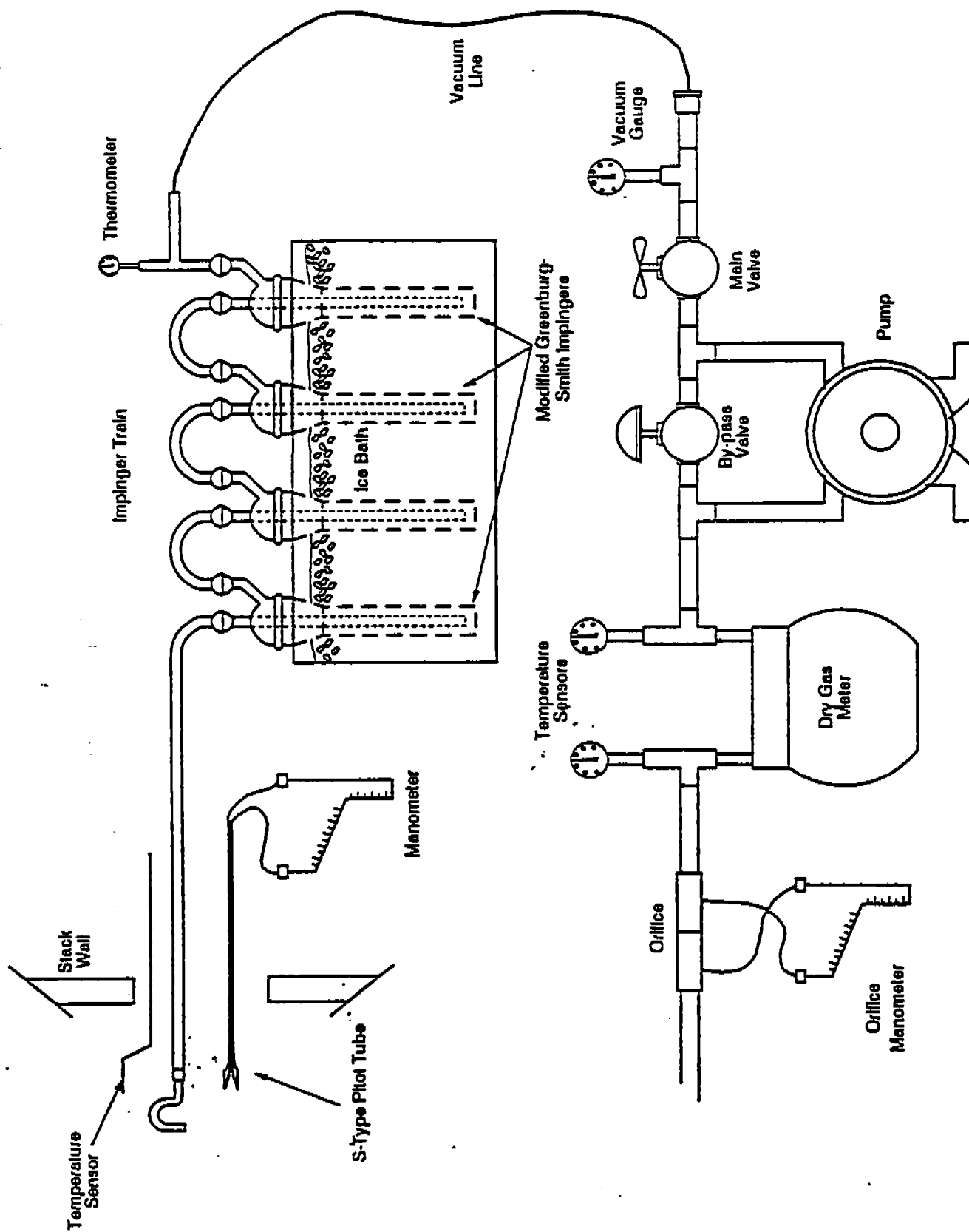
Table 3. Expected Method Performance for Formaldehyde

Parameter	Precision	¹ Accuracy ²	Detection Limit ³
Matrix: Dual trains	$\pm 15\%$ RPD	$\pm 20\%$	1.5×10^{-7} lb/ft ³ (1.8 ppbv)

¹ Relative percent difference limit for dual trains.

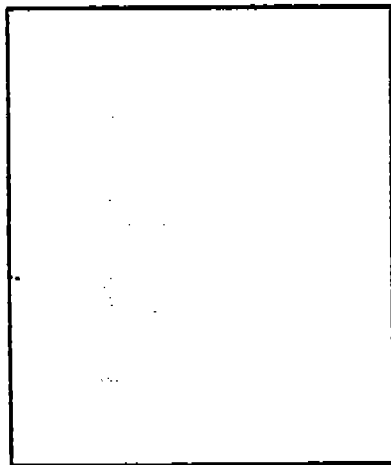
² Limit for field spike recoveries.

³ The lower reporting limit having less than 1% probability of false positive detection.



Formaldehyde Sampling Train

Plant _____
 Location _____
 Operator _____
 Date _____
 Run No. _____
 Sample Box No. _____
 Meter Box No. _____
 Meter H₂O _____
 C Factor _____
 Pilot Tube Coefficient C_p _____



Schematic of Stack Cross Section

Ambient Temperature _____
 Barometric Pressure _____
 Assumed Moisture % _____
 Probe Length, m(ft) _____
 Nozzle Identification No. _____
 Average Calibrated Nozzle Diameter, cm (in) _____
 Probe Heating Setting _____
 Leak Rate, m³/min. (cfm) _____
 Probe Liner Material _____
 Stallo Pressure, mm Hg (in. Hg) _____
 Filter No. _____

Traverse Point Number	Sampling Time (t) Min.	Vacuum mm Hg (in. Hg)	Stack Temperature (T _s) °C (°F)	Velocity Head (P _v) mm (in) H ₂ O	Pressure Differential Across Orifice Meter mm (H ₂ O) (in H ₂ O)	Gas Sample Volume m ³ (ft ³)	Gas Sample Temp. at Dry Gas Meter		Filter Holder Temperature °C (°F)	Temperature of Gas Leaving Leak Impinger °C (°F)
							Inlet °C (°F)	Outlet °C (°F)		
Total							Avg. Avg.			
Average										

Figure 2. Field Data Sheet

DRAFT

DCN No.: 93-275-065-55-07
Radian No.: 275-065-55
EPA NO.: 68-D1-0010

This document is a preliminary draft.
It has not been formally released by EPA
and should not at this stage be construed
to represent Agency policy. It is being
circulated for comment on its technical
accuracy and for any implications.

FIELD TEST OF A GENERIC METHOD FOR SAMPLING AND ANALYSIS OF ISOCYANATES

Interim Report
(Work Assignment 55)

Prepared for:

Frank Wilshire
Atmospheric Research and Exposure Assessment Laboratory
Methods Research and Development Division
Source Methods Research Branch
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Prepared by:

J. F. McGaughey
S. C. Foster
R. G. Merrill

RADIAN
CORPORATION

P.O. Box 13000
Research Triangle Park, NC 27709

July 1993

DRAFT

This document is a preliminary draft
It has not been formally released by EPA
and should not at this stage be construed
to represent Agency policy. It is being
circulated for comment on its technical
accuracy and policy implications.

DISCLAIMER

The information in this document has been funded wholly by the United States Environmental Protection Agency under EPA Contract Number 68-D1-0010 to Radian. It has been subjected to the Agency's peer and administrative review, and it has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

ACKNOWLEDGEMENT

We wish to acknowledge the contributions of the following individuals to the success of this program: Mark Owens, Danny Harrison, Darrell Doerlé and Jim Southerland

EXECUTIVE SUMMARY

Isocyanates are used extensively in the production of polyurethane materials such as flexible foam, enamel wire coatings, paint formulations and in binders for the pressed board industry. Because of their widespread use and known adverse physiological effects, several isocyanates have been listed in Title III of the Clean Air Act Amendments of 1990. The isocyanates of interest are: 2,4-toluene diisocyanate (TDI), methylene diphenyl diisocyanate (MDI), 1,6-hexamethylene diisocyanate (HDI) and methyl isocyanate (MI). Previously, no validated sampling and analytical methodology for these compounds relative to stationary sources existed.

The field validation study presented in this report is a culmination of laboratory investigations, performed under previous work assignments, which were designed to develop and evaluate a viable approach for the determination of isocyanate emissions from stationary sources. After the successful completion of the laboratory studies, the sampling and analysis approach was formulated and a field validation test was initiated. At the direction of the EPA, TDI was selected as the primary analyte.

The test site selected was a flexible foam manufacturing facility in High Point, North Carolina, which used TDI in the manufacturing process. The approximate level of TDI in the emission stream was determined by the analysis of samples collected during a presurvey. A sampling scheme was then designed to ensure the collection of sufficient samples to yield statistically valid data. Following the EPA Method 301 protocol, quadruplicate trains (QUAD) were operated simultaneously with four co-located probes. Two of the trains were spiked with TDI and two were unspiked. Samples from eight QUAD runs (minimum of six valid runs required by Method 301) were returned to the laboratory and analyzed according to the analytical procedure developed in laboratory studies. These data were statistically evaluated following Method 301 protocol to determine the performance of the method relative to bias and precision. These results are summarized in the following table. The precision for both the spiked and unspiked trains was less than 5% RSD, which is well within the precision criteria (% RSD < 50)

Method Validation Statistical Summary

Precision ^a	
% RSD for Spiked Samples	3.55 ^b
% RSD for Unspiked Samples	4.72 ^b
Accuracy ^a	
Bias:	-295 μ g
Significant?	No
Correction Factor	1.0 ^c
Recovery ^a	
Amount Spiked (as TDI)	7828 μ g
Average Percent Recovered	95

^aResults are based on the average of seven QUAD runs (14 spiked trains and 14 unspiked trains). TDI was present in the stack emissions and was therefore collected as background in the unspiked trains as well as in the spiked trains.

^bEPA Method 301 requires the precision to be <50% RSD for the method to be acceptable.

^cEPA Method 301 requires the calculated Correction Factor to be between 0.7 and 1.3 for the method to be acceptable.

for an acceptable method as tested. Using the data from all eight runs, the bias was found to be significant at the 95% level of confidence thus requiring the use of a correction factor of 1.053. Using the data from only seven runs (eliminating run number eight due to a questionable leak check for one of the trains) the bias was not significant and therefore did not require the calculation of a correction factor. In either case, the method was well within the bias acceptance criteria (correction factor between 0.7 and 1.3) for an acceptable method as tested.

TABLE OF CONTENTS

	Page
1.0 INTRODUCTION	1-1
2.0 CONCLUSIONS AND RECOMMENDATIONS	2-1
3.0 FIELD TEST	3-1
3.1 Site Description	3-1
3.2 Sampling Location	3-1
3.3 Test Schedule	3-3
3.4 Sample Collection	3-3
3.4.1 Quad Probe	3-3
3.4.2 Quad-Train Assembly	3-6
3.5 Sampling Preparation	3-6
3.5.1 Glassware Preparation	3-6
3.5.2 Preparation of Impinger Absorbing Solution	3-8
3.5.3 Preparation of TDI Spiking Solution	3-8
3.5.4 Sampling Equipment Preparation	3-9
3.5.5 Sampling Operations	3-10
3.5.6 Sample Recovery	3-13
3.6 Quality Control	3-16
4.0 ANALYTICAL PROCEDURES	4-1
4.1 Sample Preparation	4-1
4.2 Chromatographic Analyses	4-1
4.2.1 Standard Preparation	4-1
4.2.2 Analysis	4-2
4.3 Qualitative Identification	4-3
4.4 Calculations	4-3
4.4.1 Calculation of the Amount of Isocyanate Collected	4-3
4.4.2 Normalization of the Amount of Isocyanate Collected	4-6
4.5 Quality Control	4-12

TABLE OF CONTENTS, continued

	Page
5.0 RESULTS AND DISCUSSION	5-1
5.1 Bias and Precision	5-1
5.2 Breakthrough and Recovery	5-3
5.2.1 Breakthrough	5-3
5.2.2 Recovery	5-6
5.3 Quality Assurance/Quality Control	5-6
5.3.1 Overview of Data Quality	5-8
5.3.2 Sampling Quality Control	5-10
5.3.3 Sample Storage and Holding Time	5-10
5.3.4 Analytical Quality Control	5-10

LIST OF TABLES

		Page
1-1	Isocyanates Listed in the Clean Air Act Amendments of 1990	1-2
3-1	Test Schedule	3-4
3-2	Sampling Train Test Matrix	3-7
3-3	Quad Train Sample Volumes	3-14
4-1	2,4-TDI Detected in Unspiked Trains, μg	4-7
4-2	2,4-TDI Detected in Spiked Trains, μg	4-9
4-3	Normalized Amount of 2,4-TDI Detected in Unspiked Trains, μg	4-13
4-4	Normalized Amount of 2,4-TDI Detected in Spiked Trains, μg	4-14
5-1	Summary of Method 301 Statistical Calculations	5-2
5-2	Distribution of 2,4-TDI Within the Spiked Trains	5-4
5-3	Distribution of 2,4-TDI Within the Unspiked Trains	5-5
5-4	Percent Recovery of the Spiked 2,4-TDI	5-7
5-5	Data Quality Acceptance Criteria and Results	5-9
5-6	Sampling Train Leak Check Summary	5-11
5-7	Summary of Analytical Quality Control Results	5-12

LIST OF FIGURES

	Page
3-1 Sample Location	3-2
3-2 Schematic of Quad Train Setup	3-5
3-3 Sampling Train for Isocyanate	3-12
4-1 Chromatogram of Unspiked Train	4-4
4-2 Chromatogram of Spiked Train	4-5

Sampling and analytical methods for a particular analyte or group of analytes can be evaluated and validated by demonstrating their performance in field tests, thereby establishing the precision and bias of the methods experimentally. Few methods have been fully validated for sampling and analyzing the organic compounds listed in Title III of the Clean Air Act Amendments of 1990. For some analytes, methods have been validated for sample analysis, but not for sample collection. Full validation for both sampling and analytical methods, for both field and laboratory operations, is available for fewer than 10 percent of the analytes listed in Title III of the Clean Air Act Amendments at any source category. Field validation may be performed by side-by-side comparison of a candidate method to a validated method to establish comparable performance for the same analytes in the same matrix (same source category). Another procedure for validation of a method is to spike known quantities of analytes into the collection apparatus in the field so that the precision and bias of the method can be demonstrated from sample collection through analysis.

EPA, under the authority of Title III of the Clean Air Act Amendments (CAAA) of 1990, requires the identification and validation of sampling and analytical methods for the isocyanate compounds which are listed among the 189 hazardous air pollutants identified in Title III. These isocyanate compounds are listed in Table 1-1. Development of sampling and analytical methods for these four compounds was accomplished under Work Assignments 11, 21, and 40 on EPA Contract No. 68-D1-0010. At the direction of EPA, initial efforts were directed to the measurement of 2,4-toluene diisocyanate (TDI) emissions.

The objective of this work assignment was to validate the isocyanate sampling and analytical test method through field testing at an operating stationary source. The method was validated by collecting flue gas samples for the analysis of 2,4-TDI, and evaluating the data for bias and precision. EPA Method 301, "Field Validation of Pollutant Measurement Methods from Various Waste Media," was used as

Table 1-1

Isocyanates Listed in the Clean Air Act Amendments of 1990

Hexamethylene-1,6-diisocyanate (HDI)

2,4-Toluene diisocyanate (TDI)*

Methylene diphenyl diisocyanate (MDI)

Methyl isocyanate (MI)

*The 2,6 TDI isomer may also be present but is not listed in the CAAA.

a model for the validation protocol. Analyte spiking was used with quadruplicate sampling trains to generate the required data. The field validation was performed at an industrial facility which manufactures flexible foam products. Only two of the quadruplicate trains were spiked for each run. The two unspiked trains were used to establish the background level of target compound in the stack gas.

The sampling method utilizes a Method 5-type sampling train, which operates with a solution of 1-(2-pyridyl) piperazine and toluene in the impingers. Stack gas is extracted from the source through a heated probe and drawn through the impingers. TDI present in the stack gas reacts with the piperazine to form an isocyanate derivative. The quantity of isocyanate is determined by solvent exchange of the toluene solution with acetonitrile followed by high pressure liquid chromatographic (HPLC) analysis.

This report discusses the details of the field validation study. Section 2.0, Conclusions and Recommendations, summarizes the results and provides recommendations for future work. Sections 3.0 and 4.0 provide details of the sampling and analysis procedures respectively. Section 5.0 is a detailed discussion of the procedures, calculations and quality control.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results presented in Section 6.0 of this report, the following conclusions can be made concerning the validity of the method as tested under the conditions described in this report:

- The calculated values for precision (%RSD) for both the spiked and unspiked trains, 3.55 and 4.72 respectively, are both well within the acceptance criteria of less than 50% RSD found in Section 6.3 of the EPA Method 301. Therefore, the method as tested at the source category described meets the precision requirements;
- The method bias, at the concentration levels tested, was found to be significantly different from zero at the 95% level of confidence when the data from all eight runs (minimum of six runs required) were used in the calculations. A correction factor of 1.053 would be required if all eight runs are included in the bias calculation. Good technical reasons exist for excluding one of eight QUAD runs. If this run is eliminated, no bias correction is required. In either case the correction factor is well within the acceptance criteria of 0.7 to 1.3 found in Section 1.2 of the EPA Method 301. Therefore, the method as tested at the source category described meets the bias and correction factor requirements; and
- The method as tested is sufficiently robust to allow testing at sources similar to the source tested in this study where the stack gas moisture is less than 1% by volume, the stack temperature is less than 30 degrees C and the presence of other compounds that may interfere with the analysis are minimal.

Recommendations for future testing and validation of the method for the sampling and analysis of isocyanates include the following:

- Identify a source for testing that has more than one isocyanate present in the stack gas;
- Spike as many of the four CAAA target isocyanates as possible into the train before sampling in order to gain as much information as possible from the field test; and

- Design the condenser between the first and second impinger of the train to more efficiently reduce the loss of toluene from the first impinger and minimize compound breakthrough due entrained aerosols.

3.0

FIELD TEST

The objective of this program was to perform a field test to establish the bias and precision of a sampling and analytical method for isocyanate compounds listed in Title III of the Clean Air Act Amendments of 1990. The method evaluation in this test series resulted from extensive literature reviews, industry consultation and laboratory development. To achieve the test objective, an industrial source with known emissions of TDI was selected as a field test site. Factors in the site selection were easy access, ample space for the quadruple sampling trains and proximity to Radian's office and laboratory in Research Triangle Park, North Carolina.

3.1

Site Description

The field validation test was performed at a flexible foam production plant located in High Point, North Carolina. In the manufacturing process starting materials (TDI, water, a polyether resin, methylene chloride, an amine catalyst, and coloring additives) are blended and continuously fed onto a conveyer belt. The TDI reacts with water and releases CO₂, which causes foaming in the resin material. Dichloromethane (DCM) can be added as a supplemental "blowing" or foaming agent. The heat from the reaction of TDI and water causes the DCM to vaporize, resulting in increased foaming. The density of the foam is controlled by the amount of TDI, water and DCM added. The foaming action continues as the material proceeds down the conveyer belt. Finished product is then allowed to cure and degas for 24 to 48 hours.

3.2

Sampling Location

Figure 3-1 presents a schematic view of the sampling location. Three induced draft (ID) fans are used to exhaust TDI and DCM vapors from the production process through three separate uninsulated sheet metal ducts that extend through the roof. Two of the ducts are connected by a 30-foot horizontal duct, 34 inches in diameter, which then extends vertically to a height of 25 feet above the roof top. A 6 inch

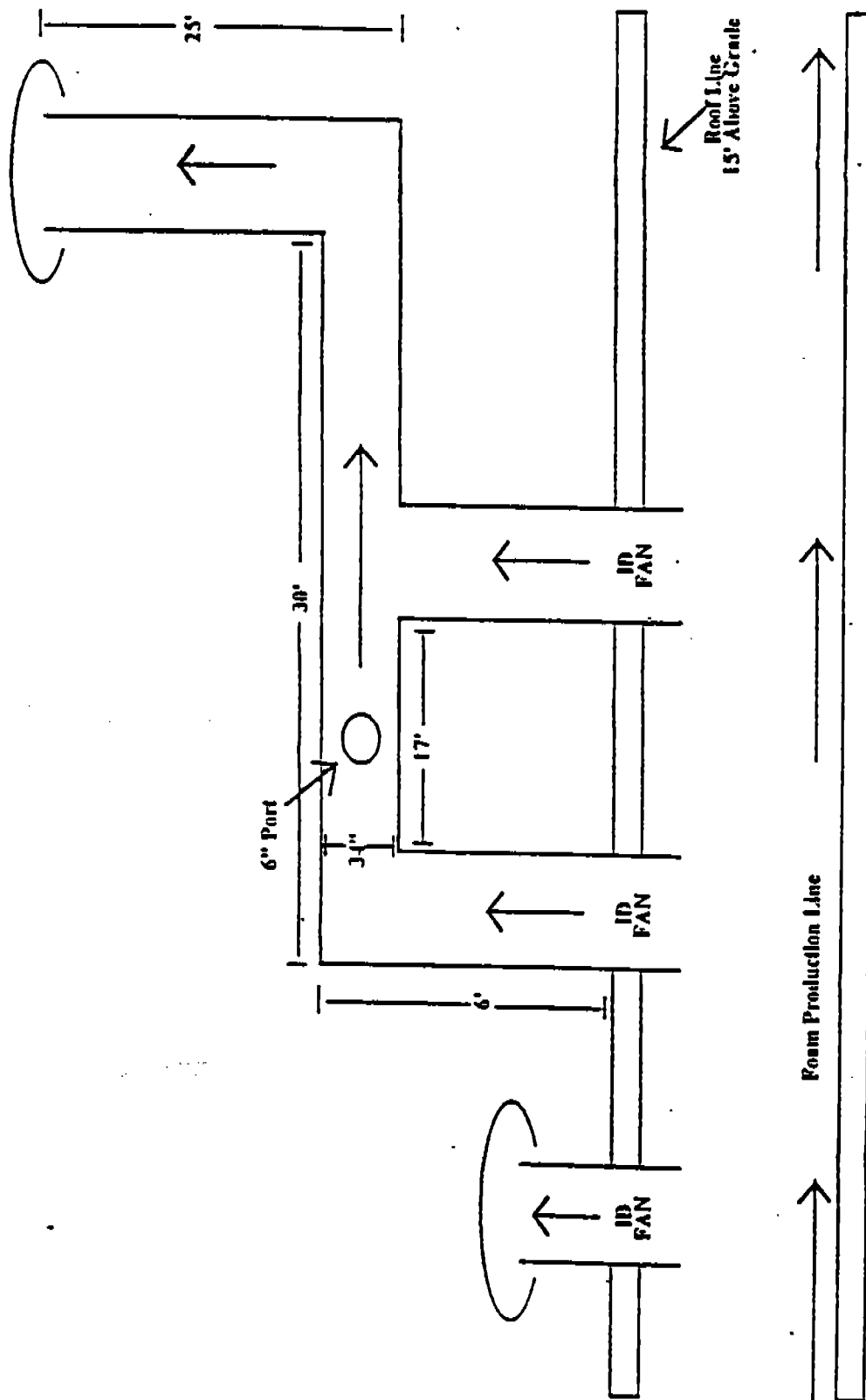


Figure 3-1. Sample Location

diameter sampling port is located in the horizontal duct midway between vertical ducts number 2 and 3, approximately 5 feet above the roof level. The roof level is approximately 15 feet above the ground.

A recovery trailer was located on the ground immediately in front of the sampling area, allowing easy communication between the sampling crew and recovery area. Two-way radio communication between the facility production personnel and the sampling crew allowed coordination between production startup and the start of each sampling run.

3.3 Test Schedule

The recovery trailer and test equipment were mobilized on Saturday, February 20, 1993. Equipment setup took place Saturday afternoon and Sunday, and testing began Monday morning.

The sampling schedule is shown in Table 3-1. Eight runs were completed, which included two extra runs above the required minimum of six.

3.4 Sample Collection

3.4.1 Quad Probe

Sampling was performed by withdrawing stack gas from a single port in the stack through a quad probe, then directing the sampled gas simultaneously to four independently operated sampling trains. The quad probe contains four similar heated sampling probes that were inserted into the stack as one unit, as shown in Figure 3-2. The front end of the quad probe was positioned in the center of the stack and remained

Table 3-1
Test Schedule

Run	Date	Start Time	Stop Time
1	2-22-93	1215	1300
2	2-22-93	1330	1410
3	2-23-93	0945	1085
4	2-23-93	1335	1415
5	2-24-93	1010	1110
6	2-24-93	1335	1420
7	2-25-93	1215	1255
8	2-25-93	1315	1355

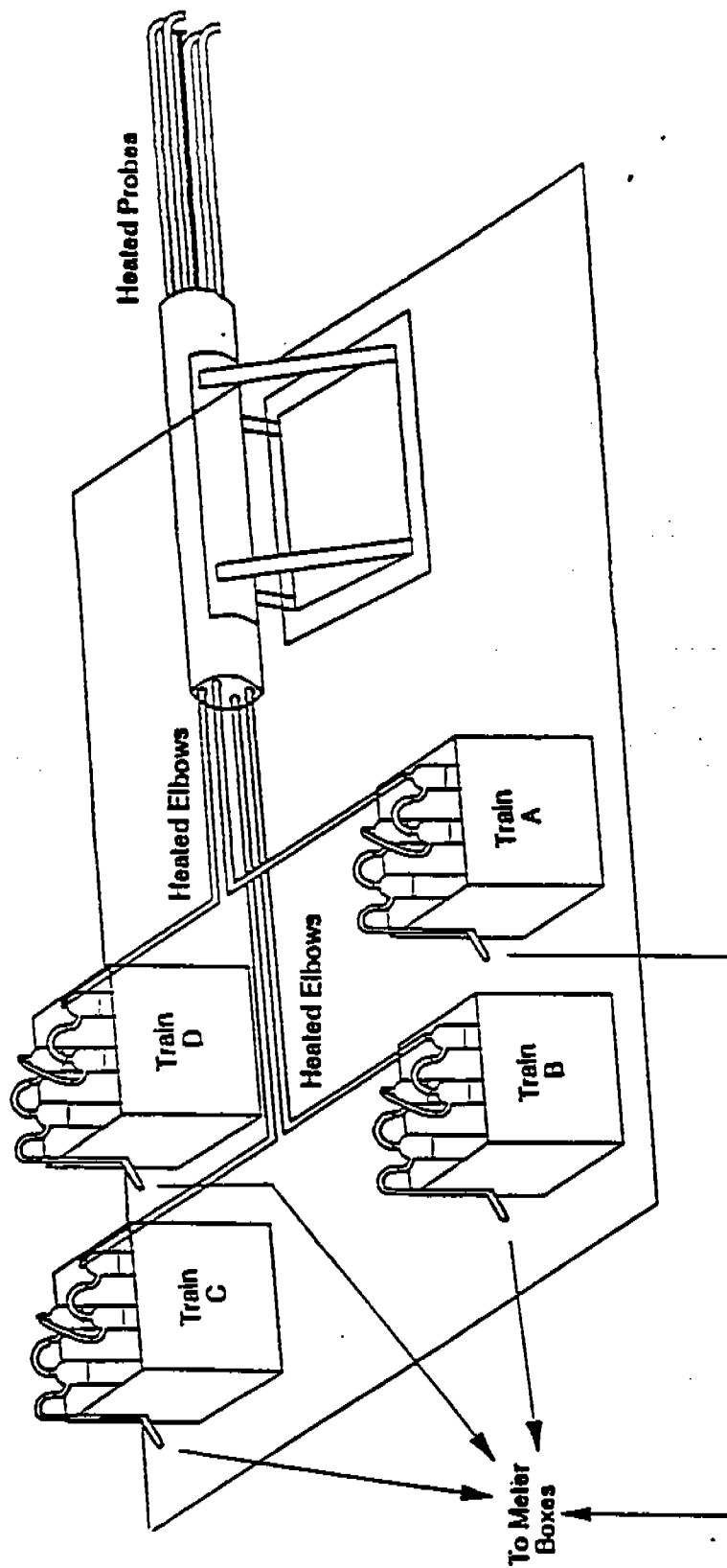


Figure 3-2. Schematic of Quad Train Setup

in that location during each test. The stack was not traversed nor were stack gas velocity measurements made, because determination of the true concentration and emission rate of the target compound in the stack gas was not required to meet the objectives of this program.

Method 301 of 40 CFR Part 63 describes field validation procedures and details the criteria for the quadruple sampling probe tip arrangement. This method requires the inside edge of sampling probe tips to be situated in a 6.0 cm x 6.0 cm square area. The area encompassed by the probe tip arrangement should occupy less than 5% of the stack cross-sectional area. The cross-sectional area of the probe tip arrangement used in this test was 5.8 square inches as measured from the probe/nozzle centerlines. This area is less than 1% of the stack cross-sectional area of 908 square inches, which satisfies the Method 301 criterion.

3.4.2 Quad-Train Assembly

Four independent sampling trains made up the quad-train assembly. Although four meter boxes were required, the velocity head (ΔP) was determined using only one set of pitot tubes. The sampling trains were identified as Train A, B, C, and D. Two of the four trains were spiked before each run. The spiking compound was added to the first impinger of these trains in the field for bias determination. The sampling train test matrix is given in Table 3-2.

3.5 Sampling Preparation

3.5.1 Glassware Preparation

All glassware used for sampling was thoroughly cleaned prior to use. This included the probe, impingers, all sample bottles and all utensils used during sample recovery. All glassware was washed with hot soapy water, rinsed with hot tap water, rinsed with distilled water and baked in an oven at 300 °C for four hours. The glassware

Table 3-2

Sampling Train Test Matrix

Run #	Train Designation	
	Spiked	Unspiked
1	A, B	C, D
2	C, D	A, B
3	A, B	C, D
4	C, D	A, B
5	A, B	C, D
6	C, D	A, B
7	A, B	C, D
8	C, D	A, B

was then triple-rinsed with HPLC grade acetonitrile, followed by triple-rinsing with HPLC grade toluene. Open ends of glassware were covered with aluminum foil to minimize potential contamination during transportation and set-up.

3.5.2 Preparation of Impinger Absorbing Solution

Historical data available from the host test site facility and data resulting from the collection of preliminary samples by Radian indicated that the concentration of TDI in the process exhaust was 1 ppm or less, depending on the density of foam being produced on any given day. At this concentration, a 30 cubic foot sample size would result in the collection of approximately 7 mg of TDI. Using the reaction stoichiometry of two moles of 1,2-PP per mole of TDI, the piperazine in toluene solution was then prepared at a concentration level three times the calculated minimum needed, or 133 $\mu\text{g/mL}$. This would provide a total of approximately 40 mg of 1,2-PP in 300 mL of impinger solution in the first impinger available for reaction with TDI. At this concentration, approximately 22 mg of TDI could be collected in the first impinger before the reagent was exhausted. This solution was prepared in the laboratory just prior to use in the field, and was used within 10 days of preparation.

3.5.3 Preparation of TDI Spiking Solution

The TDI spiking solution was prepared at a concentration of 1.5 mg of the derivatized TDI per 1 mL of acetonitrile. Fifteen mL of this spiking solution was spiked into the first impinger of two of the four trains prior to each QUAD run. This spiking scheme resulted in a total spike amount of derivatized TDI of 22.5 mg, which is equivalent to 7.83 mg of underivatized TDI. This is an amount equivalent to the amount of TDI expected to be collected in the train from the stack gas based on presurvey samples. Therefore, the amount present in the two spiked trains was designed to be at least twice the amount present in the two unspiked trains.

Final sampling train preparations included calibration and leak checking of all the train equipment, including meter boxes, thermocouples, nozzles, pitot tubes, and umbilicals. Reference calibration procedures were followed when available, and the results were properly documented and archived. If a referenced calibration technique for a particular piece of apparatus was not available, then a state-of-the-art technique was used. A discussion of the techniques used to calibrate this equipment is presented below.

S-Type Pitot Tube Calibration

The EPA has specified guidelines concerning the construction and geometry of an acceptable S-Type pitot tube. If the specified design and construction guidelines are met, a pitot tube coefficient of 0.84 can be used. Information pertaining to the design and construction of the Type-S pitot tube is presented in detail in Section 4.1.1 of EPA Document 600/4-77027b. Only S-Type pitot tubes meeting the required EPA specifications were used. Pitot tubes were inspected and documented as meeting EPA specifications prior to field sampling.

Sampling Nozzle Calibration

Glass nozzles were used for sampling. All nozzles were thoroughly cleaned, visually inspected for damage, and calibrated according to the procedure outlined in Section 4.4.2 of EPA Document 600/4-77-027b.

Dry Gas Meter Calibration

Dry gas meters (DGMs) were used in the sample trains to measure the sample volume and sampling rate. All DGMs were calibrated to document the volume correction factor prior to the departure of the equipment to the field. Post-test

calibration checks were performed after the equipment was returned to Radian's laboratory. Pre- and post-test calibrations agreed to within 5 percent.

Prior to calibration, a positive pressure leak check of the system was performed using the procedure outlined in Section 4.3.2 of EPA Document 600/4-77-23b. The system was placed under approximately 10 inches of water pressure and an oil manometer was used to determine if the pressure decreased over a one-minute period.

After the sampling console was assembled and leak checked, the pump was allowed to run for 15 minutes to allow the pump and DGM to warm up. The valve was then adjusted to obtain the desired flow rate. For the pre-test calibrations, data were collected at the orifice manometer settings (ΔH) of 0.5, 1.0, 1.5, 2.0, 3.0, and 4.0 inches of water. Gas volumes of 5 ft³ were used for the two lower orifice settings, and volumes of 10 ft³ were used for the higher settings. The individual gas meter correction factors (γ_i) were calculated for each orifice setting and averaged. The method requires that each of the individual correction factors fall within $\pm 2\%$ of the average correction factor or the meter must be cleaned, adjusted, and recalibrated. In addition, Radian requires that the average correction factor be 1.00 ± 1 percent. For the post-test calibration, the meter was calibrated three times at the average orifice setting and vacuum which were used during the actual test.

Dry gas meter calibrations were performed at Radian's laboratory using an American[®] wet test meter as an intermediate standard. The intermediate standard is calibrated every six months against the EPA spirometer at EPA's Emission Measurement Laboratory in Research Triangle Park (RTP), North Carolina.

3.5.5 Sampling Operations

Vent gas samples were collected isokinetically from a single sampling point located in the center of the duct. Preliminary information about the stack gas velocity useful in selecting nozzle size and calculating the K-factor was obtained during the

pre-site survey. Prior to testing, a leak check of pitot lines was performed according to EPA Method 2. Oxygen (O_2) and carbon dioxide (CO_2) concentrations were ambient levels as determined by EPA Method 3. The stack gas moisture data was measured by the host facility as the relative humidity.

Preparation of Sampling Train

The four sampling trains for each QUAD run were charged and assembled in the recovery trailer. The impinger buckets were marked as Train A, B, C, or D. Tared impingers were used. Approximately 300 mL of the absorbing reagent was transferred to the first impinger and 200 mL to the second impinger. The first impinger of each train was of a Greenburg-Smith design and all remaining impingers were of the modified Greenburg-Smith design. The third impinger was empty, 200 to 300 g of silica gel was placed in the fourth impinger and 400 g of charcoal was placed in the fifth impinger. A water jacketed condenser was placed between the outlet of the first impinger and the inlet to the second impinger to promote cooling and minimize evaporative losses of toluene from the first impinger. Fifteen (15) mL of the spiking solution was pipetted into the first impinger of Trains A and B. Openings were covered with Teflon® film or aluminum foil after the assembly of the trains.

Final assembly of the sampling trains occurred at the sampling location. The complete train configuration is shown in Figure 3-3. Thermocouples were attached to measure the stack temperature and probe outlet and impinger outlet temperatures. Crushed ice was added to each impinger bucket, and the probe heaters were turned on and allowed to stabilize at $120^\circ \pm 12^\circ C$ ($248^\circ \pm 25^\circ F$).

The isocyanate trains were leak checked before and after each sampling run, as required in EPA Method 5. To leak check the assembled train, the nozzle end was capped off and the sampling train evacuated to a vacuum of 15 inches of Hg. After the system was evacuated and the pump isolated from the train, the volume of gas flowing through the system was timed for 60 seconds. The leak rate is required to be

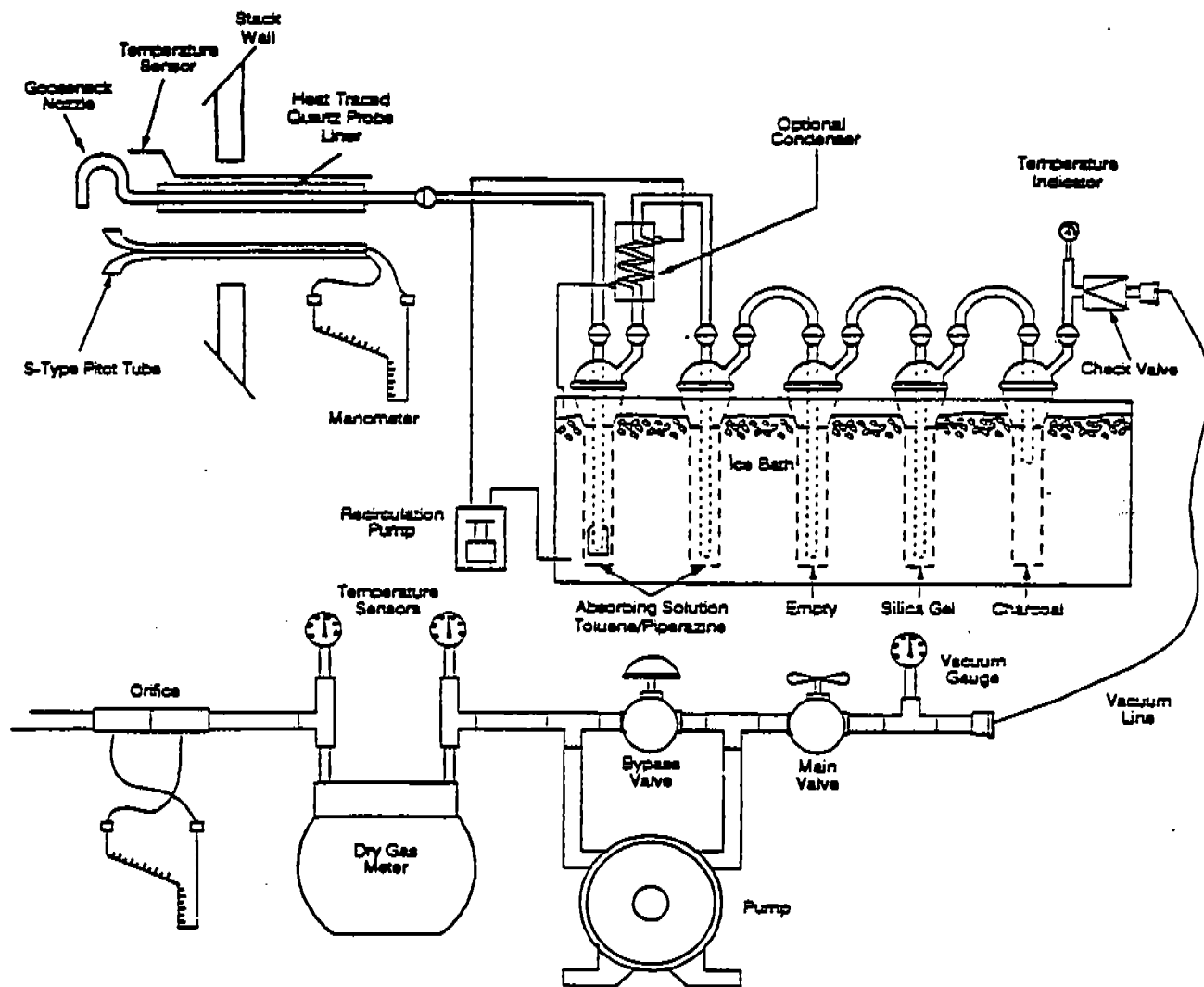


Figure 3-3. Sampling Train for Isocyanate

less than 0.02 acfm or 4% of the average sampling rate, whichever is less. After the leak rate was determined, the cap was slowly removed from the nozzle end until the vacuum in the train returned to atmospheric pressure and then the pump was turned off.

The leak rates and sampling start and stop times were recorded on the sampling task log. Also, any other events that occur during sampling were recorded on the task log (such as pitot cleaning, thermocouple malfunctions, heater malfunctions, and any other unusual occurrences). A nominal sample size of 30 cubic feet was collected in all sampling train. This was accomplished by sampling at a flowrate of 0.5 cubic feet per minute for 60 minutes. The sample volumes for each train by QUAD run are presented in Table 3-3.

3.5.6 Sample Recovery

The sample bottles containing the probe and nozzle washings and the impinger portion of the sampling trains were moved to the recovery trailer.

Each impinger was carefully removed from the impinger bucket, the outside was wiped dry, and the final impinger weight was determined and recorded to calculate stack moisture. The isocyanate sample was then collected in the following two fractions:

- First impinger contents, toluene rinses from the nozzle/probe liner and toluene/acetonitrile rinses of the first impinger and connecting glassware; and
- Contents and toluene/acetonitrile rinses from the second and third impingers and the condenser.

Recovery procedures are detailed in this section. All recovery bottles were wide mouth amber glass with Teflon® lined lids.

Table 3-3.

Quad Train Sample Volumes

Date	Run Number	Train A Vm @ 68° (ft³)	Train B Vm @ 68° (ft³)	Train C Vm @ 68° (ft³)	Train D Vm @ 68° (ft³)
2/22/93	1	33.42	33.89	33.02	33.04
2/22/93	2	29.07	29.65	28.67	28.40
2/23/93	3	34.24	35.15	33.75	33.01
2/23/93	4	30.60	31.17	30.35	29.54
2/24/93	5	34.14	34.70	34.46	32.59
2/24/93	6	35.10	35.17	34.49	33.78
2/25/93	7	31.11	31.94	30.14	29.91
2/25/93	8	30.89	29.73	30.49	31.95

Container 1 - Probe and First Impinger Contents

The contents and rinses of each of the first impingers and first impinger connectors were combined with the corresponding probe/nozzle washing solution. The entire contents of the first impinger were recovered as a single sample, even if two phases were present. The first impinger and connecting tubing were rinsed three times with 15 mL aliquots of toluene. A final rinse of the impinger with acetonitrile was also necessary to remove any water left on the impinger wall and to recover any remaining derivatized TDI.

Container 2 - Second and Third Impinger Contents/Condenser Rinse

The contents and toluene/acetonitrile rinses of the second and third impingers and the condenser of each train were collected in the same manner used for the first impinger described above. The contents of these impingers were analyzed separately from the contents collected in the first impinger to check for breakthrough; therefore, care was taken to avoid physical carryover from the first impinger to the second. The contents of the fourth and fifth impingers were weighed as previously described and then discarded.

Field Blanks

Four field blanks were prepared and recovered during the test, one on each day of testing. The four field blanks were prepared using Trains A, B, C, and D from the two sets of glassware used during the testing. A sampling train was assembled in the staging area, taken to the sampling location, and leak-checked. The probe of the blank train was heated during the generation of the field blank, but no gas sample was passed through the sampling train. The sampling train for the field blank was recovered with the same procedure described for authentic source samples.

Reagent Blank(s)

Aliquots of each lot of toluene, acetonitrile and absorbing reagent were collected daily to be analyzed as reagent blanks.

Sample Storage and Shipping

Sample containers were checked to ensure that complete labels had been affixed. The labels identified Trains A, B, C, or D, as appropriate. Teflon® lids were tightened and secured with Teflon® tape. The sample bottles were stored in a cooler packed with ice and were returned to Radian's laboratory in these coolers at the end of the field test.

3.6 Quality Control

The following quality control measures were implemented during the field testing phase of this program:

- All dry gas meters were calibrated. Calibration procedures were followed for the pitot tube/probe assembly and all thermocouple readout devices.
- Temperatures of the sampling train were maintained at the specified setting ($120 \pm 12^{\circ}\text{C}$) during each sampling run at levels prescribed in the test plan.
- Sampling trains were leak-checked both prior to and after sampling.
- All glassware was washed and oven-baked following appropriate method protocol, given in the test plan.
- All recovery solvents were HPLC grade and an aliquot of each was collected daily as reagent blanks.
- One field blank was collected for every two sampling runs.

- Chain of Custody forms and log books were filled in at the completion of each day of sampling.

4.0 ANALYTICAL PROCEDURES

4.1 Sample Preparation

The samples were received in the laboratory in screw-capped glass bottles with Teflon®-lined caps, sealed with Teflon® tape and stored in coolers packed with ice. Samples were logged into the laboratory sample tracking system and stored in a secure, refrigerated (4°C) sample storage area prior to analysis. Samples were prepared for analysis within 30 days of collection and analyzed within 30 days of preparation.

All labware was washed with detergent and water and rinsed with hot tap water, rinsed with deionized water, baked at 300°C, rinsed with acetonitrile and toluene prior to use. Solvents used were HPLC grade or equivalent.

Each of the two recovered samples from each train was transferred along with rinses to separate 500 mL round bottom flasks and then evaporated to dryness under vacuum in a 65°C water bath. Each round-bottom flask was then rinsed three times with separate two (2) mL aliquots of acetonitrile (ACN) and the rinses transferred to a 10-mL volumetric flask. The sample was then brought to volume with ACN and transferred to a 15-mL vial and sealed with a Teflon®-lined lid. The vial was stored in a refrigerated sample storage area at 4°C until analysis.

4.2 Chromatographic Analyses

The procedures for the HPLC analyses of the samples are described in the following sections.

4.2.1 Standard Preparation

A 300 µg/mL stock solution of TDI piperazine urea derivative was prepared by dissolving 7.5 mg of the purified crystals of the derivatized TDI in 25 mL of

ACN. [The derivatized TDI was previously prepared by adding 1 g of the neat TDI to a solution of 1-(2-pyridyl) piperazine in ACN, evaporating to dryness and recrystallizing the urea derivative three times from ACN.] Working standards for the calibration curve were made from this stock at six concentration levels in ACN ranging from 0 to 50 $\mu\text{g/mL}$. This concentration range covered the amount of TDI expected to be collected at the host facility. This stock solution was also used to prepare the field spiking solution. A check standard was prepared from a separately prepared stock solution. This check standard fell in the middle of the calibration curve.

4.2.2 Analysis

HPLC System

The HPLC system operating parameters for analysis of standards and samples were as follows:

Instrument:	RAININ HPXL Delivery System Waters 710B WISP autosampler
Data System:	Nelson 2600 (1 volt)
Column:	Zorbax ODS (4.6 mm ID x 25 cm)
Mobile Phase:	Acetonitrile/0.1M Ammonium Acetate Buffer
Gradient:	25:75 ACN/0.1 m ammonium acetate buffer, pH 6.2, hold 2 minutes, then to 60:40 by 19.5 minutes.
Detector:	RAININ Dynamax Dual-Wavelength, Ultraviolet at 254 nm
Flow Rate:	2 mL/min
Injector Volume:	50 μL
Retention Time:	2,4-TDI, 10.2 min.; 2,6-TDI 8.5 min.

Instrument Calibration

Calibration standards were prepared at seven levels as described in Section 4.2.1. Each calibration standard was injected in duplicate. Linear regression analysis of peak area response versus concentrations of TDI was used to prepare a calibration curve. Linearity of the calibration curve was confirmed by visual inspection and verified by a correlation coefficient of 0.9995. After an initial calibration curve was obtained, the calibration check standard described in Section 4.2.1 was analyzed. This standard was injected after every 3 samples, and was used for daily calibration. This check standard consistently agreed to within 10% of the true value.

All samples were analyzed in triplicate on the HPLC. An acetonitrile blank was analyzed once per day to ensure that the system was not contaminated. A check standard was analyzed prior to sample analysis, after every 3 samples, and at the end of the sample analysis each day.

4.3 Qualitative Identification

Analytes were identified by retention time. The retention time for 2,4-TDI was 10.2 min and 8.5 min for 2,6-TDI. Figures 4-1 and 4-2 show chromatograms from the analysis of first impinger contents from QUAD run number 4 for the unspiked and spiked trains respectively. As seen in the chromatograms, the TDI peaks are well separated from the peak for unreacted 1-2 PP. The peak at 17.5 min. was not identified.

4.4 Calculations

4.4.1 Calculation of the Amount of Isocyanate Collected

A least squares linear regression analysis of the calibration data was used to calculate a correlation coefficient, slope, and intercept. Concentration was used as the independent or X-variable and response was used as the dependent or Y-variable.

Unspiked Train
Quad Run Number 4

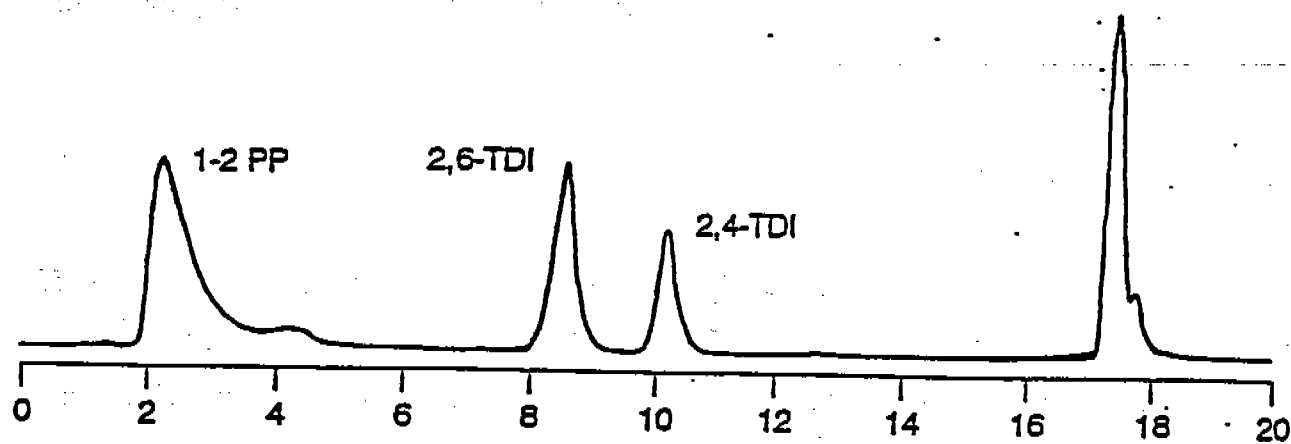


Figure 4-1. Chromatogram of Unspiked Train
K-76

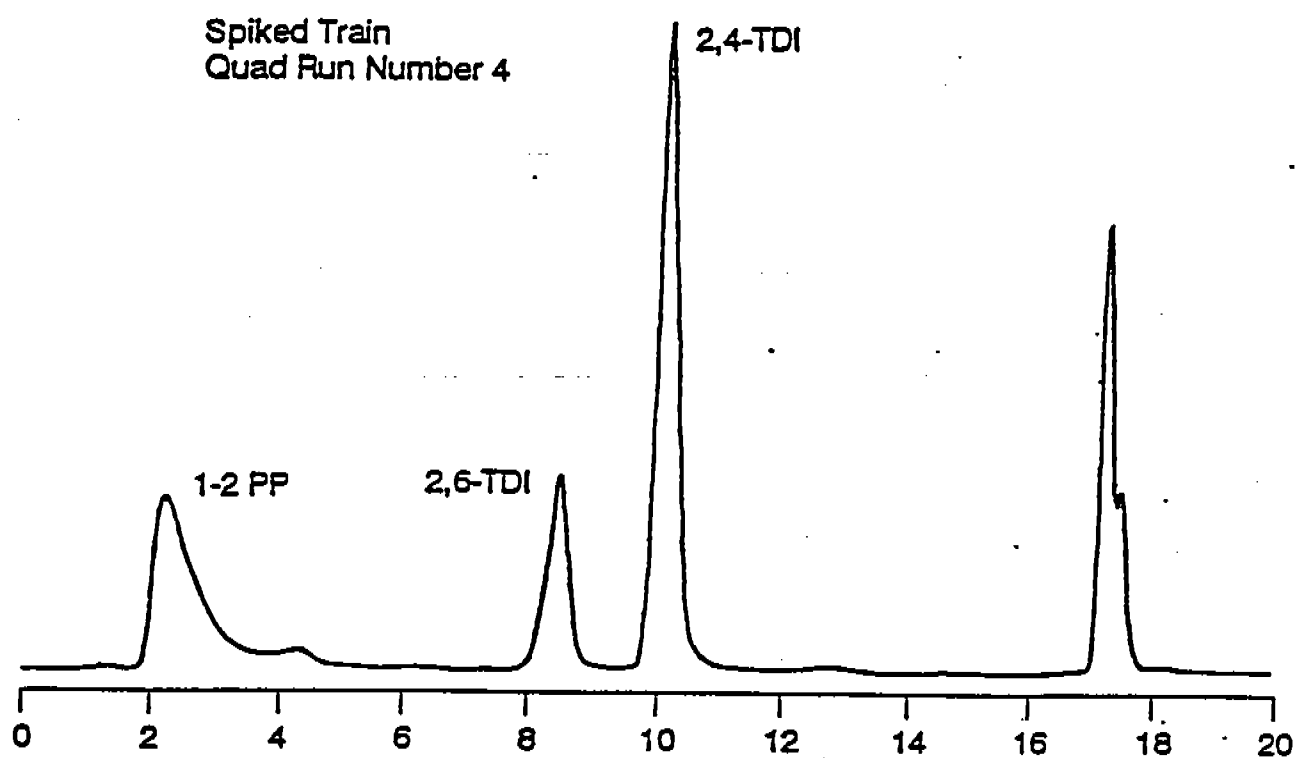


Figure 4-2. Chromatogram of Spiked Train
K-77

The concentration of isocyanate (as the derivative) in the concentrated samples was then calculated as follows:

$$\text{Concentration} = \frac{(\text{Sample Response} - \text{Intercept})}{\text{Slope}} \quad 4-1$$

The total amount (μg) collected in a sample was then calculated by multiplying the concentration ($\mu\text{g/mL}$) times the final volume (10 mL) of ACN used to redissolve the concentrated sample.

$$\text{Amount TDI derivative} = \text{Concentration } (\mu\text{g/mL}) \times \text{Final Volume (10 mL)} \quad 4-2$$

The equivalent amount of TDI required to generate this much derivative was calculated by multiplying the ratio of the molecular weights of TDI (174) and the TDI derivative (501) times the amount of TDI derivative (determined by using equation 4-2).

The total amount of 2,4-TDI (underivatized) collected in the unspiked and spiked trains is given in Table 4-1 and Table 4-2 respectively.

4.4.2 Normalization of the Amount of Isocyanate Collected

In order to simplify the comparison of the analytical results of the four trains in each QUAD run for subsequent calculations of bias and precision, the test plan called for the collected of 30 ft^3 of sample in each train. Due to operational variabilities inherent to each train, accurate but slightly differing sample volumes resulted as shown in Table 3-3. Therefore, it was necessary to normalize the data presented in Tables 4-1 and 4-2 to a common sample volume. The sample volume to which all data were normalized was selected to be 35.31 ft^3 which is equivalent to 1m^3 . The following stepwise calculations were used to normalize the data. The data from QUAD run number 1 are used as an example.

SENT BY:

07-21-93, 0-0/NE

RAJLIVE 13.8

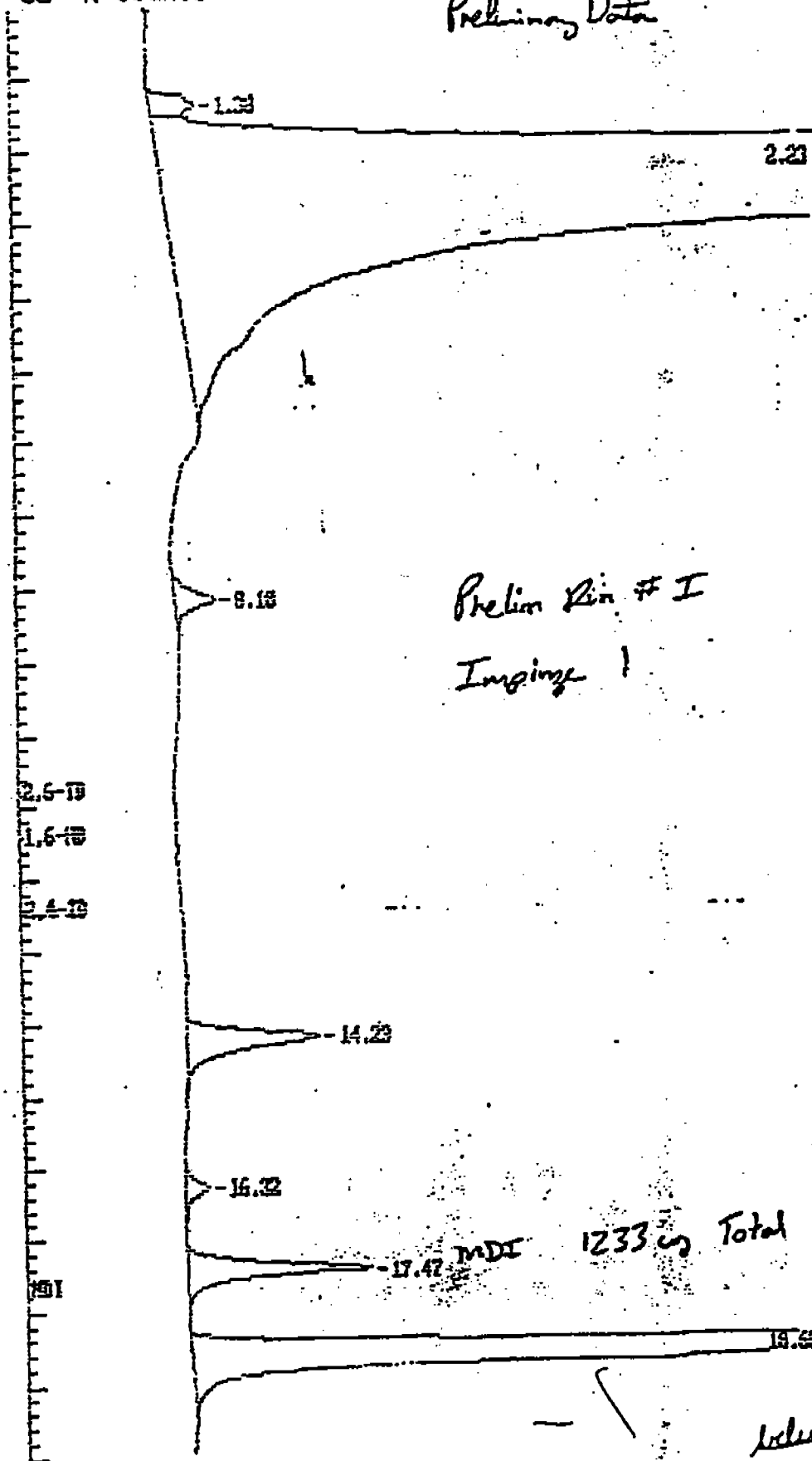
11/07/1993 12:29

Data File = E:\S3253F6.PTS Printed on 09-10-1993 at 12:29:41

Start time: 0.00 min. Stop time: 20.00 min. Offset: 0 cts

Full Range: 50 K-Counts

Preliminary Data



*Radiation
15 checks
10*

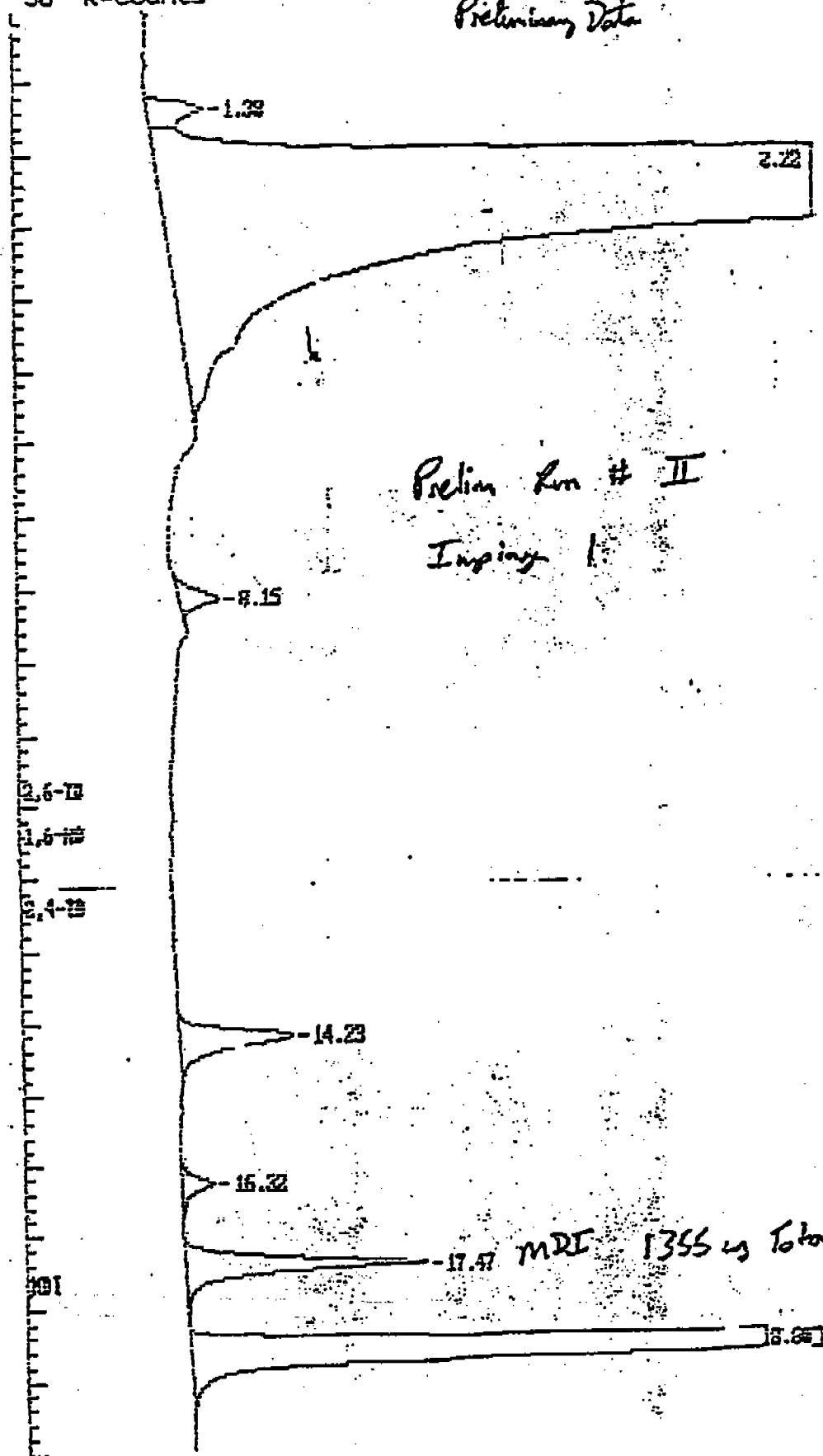
Index in Table

SENT BY:

07-21-93 10:00 AM

Areas, times, and heights stored in: E:\S3253F7.ATB
Data File = E:\S3253F7.PTS Printed on 09-10-1993 at 13:01:05
Start time: 0.00 min. Stop time: 20.00 min. Offset: 0 cts
Full Range: 50 K-Counts

Preliminary Data



SENT BY: 0-21-00 0-0-00 0-0-00
Data File = E:\S3256F7.PTS Printed on 09-13-1993 at 14:43:58
Start time: 0.00 min. Stop time: 20.00 min. Offset: 0 cts
Full Range: 50 K-Counts

Preliminary Data

Toluene Blank

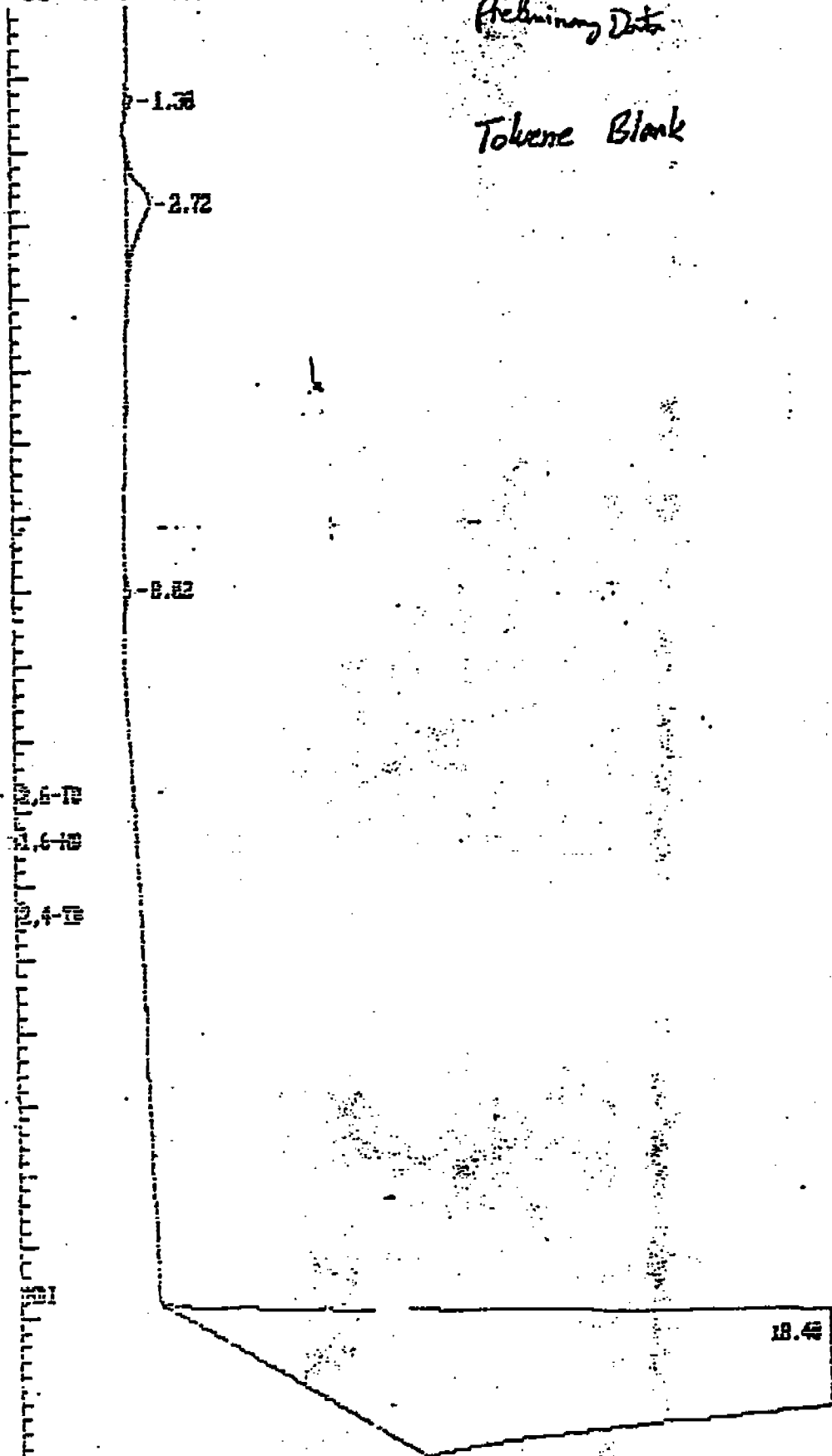


Table 4-1

2,4-TDI Detected in Unspiked Trains, μg

Train ¹	QUAD Run No.											
	1			2			3			4		
	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total
A	--	--	--	5114	61	5175	--	--	--	1832	16	1848
B	--	--	--	5224	40	5264	--	--	--	1864	24	1888
C	4409 ²	18	4427	--	--	--	3281	32	3313	--	--	--
D	4416	85	4501	--	--	--	2928	33	2960	--	--	--

¹The unspiked trains alternated from run to run, C and D then A and B.

²All values are in micrograms of underivatized TDI.

Table 4-1 (Continued)

Train ¹	QUAD Run No.										
	5			6			7			8	
	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total	Imp 1	Total
A	--	--	--	7880	105	7993	--	--	--	3521	3574
B	--	--	--	7488	89	7577	--	--	--	3805	3855
C	4810	17	4827	--	--	--	2160	23	2183	--	--
D	5054	42	5096	--	--	--	2180	36	2216	--	--

¹The unpiked trains alternated from run to run, C and D then A and B.

²All values are in micrograms of underivatized TDI.

Table 4-2

2,4-TDI Detected in Spiked Trains, μg

Train ¹	QUAD Run No.											
	1			2			3			4		
	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total
A	11943 ²	64	12007	--	--	--	11488	36	11524	--	--	--
B	11301	28	11329	--	--	--	12024	38	12062	--	--	--
C	--	--	--	12045	35	12080	--	--	--	9329	58	9387
D	--	--	--	12454	49	12503	--	--	--	9429	26	9455

¹The spiked trains alternated from run to run, A and B then C and D.

²All values are in micrograms of underivatized TDI.

Table 4-2 (Continued)

Train ¹	QUAD Run No.											
	5			6			7			8		
	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total	Imp 1	Imp 2	Total
A	12014	45	12059	--	--	--	10094	46	10140	--	--	--
B	12588	37	12625	--	--	--	9003	40	9043	--	--	--
C	--	--	--	15201	88	15289	--	--	--	10561	45	10606
D	--	--	--	15173	96	15269	--	--	--	10315	44	10359

¹The spiked trains alternated from run to run, A and B then C and D.

²All values are in micrograms of underivatized TDI.

Step 1 Normalize unspiked Trains C and D first impinger amounts (μg) to the sample volume collected (cubic feet) in spiked Train A;

$$\text{Train C} \quad \frac{33.42 \text{ ft}^3}{33.02 \text{ ft}^3} \times 4409 \mu\text{g} = 4462 \mu\text{g} \quad 4-3A$$

$$\text{Train D} \quad \frac{33.42 \text{ ft}^3}{33.04 \text{ ft}^3} \times 4416 \mu\text{g} = 4467 \mu\text{g} \quad 4-3B$$

Step 2 Average the normalized, unspiked train amounts from step 1 above. Assuming the collection efficiency of all trains to be the same, this value would also be the amount of TDI that would be collected by Train A due to sampling the stack gas;

$$\frac{4462 \mu\text{g} + 4467 \mu\text{g}}{2} = 4465 \mu\text{g} \quad 4-4$$

Step 3 Subtract the average value (step 2) from the uncorrected amount (sampled amount plus spike) for spiked Train A, first impinger, to get recovered spike amount;

$$11943 \mu\text{g} - 4465 \mu\text{g} = 7478 \mu\text{g} \quad 4-5$$

Step 4 Normalize the amount collected in spiked Train A, first impinger to 35.31 ft^3 using the sample volume for Train A and the value obtained in step 2;

$$\frac{35.31 \text{ ft}^3}{33.42 \text{ ft}^3} \times 4465 \mu\text{g} = 4718 \mu\text{g} \quad 4-6$$

Step 5 Normalize the amount collected in the second impinger of spiked Train A to 35.31 ft^3 using the sample volume for Train A and the amount determined by HPLC;

$$\frac{35.31 \text{ ft}^3}{33.42 \text{ ft}^3} \times 63.9 \text{ } \mu\text{g} = 67.5 \text{ } \mu\text{g} \quad 4-7$$

Step 6 Sum the values determined from steps 3, 4 and 5 to get the total amount of TDI found in spiked Train A, normalized to 35.31 ft³;

$$7478 \text{ } \mu\text{g} + 4718 \text{ } \mu\text{g} + 67.5 \text{ } \mu\text{g} = 12264 \text{ } \mu\text{g} \quad 4-8$$

Steps 1-6 can be repeated for similar calculations for spiked Train B. The total amount of TDI collected in each of the unspiked trains can be determined by first normalizing the amounts found in the two impingers of each train to 1m³ and then summing the two values. The raw and normalized data for all analysis results are presented in Appendix A. The resulting normalized values are summarized in Tables 4-3 and 4-4.

4.5 Quality Control

Quality control procedures that were implemented for this program include:

- Adhering to applicable sampling and analysis protocols;
- Collecting and analyzing field blanks, trip blanks, reagent blanks, and laboratory blanks;
- Tracking samples from collection to analysis;
- Calibrating all analytical equipment prior to use;
- Maintaining accurate and complete written documentation;
- If any changes were made to the analytical system (i.e., column changed, column maintenance), a calibration check was performed to verify the validity of the calibration curve. If the calibration check did not meet acceptance criteria, the analytical system was recalibrated.

Table 4-3

Normalized Amount of 2,4-TDI Detected in Unspiked Trains, μg

Train ¹	QUAD Run No.							
	1	2	3	4	5	6	7	8
A	--	6287	--	2132	--	8042	--	4086
B	--	6270	--	2139	--	7608	--	4579
C	4735 ²	--	3466	--	4947	--	2557	--
D	4811	--	3166	--	5522	--	2616	--

¹The unspiked trains alternated from run to run, C and D then A and B.

²All values are in micrograms of underivatized TDI, normalized to a sample volume of 35.31 ft³ (1m³).

Table 4-4

Normalized Amount of 2,4-TDI Detected in Spiked Trains, μg

Train ¹	QUAD Run No.							
	1	2	3	4	5	6	7	8
A	12264 ²	--	11625	--	12233	--	10450	--
B	11520	--	12078	--	12717	--	9290	--
C	--	13258	--	9694	--	15471	--	11197
D	--	13733	--	9805	--	15610	--	10947

¹The spiked trains alternated from run to run, A and B then C and D.

²All values are in micrograms of underivatized TDI, normalized to a sample volume of 35.31 ft³ (1m³).

- Analysis of field spiked QC samples; and
- Analysis of check standards every 3 samples.

This section presents the results of the eight sampling runs relative to the criteria for method precision and bias. Fractional results are also presented to show the amount of isocyanate breakthrough occurring in the impinger train. All sample fractions were prepared and analyzed for toluene diisocyanate at Radian's Research Triangle Park laboratory.

5.1

Bias and Precision

Table 5-1 is a summary table which presents the results of the statistical evaluation of the test data following the EPA Method 301 criteria showing the method precision and bias for 2-4 TDI. Method 301 requires valid data from a minimum of six QUAD runs. Table 5-1 presents data from all eight runs. Precision is shown as the percent relative standard deviation of the measured amounts of TDI in the samples. Results for precision of both the spiked and unspiked samples were less than 5 percent RSD, which is well within the limits of acceptable precision (upper limit of 50%) given in EPA Method 301.

Using the data from all eight QUAD runs, method bias was measured at -395 micrograms. This value was determined to be statistically significant at the 95% confidence level, using the t statistic calculated for the analytical data. A correction factor of 1.053 was calculated for use with the method to compensate for the bias should the method be used to measure TDI emissions from similar sources.

Using the data from only seven QUAD runs (eliminating run 8 because this run had the lowest average % recovery and the final leak check for one of the trains was questionable), the method bias was -295 micrograms. This bias was not statistically significant and therefore no correction factor was calculated. In either case, the criteria for an acceptable method were met (i.e., a correction factor between 0.7 and 1.3).

Table 5-1

Summary of Method 301 Statistical Calculations

Parameter	Spiked Trains		Unspiked Trains	
	7 Runs	8 Runs	7 Runs	8 Runs
Spiked Amount ¹	7828	7828	--	--
RSD, %	3.6	3.4	4.7	5.2
Average Bias ¹	-295	-395	--	--
Bias Significant?	No	Yes	--	--
Correction Factor	1.0	1.053	--	--

¹Values are presented as μg of underivatized TDI

5.2 Breakthrough and Recovery

This section presents details of the breakthrough and recovery results for the field samples, as well as recovery information for the spiked compound (2,4-TDI).

5.2.1 Breakthrough

Tables 4-1 and 4-2 provide a summary of the combined total mass of 2,4-TDI collected in the probe/first impinger and second/third impinger samples for the unspiked and spiked trains, respectively. These totals are used as a basis for calculating breakthrough of the TDI from the first impinger to the second impinger. The mass of compound found in the probe/first impinger fraction and in the second impinger fraction were each divided by the total mass of TDI for that train and then multiplied by 100 to yield the percent of the total TDI found in the separate train sections. The results are presented in Table 5-2 and 5-3 for the spiked and unspiked trains respectively.

The average breakthrough for the spiked trains was 1.5% and for the unspiked trains 1.1%. More than 98% of the TDI was collected in the first impinger under the sampling conditions used in this study.

The amount of the toluene contained in the first impingers of each of the trains was reduced by approximately 25% (by weight) during the sampling run due to evaporation. The second impingers showed, on the average, a net gain of approximately 5%. The remainder was collected in the silica gel and the charcoal, both of which showed net weight gains. The total weight gained in the train components following the first impinger more than compensate for losses from the first impinger, probably due to the collection of a small amount of moisture. The loss of toluene from the first impinger was minimized by keeping the impingers in an ice bath and placing a water cooled condenser between the outlet of the first impinger and the inlet of the second impinger.

Table 5-2

Distribution of 2,4-TDI Within the Spiked Trains

Train ¹	Impinger No.	QUAD Run No.							
		1	2	3	4	5	6	7	8
A	1	98.5 ²	--	99.0	--	99.0	--	98.0	--
	2	1.5	--	1.0	--	1.0	--	2.0	--
B	1	99.2	--	99.1	--	99.2	--	97.0	--
	2	0.8	--	0.9	--	0.8	--	3.0	--
C	1	--	99.2	--	96.4	--	98.8	--	98.4
	2	--	0.8	--	3.6	--	1.2	--	1.6
D	1	--	99.0	--	98.5	--	98.7	--	98.4
	2	--	1.0	--	1.5	--	1.3	--	1.6
Average/ % RSD	1	98.5/0.81							
	2	1.5/54.4							

¹Spiked Trains alternate from run to run, A and B, then C and D.

²Values are a percentage of the total amount of 2,4 TDI determined to be in each train.

Table 5-3
Distribution of 2,4-TDI Within the Unspiked Trains

Train ¹	Impinger No.	QUAD Run No.							
		1	2	3	4	5	6	7	8
A	1	--	98.8	--	99.1	--	98.7	--	98.5
	2	--	1.2	--	0.9	--	1.3	--	1.5
B	1	--	99.2	--	98.8	--	98.8	--	98.7
	2	--	0.8	--	1.2	--	1.2	--	1.3
C	1	99.6 ²	--	99.0	--	99.6	--	99.0	--
	2	0.4	--	1.0	--	0.4	--	1.0	--
D	1	99.1	--	98.9	--	99.2	--	98.4	--
	2	1.9	--	1.1	--	0.8	--	1.6	--
Average/ % RSD	1	98.9/0.41							
	2	1.1/37.1							

¹Unspiked Trains alternate from run to run, C and D, then A and B.

²Values are a percentage of the total amount of 2,4-TDI determined to be in each train.

One of the objectives of this test program was to obtain bias and precision data to validate the proposed test method for isocyanates. Samples from two of the four trains of each quad assembly were spiked with TDI before each sampling run. The estimation of method bias is based on the percentage of the TDI spikes recovered. Analytical results used for this calculation are the averages of the triplicate analysis results for each spiked sample. A summary of the spiked TDI recovery percentages is presented in Table 5-4.

The percent recovery was calculated for each spiked train for each run following the calculation procedures outlined in steps 1-3 of Section 5.0. The value obtained at step 3, the amount of spike recovered, is divided by the actual amount of TDI spiked, 7827 μg , multiplied by 100. An average recovery was determined by averaging the 16 individual run recoveries.

The recovery for TDI ranged between 83 and 112 percent and averaged 95 percent with a %RSD of 8.2.

5.3

Quality Assurance/Quality Control

As a part of the testing for Work Assignment No. 55, Radian designed and implemented a quality assurance/quality control (QA/QC) effort tailored to meet the specific needs of this project. The testing was conducted in accordance with QA/QC procedures described in the Quality Assurance Project Plan (QAPP). The results of the QA/QC effort demonstrate that the data are reliable and meet project objectives for completeness and representativeness. The data met the QA objectives for precision and accuracy and there are no data quality issues that effect conclusions regarding the objectives of this project.

Table 5-4

Percent Recovery of the Spiked 2,4-TDI

Train ¹	QUAD Run No.							
	1	2	3	4	5	6	7	8
A	96 ²	--	106	--	89	--	100	--
B	86	--	112	--	96	--	86	--
C	--	89	--	97	--	98	--	88
D	--	95	--	98	--	99	--	83
Average	95							
% RSD	8.2							

¹Spiked Trains alternated from run to run, A and B, then C and D.

²Values are a percentage based upon a spiked amount of 7827.8 µg as 2,4-TDI.

The primary objectives of the QA/QC effort were to control, assess, and document data quality. In order to accomplish these objectives, the QA/QC approach consisted of the following key elements:

- Definition of data quality objectives that reflect the overall technical objectives of the project;
- Design of a sampling, analytical, QA/QC, and data analysis system to meet these objectives; and
- Initiation of corrective action when measurement system performance did not meet the specifications.

These elements include the use of selected standard sampling and analytical procedures as components of the overall approach in addition to, specified calibration requirements, QC checks, data reduction and validation procedures, and sample tracking.

A summary of analysis results for QA/QC samples, which includes measures of precision and accuracy and limitations in the use of these data is presented in this section.

5.3.1 Overview of Data Quality

The QAPjP established specific QA objectives for precision (15% RSD), accuracy ($\pm 30\%$), and completeness (100%) for the determination of TDI emissions. The statistical results presented in Table 5-1 and the % recovery values given in Table 5-4 show that the objectives were met. The data quality acceptance criteria and the experimental results are summarized in Table 5-5. Results for spike/spike duplicates and triplicate analyses were compared with the criteria. In all cases the criteria were met. Other data quality indicators for each type of analysis are also presented throughout the remainder of Section 5.3.

There are no cases where data quality issues impair the study's conclusions with respect to the validity of the sampling and analytical test method procedures. With

Table 5-5

Data Quality Acceptance Criteria and Results

Parameter	Criteria	Results
TDI Spike Recovery	70 - 130%	83 - 112%
TDI Analysis Results QUAD Train, % RSD	15%	5%
Individual DGM Correction Factor Agreement	$\pm 2\%$ of Avg	$< 2\%$
Analytical Balance	≤ 0.1 g of Class S Weights	< 0.1 g
HPLC Linearity Correlation Coeff.	> 0.995	0.9995
HPLC Retention Time Variation	$\pm 15\%$	$\pm 10\%$
HPLC Calibration Check	$\pm 10\%$ of Curve	$\pm 9\%$
HPLC System Blank	$< 0.1\%$ Analyte level	$< 0.1\%$
HPLC Replicate Analyses	$\pm 10\%$ of 1st injection	$\pm 2\%$
HPLC Method Spikes	$\pm 20\%$ of theoretical	$\pm 5\%$

exception of a limited number of samples, the quality of measurement data generated for the test parameters fully meets the data quality objectives outlined in the QAPjP.

5.3.2 Sampling Quality Control

Quality control activities associated with the field sampling are described in the QAPjP. These activities include adherence to accepted reference method protocols, use of standardized data recording sheets, equipment calibration, and collection of field blanks.

Stack sampling QC data, including sampling rates, sample volume collected, maximum recorded leak rate, and maximum allowable leak rate, are summarized in Table 5-6 for each run. All of the data quality indicators are within acceptable limits, with the exception of a slightly high leak rate value for Train C Run 8. However, this train was leak checked at a vacuum of 7 inches of mercury which was almost twice that achieved during sampling and the leak would therefore have very little, if any, effect on the data. The leak rate criterion is $<4\%$ of the average sampling rate or 0.02 dscf, whichever is less.

5.3.3 Sample Storage and Holding Time

Sample hold times specified in the QAPP were met for all samples. All samples were prepared within 30 days of collection and analyzed within 30 days of preparation.

5.3.4 Analytical Quality Control

Results for method spikes, field spikes, field blanks, reagent blanks and method blanks are summarized in Table 5-7. These samples served the dual purpose of controlling and assessing measurement data quality, and providing the basis for precision and accuracy estimates. The QC acceptance criteria for each of these types of samples

Table 5-6
Sampling Train Leak Summary

Rm Number	Std. Metered Volume (dscf)	Average Sampling Rate (dscfm)	Maximum Leak Check (dscf @ in Hg)	4% Sample Rate (dscfm)	Acceptable^a Leak Rate?
1A	33.42	0.743	0.010 @ 10	0.030	Yes
1B	33.89	0.753	0.010 @ 15	0.030	Yes
1C	33.02	0.734	0.010 @ 8	0.029	Yes
1D	33.04	0.734	0.020 @ 10	0.029	Yes
2A	29.07	0.727	0.016 @ 8	0.029	Yes
2B	29.65	0.741	0.009 @ 8	0.030	Yes
2C	28.67	0.717	0.010 @ 7	0.029	Yes
2D	28.40	0.710	0.010 @ 8	0.028	Yes
3A	34.24	0.571	0.012 @ 10	0.023	Yes
3B	35.15	0.586	0.010 @ 8	0.023	Yes
3C	33.75	0.563	0.009 @ 8	0.023	Yes
3D	33.01	0.550	0.020 @ 5	0.022	Yes
4A	30.60	0.765	0.012 @ 8	0.031	Yes
4B	31.17	0.779	0.012 @ 7	0.031	Yes
4C	30.35	0.759	0.008 @ 7	0.030	Yes
4D	29.54	0.739	0.015 @ 10	0.030	Yes
5A	34.14	0.569	0.014 @ 10	0.023	Yes
5B	34.70	0.578	0.012 @ 8	0.023	Yes
5C	34.46	0.574	0.012 @ 8	0.023	Yes
5D	32.59	0.543	0.016 @ 7	0.022	Yes
6A	35.10	0.780	0.007 @ 7	0.031	Yes
6B	35.17	0.782	0.010 @ 8	0.031	Yes
6C	34.49	0.766	0.008 @ 7	0.031	Yes
6D	33.78	0.751	0.008 @ 10	0.030	Yes
7A	31.11	0.778	0.015 @ 9	0.031	Yes
7B	31.94	0.799	0.011 @ 8	0.032	Yes
7C	30.14	0.754	0.009 @ 7	0.030	Yes
7D	29.91	0.748	0.014 @ 10	0.030	Yes
8A	30.89	0.772	0.009 @ 10	0.031	Yes
8B	29.73	0.743	0.011 @ 8	0.030	Yes
8C	30.49	0.762	0.021 @ 7	0.030	No
8D	31.95	0.799	0.018 @ 8	0.032	Yes

^aThe maximum acceptable leak rate is the lesser of 0.020 dscfm or 4% of the average sampling rate.

Table 5-7

Summary of Analytical Quality Control Results

Sample ID	Total Detected μg	Theoretical μg	Percent Error %
Field Blank A	2.5	NA ⁴	NA
Field Blank B	8.3	NA	NA
Field Blank C	6.4	NA	NA
Field Spike 1	7570	7828	96.7
Field Spike 2	7686	7828	98.2
Method Spike 1	8120	7828	104
Method Spike 2	7838	7828	100
Method Spike 3	7890	7828	101
Method Spike 4	7945	7828	101
Toluene Reagent Blank ¹	0.5	NA	NA
ACN Reagent Blank ²	0.4	NA	NA
Method Blank ³	10.2	NA	NA

¹Average of four, ranging from 0.1 to 1.2 μg

²Average of four, ranging from 0.1 to 0.8 μg

³Average of three, ranging from 0.3 to 20.7 μg

⁴NA, Not Applicable

were met as shown in Table 5-5. Field blanks were collected by assembling a sampling train as if to collect a sample, transporting to the sampling location, leak checking and returning the train to the onsite laboratory for recovery. Field spikes and method spikes were prepared by spiking approximately 300 mL of the toluene 1,2-PP solution with 15 mL of the field spiking solution. Method and reagent blanks were prepared by evaporating approximately 300 mL of solvent to dryness and dissolving any residue with 10 mL of ACN. All spikes and blanks met the data acceptance criteria listed in Table 5-5.

No blank contamination problems were identified during the analysis of field and laboratory blanks and no blank corrections were performed for the reported data. All blank analysis data are presented along with other QC and field sample results in Appendix A.

APPENDIX A

Analytical Data for Samples, Blanks, Spikes and Quality Control Samples

Sample Name	AREA	AMOUNT ng/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample ug	Avg Amt Sample ug	Volume Sampled Cu Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ISO-SCF-32293-4	1263013	5.90	5.40641	9%	2000	11931.6	11942.9	33.42	1.05669	12196.0	12263.5	7827.81	95.69%	I-A-1
ISO-SCF-32293-4	1253783	5.86	5.40641	8%	2000	11930.1								
ISO-SCF-32293-4	1249199	5.84	5.40641	8%	2000	11966.8								
ARL-1	1277072	5.97			100	64.1	63.9	33.42	1.05669	67.5				I-A-2
ARL-1	1276918	5.97			100	64.4								
ARL-1	1280852	5.98			100	63.1								
ARL-2	135291	0.64			2000	11178.7	11300.8	33.89	1.04204	11491.1	11520.1	7827.81	86.19%	I-B-1
ARL-2	135913	0.63			2000	11348.3								
ARL-2	131152	0.63			2000	11375.3								
ARL-3	1196354	5.59			100	28.6	27.8	33.89	1.04204	29.0				I-B-2
ARL-3	1214512	5.67			100	27.7								
ARL-3	1217429	5.69			100	27.2								
ARL-4	59159	0.29			2000	4418.4	4409.3	33.02	1.06949	4715.7	4735.0			I-C-1
ARL-4	57134	0.28			2000	4411.3								
ARL-4	56201	0.27			2000	4398.2								
ISO-SCF-32293-4	1255771	5.87	5.40641	9%	100	17.8	18.1	33.02	1.06949	19.3				I-C-2
ISO-SCF-32293-4	1231918	5.85	5.40641	8%	100	18.3								
ISO-SCF-32293-4	1242330	5.80	5.40641	7%	100	18.2								
ARL-5	471546	2.21			2000	4199.5	4416.1	33.04	1.06885	4720.1	4811.1			I-D-1
ARL-5	470785	2.21			2000	4124.4								
ARL-5	469380	2.20			2000	4524.4								
ARL-6	35898	0.18			100	85.0	85.1	33.04	1.06885	90.9				I-D-2
ARL-6	37029	0.18			100	84.8								
ARL-6	36906	0.18			100	85.4								
ARL-7	469526	2.20			2000									
ARL-7	461467	2.16			2000									
ARL-7	482909	2.26			2000									
ARL-8	180141	0.85			100									
ARL-8	179633	0.85			100									
ARL-8	181047	0.85			100									
ISO-SCF-32293-4	1238919	5.79	5.40641	7%										
ISO-SCF-32293-4	1245019	5.82	5.40641	8%										
ISO-SCF-32293-4	1235673	5.77	5.40641	7%										

Sample Name	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample ug	Avg Amt Sample ug	Volume Sampled Cn Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-9	544346	2.55			2000	5097.4	5114.2	29.07	1.21481	6212.9	6287.4			2-A-1
ARL-9	548157	2.57			2000	5132.9								
ARL-9	545954	2.56			2000	5112.4								
ARL-10	130306	0.62			100	61.8	61.4	29.07	1.21481	74.6				2-A-2
ARL-10	130940	0.62			100	62.1								
ARL-10	127140	0.60			100	60.3								
ARL-11	567669	2.66			2000	5114.9	5224.4	29.65	1.19105	6222.5	6269.9			2-B-1
ARL-11	563460	2.64			2000	5275.7								
ARL-11	542754	2.54			2000	5082.6								
ARL-12	83414	0.40			100	39.9	39.8	29.65	1.19105	47.4				2-B-2
ARL-12	83620	0.40			100	40.0								
ARL-12	82237	0.39			100	39.4								
ISO-SCF-32293-4	1220899	5.70	5.40641	6%	1	5.7								
ISO-SCF-32293-4	1232005	5.76	5.40641	6%	1	5.8								
ISO-SCF-32293-4	1230936	5.73	5.40641	6%	1	5.8								
ARL-13	1287864	6.02			2000	12032.2	12045.3	28.67	1.23176	13215.1	13258.2	7827.81	89.16%	2-C-1
ARL-13	1288870	6.02			2000	12041.6								
ARL-13	1291041	6.03			2000	12061.9								
ARL-14	71522	0.34			100	34.4	35.0	28.67	1.23176	43.1				2-C-2
ARL-14	73423	0.35			100	35.3								
ARL-14	73513	0.35			100	35.3								
ARL-15	1335291	6.24			2000	12474.6	12454.1	28.40	1.24347	13671.5	13732.6	7827.81	95.22%	2-D-1
ARL-15	1334709	6.23			2000	12469.2								
ARL-15	1329284	6.21			2000	12418.6								
ARL-16	103190	0.49			100	49.1	49.1	28.40	1.24347	61.1				2-D-2
ARL-16	103848	0.49			100	49.4								
ARL-16	102349	0.49			100	48.7								
ISO-SCF-32293-4	1246426	5.82	5.40641	8%	1	5.8								
ISO-SCF-32293-4	1237852	5.78	5.40641	7%	1	5.8								
ISO-SCF-32293-4	1239959	5.79	5.40641	7%	1	5.8								

Sample Name	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample ug	Avg Amt Sample ug	Volume Sampled Cu Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-17	1229990	5.75			2000	11492.4	11487.9	34.24	1.03139	11587.8	11624.8	7827.81	106.14%	3-A-1
ARL-17	1214060	5.67			2000	11343.9								
ARL-17	1244450	5.81			2000	11627.3								
ARL-18	75825	0.36			100	36.4	35.9	34.24	1.03139	37.0				3-A-2
ARL-18	74917	0.36			100	36.0								
ARL-18	73672	0.35			100	35.4								
ARL-19	1282836	5.99			2000	11985.3	12024.4	35.15	1.00468	12039.7	12077.7	7827.81	111.93%	3-B-1
ARL-19	1289518	6.02			2000	12017.7								
ARL-19	1288725	6.02			2000	12010.3								
ARL-20	79007	0.38			100	37.9	37.8	35.15	1.00468	38.0				3-B-2
ARL-20	78713	0.38			100	37.7								
ARL-20	79021	0.38			100	37.9								
ISO-SCF-32293-4	1263449	5.90	5.40641	9%	1	5.9								
ISO-SCF-32293-4	1253499	5.86	5.40641	8%	1	5.9								
ISO-SCF-32293-4	1260480	5.89	5.40641	9%	1	5.9								
ARL-21	351376	1.65			2000	3297.6	3281.0	33.75	1.04636	3433.1	3466.4			3-C-1
ARL-21	343323	1.61			2000	3222.4								
ARL-21	354099	1.66			2000	3123.0								
ARL-22	65492	0.32			100	31.6	31.8	33.75	1.04636	33.3				3-C-2
ARL-22	66002	0.32			100	31.8								
ARL-22	66603	0.32			100	32.1								
ARL-23	319713	1.50			2000	3002.2	2927.6	33.01	1.06982	3132.0	3165.7			3-D-1
ARL-23	310818	1.46			2000	2919.3								
ARL-23	304609	1.43			2000	2861.4								
ARL-24	65115	0.31			100	31.4	31.5	33.01	1.06982	33.7				3-D-2
ARL-24	66054	0.32			100	31.8								
ARL-24	64767	0.31			100	31.2								
ISO-SCF-32293-4	1223529	5.72	5.40641	6%	1	5.7								
ISO-SCF-32293-4	1220297	5.70	5.40641	5%	1	5.7								
ISO-SCF-32293-4	1183133	5.70	5.40641	5%										

Sample Name	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample ug	Avg Amt Sample ug	Volume Sampled Cu Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-25	198810	0.94			2000	1874.6	1831.7	30.60	1.15407	2113.9	2132.1			4-A-1
ARL-25	195931	0.92			2000	1847.7								
ARL-25	187888	0.89			2000	1772.7								
ARL-26	33336	0.17			100	16.6	15.8	30.60	1.15407	18.3				4-A-2
ARL-26	32875	0.16			100	16.3								
ARL-26	29079	0.15			100	14.6								
ARL-27	200805	0.95			2000	1893.2	1864.2	31.17	1.13297	2112.1	2138.7			4-B-1
ARL-27	200538	0.95			2000	1890.7								
ARL-27	191767	0.90			2000	1808.9								
ARL-28	48281	0.24			100	23.5	23.5	31.17	1.13297	26.6				4-B-2
ARL-28	49506	0.24			100	24.1								
ARL-28	46705	0.23			100	22.8								
ISO-SCF-32293-4	1202635	5.62	5.40641	4%	1	5.6								
ISO-SCF-32293-4	1219147	5.70	5.40641	5%	1	5.7								
ARL-29	1001159	4.68			2000	9358.1	9329.4	30.35	1.16358	9626.4	9693.9	7827.81	96.56%	4-C-1
ARL-29	987039	4.61			2000	9226.4								
ARL-29	1006035	4.70			2000	9403.6								
ARL-30	124507	0.59			100	59.1	58.0	30.35	1.16358	67.5				4-C-2
ARL-30	122754	0.58			100	58.3								
ARL-30	119182	0.57			100	56.6								
ARL-31	1004933	4.70			2000	9393.3	9428.7	29.54	1.19549	9774.2	9804.7	7827.81	97.97%	4-D-1
ARL-31	1018359	4.76			2000	9518.5								
ARL-31	1002870	4.69			2000	9374.1								
ARL-32	53598	0.26			100	26.0	25.5	29.54	1.19549	30.5				4-D-2
ARL-32	53113	0.26			100	25.8								
ARL-32	50832	0.25			100	24.7								
ISO-SCF-32293-4	1200453	5.61	5.40641	4%	1	5.6								
ISO-SCF-32293-4	1204115	5.63	5.40641	4%	1	5.6								
ISO-SCF-32293-4	1109454	5.56	5.40641	3%	1	5.6								

Sample Name	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample ug	Avg Amt Sample ug	Volume Sampled Cu Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-33	1309769	6.12			2000	12236.5	12014.2	34.14	1.03441	12187.3	12233.3	7827.81	89.41%	5-A-1
ARL-33	1323802	6.18			2000	12367.4								
ARL-33	1224229	5.72			2000	11438.7								
ARL-34	101486	0.49			100	49.3	44.5	34.14	1.03441	46.1				5-B-1
ARL-34	103836	0.49			100	49.4								
ARL-34	72585	0.35			100	34.9								
ARL-35	1369996	6.40			2000	12798.3	12588.1	34.70	1.01771	12678.6	12716.7	7827.81	95.59%	5-B-1
ARL-35	1382908	6.46			2000	12918.7								
ARL-35	1289467	6.02			2000	12047.2								
ARL-36	81360	0.40			100	40.4	37.4	34.70	1.01771	38.0				5-B-2
ARL-36	85164	0.41			100	40.7								
ARL-36	84462	0.31			100	31.1								
ISO-SCF-32293-4	1198549	5.60	5.40641	4%	1	5.6								
ISO-SCF-32293-4	1178529	5.51	5.40641	2%	1	5.5								
ARL-37	511915	2.40			2000	4794.9	4809.8	34.46	1.02480	4929.1	4946.9			5-C-1
ARL-37	520667	2.44			2000	4876.5								
ARL-37	507945	2.38			2000	4757.9								
ARL-38	36452	0.18			100	18.0	17.4	34.46	1.02480	17.8				5-C-2
ARL-38	36462	0.18			100	18.0								
ARL-38	32321	0.16			100	16.1								
ARL-39	532851	2.50			2000	4990.2	5054.0	32.59	1.08360	5476.5	5521.9			5-D-1
ARL-39	544154	2.55			2000	5095.6								
ARL-39	542068	2.54			2000	5076.1								
ARL-40	90692	0.43			100	43.3	41.9	32.59	1.08360	45.4				5-D-2
ARL-40	82975	0.40			100	39.7								
ARL-40	89246	0.43			100	42.6								
ISO-SCF-32293-4	1187611	5.55	5.40641	3%	1	5.5								
ISO-SCF-32293-4	1199464	5.60	5.40641	4%	1	5.6								
ISO-SCF-32293-4	1183133	5.53	5.40641	2%	1	5.5								

Sample Name	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample ug	Avg Amt Sample ug	Volume Sampled Cu Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-41	861252	4.03			2000	8053.2	7887.9	35.10	1.00612	7936.1	8041.6			6-A-1
ARL-41	860232	4.02			2000	8043.7								
ARL-41	809094	3.78			2000	7566.7								
ARL-42	227095	1.07			100	106.9	104.8	35.10	1.00612	105.4				6-A-2
ARL-42	228142	1.07			100	107.4								
ARL-42	212430	1.00			100	100.1								
ARL-43	815730	3.81			2000	7628.6	7488.0	35.17	1.00411	7518.8	7607.6			6-B-1
ARL-43	825689	3.86			2000	7721.5								
ARL-43	760533	3.56			2000	7113.8								
ARL-44	193894	0.91			100	91.4	88.5	35.17	1.00411	88.8				6-B-2
ARL-44	197908	0.93			100	93.3								
ARL-44	170746	0.81			100	80.6								
ISO-SCF-32293-4	1189088	5.56	5.40641	3%	1	5.6								
ISO-SCF-32293-4	1190921	5.56	5.40641	3%	1	5.6								
ARL-45	1656820	7.74			2000	15473.5	15201.1	34.49	1.02391	15381.5	15471.2	7827.81	97.69%	6-C-1
ARL-45	1652121	7.71			2000	15429.7								
ARL-45	1573083	7.35			2000	14700.0								
ARL-46	187832	0.89			100	88.6	87.6	34.49	1.02391	89.7				6-C-2
ARL-46	195647	0.92			100	92.3								
ARL-46	173379	0.82			100	81.9								
ARL-47	1649873	7.70			2000	15408.7	15173.2	33.78	1.01543	15509.0	15609.8	7827.81	99.46%	6-D-1
ARL-47	1634325	7.63			2000	15263.7								
ARL-47	1589678	7.42			2000	14847.3								
ARL-48	220417	1.04			100	103.8	96.3	33.78	1.01543	100.7				6-D-2
ARL-48	206802	0.97			100	97.5								
ARL-48	186023	0.88			100	87.8								
ISO-SCF-32293-4	1205054	5.63	5.40641	4%	1	5.6								
ISO-SCF-32293-4	1195876	5.59	5.40641	3%	1	5.6								
ISO-SCF-32293-4	1183664	5.53	5.40641	2%	1	5.5								

Sample Name	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample ug	Avg Amt Sample ug	Volume Sampled Cu Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-49	1081312	5.05			2000	10105.7	10094.4	31.11	1.13515	10398.3	10450.0	7827.81	100.45%	7-A-1
ARL-49	1074952	5.02			2000	10046.4								
ARL-49	1084020	5.07			2000	10131.0								
ARL-50	98427	0.47			100	46.9	45.6	31.11	1.13515	51.8				7-A-2
ARL-50	96270	0.46			100	45.9								
ARL-50	92145	0.44			100	44.0								
ARL-51	963252	4.50			2000	9004.6	9002.6	31.91	1.10566	9246.5	9290.2	7827.81	85.63%	7-B-1
ARL-51	970463	4.54			2000	9071.8								
ARL-51	955412	4.47			2000	8931.4								
ARL-52	83965	0.40			100	40.2	39.5	31.91	1.10566	43.6				7-B-2
ARL-52	83998	0.40			100	40.2								
ARL-52	79455	0.18			100	38.1								
ISO-SCF-32293-4	1194001	5.58	5.40641	3%	1	5.6								
ISO-SCF-32293-4	1201282	5.61	5.40641	4%	1	5.6								
ARL-53	230346	1.08			2000	2168.7	2159.8	30.14	1.17169	2530.6	2557.9			7-C-1
ARL-53	232911	1.10			2000	2192.6								
ARL-53	224911	1.06			2000	2118.0								
ARL-54	49290	0.24			100	24.0	23.3	30.14	1.17169	27.3				7-C-2
ARL-54	49749	0.24			100	24.2								
ARL-54	44499	0.22			100	21.8								
ARL-55	217247	1.12			2000	2233.1	2180.2	29.91	1.18070	2574.2	2616.4			7-D-1
ARL-55	228829	1.08			2000	2154.5								
ARL-55	228660	1.08			2000	2153.0								
ARL-56	75486	0.36			100	36.2	35.8	29.91	1.18070	42.3				7-D-2
ARL-56	75034	0.36			100	36.0								
ARL-56	73273	0.35			100	35.2								
ISO-SCF-32293-4	1201622	5.61	5.40641	4%	1	5.6								
ISO-SCF-32293-4	1192039	5.57	5.40641	3%	1	5.6								
ISO-SCF-32293-4	1184261	5.53	5.40641	2%	1	5.5								

Sample Name	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample ug	Avg Amt Sample ug	Volume Sampled Cu Ft	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-57	374801	1.76			2000	3516.0	3520.7	30.89	1.14324	4025.0	4086.0			8-A-1
ARL-57	377410	1.77			2000	3540.4								
ARL-57	373601	1.75			2000	3505.6								
ARL-58	111353	0.53			100	52.9	53.4	30.89	1.14324	61.0				8-A-2
ARL-58	112493	0.53			100	53.5								
ARL-58	113066	0.54			100	53.7								
ARL-59	406803	1.91			2000	3815.3	3805.4	29.73	1.18785	4520.2	4579.2			8-B-1
ARL-59	401924	1.88			2000	3769.0								
ARL-59	408657	1.92			2000	3811.8								
ARL-60	105005	0.50			100	50.0	49.7	29.73	1.18785	59.0				8-B-2
ARL-60	104950	0.50			100	50.0								
ARL-60	102971	0.49			100	49.0								
ISO-SCF-32293-4	1187542	5.59	5.40641	3%	1	5.6								
ISO-SCF-32293-4	1200088	5.61	5.40641	4%	1	5.6								
ISO-SCF-32293-4	1190471	5.56	5.40641	3%	1	5.6								
ARL-61	1137017	5.31			2000	10625.3	10561.2	30.49	1.15824	11144.9	11197.4	7827.81	88.46%	8-C-1
ARL-61	1120569	5.24			2000	10471.9								
ARL-61	1132853	5.29			2000	10586.4								
ARL-62	94647	0.45			100	45.2	45.3	30.49	1.15824	52.5				8-C-2
ARL-62	95991	0.46			100	45.8								
ARL-62	94335	0.45			100	45.0								
ARL-63	1108755	5.18			2000	10361.7	10314.5	31.95	1.10531	10721.6	10770.2	7827.81	83.01%	8-D-1
ARL-63	1096270	5.12			2000	10245.2								
ARL-63	1106072	5.17			2000	10336.7								
ARL-64	92259	0.44			100	44.0	44.0	31.95	1.10531	48.6				8-D-2
ARL-64	92558	0.44			100	44.2								
ARL-64	91687	0.44			100	43.8								
ISO-SCF-32293-4	1188551	5.54	5.40641	3%	1	5.5								
ISO-SCF-32293-4	1187157	5.55	5.40641	3%	1	5.5								
ISO-SCF-32293-4	1196473	5.59	5.40641	3%	1	5.6								

Sample Name	FILE	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample	Avg Anal Sample	Amount Spiked	Spike Recovery	Train ID
ISO-SCF-32293-4	S1083F4	1263013	5.90	5.41	9%	1	5.9	5.9			QC
ISO-SCF-32293-4	S1083F5	1253783	5.86	5.41	8%	1	5.9				
ISO-SCF-32293-4	S1083F6	1249399	5.84	5.41	8%	1	5.8				
ARL-81	S1083F19	30452	0.15			10	1.5	1.6			FBA
ARL-81	S1083F20	31446	0.16			10	1.6				
ARL-81	S1083F21	33523	0.17			10	1.7				
ARL-104	S1083F22	809699	3.79			2000	7572.4	7569.9	7827.81	97%	FS-1
ARL-104	S1083F23	808659	3.78			2000	7562.7				
ARL-104	S1083F24	809952	3.79			2000	7574.7				
ISO-SCF-32293-4	S1083F25	1255771	5.87	5.41	9%	1	5.9	5.8			QC
ISO-SCF-32293-4	S1083F26	1251918	5.85	5.41	8%	1	5.8				
ISO-SCF-32293-4	S1083F27	1242330	5.80	5.41	7%	1	5.8				
ARL-82	S1083F40	16055	0.08			10	0.8	0.9			FBA
ARL-82	S1083F41	16597	0.09			10	0.9				
ARL-82	S1083F42	16113	0.09			10	0.9				
ARL-105	S1083F43	832058	3.89			2000	7780.9	7686.3	7827.81	98%	FS-2
ARL-105	S1083F44	822507	3.85			2000	7691.8				
ARL-105	S1083F45	811167	3.79			2000	7586.1				
ISO-SCF-32293-4	S1083F46	1238919	5.79	5.41	7%	1	5.8	5.8			QC
ISO-SCF-32293-4	S1083F47	1245039	5.82	5.41	8%	1	5.8				
ISO-SCF-32293-4	S1083F48	1235673	5.77	5.41	7%	1	5.8				
ARL-83	S1084F13	163746	0.77			10	7.7	7.7			FBB
ARL-83	S1084F14	162706	0.77			10	7.7				
ARL-83	S1084F15	164806	0.78			10	7.8				
ARL-106	S1084F16	869707	4.07			2000	8132.1	8120.1	7827.81	104%	MS-1
ARL-106	S1084F17	867360	4.06			2000	8110.2				
ARL-106	S1084F18	868206	4.06			2000	8118.1				
ISO-SCF-32293-4	S1084F19	1220899	5.70	5.41	6%	1	5.7	5.7			QC
ISO-SCF-32293-4	S1084F20	1232005	5.76	5.41	6%	1	5.8				
ISO-SCF-32293-4	S1084F21	1230936	5.75	5.41	6%	1	5.8				
ARL-84	S1084F34	33054	0.16			10	1.6	1.6			FBB
ARL-84	S1084F35	32381	0.16			10	1.6				
ARL-84	S1084F36	32300	0.16			10	1.6				

Sample Name	FILE	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample	Avg Amt Sample	Amount Spiked	Spike Recovery	Train ID
ARL-107	S3084F37	829745	3.88			2000	7759.3	7837.5	7827.81	100%	MS-2
ARL-107	S3084F38	838117	3.92			2000	7837.4				
ARL-107	S3084F39	846508	3.96			2000	7915.7				
ISO-SCF-32293-4	S3084F40	1246426	5.82	5.41	8%	1	5.8	5.8			QC
ISO-SCF-32293-4	S3084F41	1217852	5.78	5.41	7%	1	5.8				
ISO-SCF-32293-4	S3084F42	1219959	5.79	5.41	7%	1	5.8				
ARL-85	S3085F19	75475	0.36			10	3.6	3.6			FBC
ARL-85	S3085F20	75608	0.36			10	3.6				
ARL-85	S3085F21	72681	0.35			10	3.5				
ARL-108	S3085F22	847084	3.96			2000	7921.1	7890.2	7827.81	101%	MS-3
ARL-108	S3085F23	836897	3.91			2000	7826.0				
ARL-108	S3085F24	847337	3.96			2000	7923.4				
ISO-SCF-32293-4	S3085F25	1263449	5.90	5.41	9%	1	5.9	5.9			QC
ISO-SCF-32293-4	S3085F26	1253499	5.86	5.41	8%	1	5.9				
ISO-SCF-32293-4	S3085F27	1260480	5.89	5.41	9%	1	5.9				
ARL-86	S3085F40	59577	0.29			10	2.9	2.8			FBC
ARL-86	S3085F41	56343	0.27			10	2.7				
ARL-86	S3085F42	59626	0.29			10	2.9				
ARL-109	S3085F43	851309	3.98			2000	7960.5	7944.8	7827.81	101%	MS-4
ARL-109	S3085F44	850793	3.98			2000	7955.6				
ARL-109	S3085F45	846800	3.96			2000	7918.4				
ISO-SCF-32293-4	S3085F46	1245663	5.82	5.41	8%	1	5.8	4.0			QC
ISO-SCF-32293-4	S3085F47	0	0.01	5.41	-100%	1	0.0				
ISO-SCF-32293-4	S3085F48	1296988	6.06	5.41	12%	1	6.1				
ISO-SCF-32293-4	S3088F1	1158548	5.41	5.41	0%	1	5.4				
ARL-89	S3088F2	0	0.01			10	0.1	0.1			T-RB1
ARL-89	S3088F3	0	0.01			10	0.1				
ARL-89	S3088F4	0	0.01			10	0.1				
ARL-90	S3088F5	0	0.01			10	0.1	0.1			T-RB2
ARL-90	S3088F6	5758.5	0.04			10	0.4				
ARL-90	S3088F7	5867.5	0.04			10	0.4				
ARL-91	S3088F8	0	0.01			10	0.1	0.2			T-RB3
ARL-91	S3088F9	3273	0.03			10	0.3				
ARL-91	S3088F10	0	0.01			10	0.1				

Sample Name	FILE	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Dias %	Dilution Factor	Amount Sample	Avg Amt Sample	Amount Spiked	Spike Recovery	Train ID
ARL-92	S3098F11	26248	0.13			10	1.3	1.2			T-RB4
ARL-92	S3098F12	22909.08	0.12			10	1.2				
ARL-92	S3098F13	22154	0.11			10	1.1				
ISO-SCF-32293-4	S3098F14	1202.98	5.62	5.41	4%	1	5.6	5.7			QC
ISO-SCF-32293-4	S3098F15	1212015	5.66	5.41	5%	1	5.7				
ISO-SCF-32293-4	S3098F16	1220989	5.70	5.41	6%	1	5.7				
ARL-94	S3098F17	0	0.01			10	0.1	0.2			A-RB1
ARL-94	S3098F18	5431	0.04			10	0.4				
ARL-94	S3098F19	0	0.01			10	0.1				
ARL-95	S3098F20	0	0.01			10	0.1	0.1			A-RB2
ARL-95	S3098F21	0	0.01			10	0.1				
ARL-95	S3098F22	0	0.01			10	0.1				
ARL-96	S3098F23	8352.5	0.04			10	0.4	0.4			A-RB3
ARL-96	S3098F24	6436	0.04			10	0.4				
ARL-96	S3098F25	5888	0.04			10	0.4				
ARL-97	S3098F26	25808	0.13			10	1.3	0.8			A-RB4
ARL-97	S3098F27	21934	0.11			10	1.1				
ARL-97	S3098F28	0	0.01			10	0.1				
ISO-SCF-32293-4	S3098F29	1164624	5.44	5.41	1%	1	5.4	5.4			QC
ISO-SCF-32293-4	S3098F30	1159319	5.42	5.41	0%	1	5.4				
ISO-SCF-32293-4	S3098F31	1149310	5.37	5.41	-1%	1	5.4				
ARL-99	S3098F32	0	0.01			10	0.1	0.1			ABS-RB
ARL-99	S3098F33	0	0.01			10	0.1				
ARL-99	S3098F34	0	0.01			10	0.1				
ARL-100	S3098F35	0	0.01			10	0.1	0.1			ABS-RB
ARL-100	S3098F36	0	0.01			10	0.1				
ARL-100	S3098F37	0	0.01			10	0.1				
ARL-101	S3098F38	15010.13	0.08			10	0.8	0.9			ABS-RB
ARL-101	S3098F39	15823	0.08			10	0.8				
ARL-101	S3098F40	23127	0.12			10	1.2				
ARL-102	S3098F41	0	0.01			10	0.1	0.1			ABS-RB
ARL-102	S3098F42	0	0.01			10	0.1				
ARL-102	S3098F43	0	0.01			10	0.1				

Sample Name	FILE	AREA	AMOUNT ug/mL	QC Con ug/mL	QC Bias %	Dilution Factor	Amount Sample	Avg Amt Sample	Amount Spiked	Spike Recovery	Train ID
ISO-SCF-32293-4	S3098F44	1187727	5.55	5.41	3%	1	5.5	5.6			QC
ISO-SCF-32293-4	S3098F45	1109251	5.60	5.41	4%	1	5.6				
ISO-SCF-32293-4	S3098F46	1208008	5.63	5.41	4%	1	5.6				
ARL-117	S3098F47	4701	0.03			10	0.3	0.3			MB-1
ARL-117	S3098F48	4680.5	0.03			10	0.3				
ARL-117	S3098F49	5001	0.03			10	0.3				
ARL-118	S3098F50	204900	0.96			10	9.6	9.7			MB-2
ARL-118	S3098F51	207157	0.98			10	9.8				
ARL-118	S3098F52	207481	0.98			10	9.8				
ARL-119	S3098F53	446217.5	2.09			10	20.9	20.7			MB-3
ARL-119	S3098F54	427633.1	2.01			10	20.1				
ARL-119	S3098F55	452112	2.12			10	21.2				
ISO-SCF-4893-1	S3098F56	1184164	5.44	5.41	1%	1	5.4	5.5			QC
ISO-SCF-4893-1	S3098F57	1178245	5.50	5.41	2%	1	5.5				
ISO-SCF-4893-3	S3098F58	1180212	5.42	5.41	0%	1	5.4				

2,4-TDI Summary Information

Amount of 2,4-TDI Spiked into the Trains: 7827.81 ug

Percent Recovery for Spiked Quad Trains

Quad No.	1		2		3		4		5		6		7		8		Average	RSD
Train ID	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D		
% Recovery	95.69%	86.19%	89.10%	95.22%	108.14%	111.93%	96.56%	97.97%	89.41%	95.59%	97.69%	99.46%	100.45%	85.63%	88.46%	83.01%	95%	8%
Total ug	12263	11520	13258	13733	11825	12078	9694	9805	12233	12717	15471	15610	10450	9290	11197	10770	11062	16%

Amount Collected in Unspiked Quad Trains

Quad No.	1		2		3		4		5		6		7		8		Average	RSD
Train ID	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B		
Total ug	4735	4011	6287	6270	3466	3166	2132	2139	4947	5522	8042	7608	2558	2818	4068	4579	4560	41%

Percent Carry over from 1st Impinger in Spiked Quad Trains

Quad No.	1		2		3		4		5		6		7		8		Average	RSD
Train ID	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D		
1st Impinger	98.48%	99.21%	99.21%	98.97%	99.02%	99.11%	96.38%	98.46%	98.95%	98.22%	98.83%	98.71%	98.03%	97.02%	98.44%	98.35%	98.52%	0.61%
2nd Impinger	1.52%	0.78%	0.79%	1.03%	0.98%	0.89%	3.62%	1.54%	1.05%	0.78%	1.17%	1.29%	1.97%	2.88%	1.59%	1.65%	1.46%	54.38%

Percent Carry over from 1st Impinger in Unspiked Quad Trains

Quad No.	1		2		3		4		5		6		7		8		Average	RSD
Train ID	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B		
1st Impinger	99.59%	98.11%	98.81%	99.24%	99.04%	98.94%	99.14%	98.76%	99.84%	99.18%	98.69%	98.83%	98.83%	98.38%	98.51%	98.71%	98.91%	0.41%
2nd Impinger	0.41%	1.89%	1.19%	0.76%	0.98%	1.06%	0.86%	1.24%	0.38%	0.82%	1.31%	1.17%	1.07%	1.62%	1.49%	1.29%	1.09%	37.05%

AREAL WA 55 -- Method 301 Results
Using Modified Data

Run #	Train			Amount		Precision of UNSpiked Samples			
	A	B	C	D	Spiked	Diff	STDu	STDm	RSD
1	12263.0	11520.0	4735.0	4811.0	7827.81	-76.00	216.596	30.942	4.721
2	6287.0	6270.0	13258.0	13733.0	7827.81	17.00			
3	11625.0	12078.0	3466.0	3166.0	7827.81	300.00			
4	2132.0	2139.0	9694.0	9805.0	7827.81	-7.00			
5	12233.0	12717.0	4947.0	5522.0	7827.81	-575.00			
6	8084.0	7608.0	15471.0	15610.0	7827.81	476.00			
7	10450.0	9290.0	2557.0	2616.0	7827.81	-59.00			

AREAL WA 55 -- Method 301 Results
Using Modified Data

Run #	Train			Amount		Precision of Spiked Samples				Bias					
	A	B		C	D	Spiked	Diff	SDs	SDm	RSD	Run	Compound	SD	t Test	CF
1	12263.0	11520.0		4735.0	4811.0	7827.81	743.00	430.48	162.71	3.55	-709.31	-295.41	481.90	-1.622	N/A
2	6287.0	6270.0		13258.0	13733.0	7827.81	-475.00				-610.81			^	
3	11625.0	12078.0		3466.0	3166.0	7827.81	-453.00				707.69				
4	2132.0	2139.0		9694.0	9805.0	7827.81	-111.00				-213.81				critical Value
5	12233.0	12717.0		4947.0	5522.0	7827.81	-484.00				-587.31				is 2.160
6	8084.0	7608.0		15471.0	15610.0	7827.81	-139.00				-133.31				
7	10450.0	9290.0		2557.0	2616.0	7827.81	1160.00				-544.31				

REAL WA 55 -- Method 301 Results
Using Modified Data

Run #	Train				Amount				Precision of UNSpiked Samples			
	A	B	C	D	Spiked	Diff	STDu	STDm	RSD			
1	12263.0	11520.0	4733.0	4811.0	7827.81	-76.00	237.150	29.644	5.205			
2	6287.0	6270.0	13258.0	13733.0	7827.81	17.00						
3	11623.0	12078.0	3466.0	3166.0	7827.81	300.00						
4	2132.0	2139.0	9694.0	9805.0	7827.81	-7.00						
5	12233.0	12717.0	4947.0	5522.0	7827.81	-575.00						
6	8084.0	7608.0	15471.0	15610.0	7827.81	476.00						
7	10430.0	9290.0	2557.0	2616.0	7827.81	-59.00						
8	4086.0	4579.0	11197.0	10947.0	7827.81	-493.00						

AREAL WA 55 -- Method 301 Results
Using Modified Data

Run #	Train			Amount Spiked	Precision of Spiked Samples				Bias					
	A	B	C		D	Diff	SDs	SDm	RSD	Run Compound	SD	t Test	CF	
1	12263.0	11520.0	4735.0	4811.0	7827.81	743.00	407.50	144.07	3.40	-709.31	-394.53	471.48	-2.367	1.053
2	6287.0	6270.0	13258.0	13733.0	7827.81	-475.00				-610.81				
3	11625.0	12078.0	3466.0	3166.0	7827.81	-453.00				707.69				
4	2132.0	2139.0	9694.0	9805.0	7827.81	-111.00				-213.81				
5	12233.0	12717.0	4947.0	5522.0	7827.81	-484.00				-587.31				
6	8084.0	7608.0	15471.0	15610.0	7827.81	-139.00				-133.31				
7	10450.0	9290.0	2557.0	2616.0	7827.81	1160.00				-544.31				
8	4086.0	4579.0	11197.0	10947.0	7827.81	250.00				-1088.31				

critical Value
Is 2.131

APPENDIX L

CALCULATION EQUATIONS

METHOD 2
CALCULATION EQUATIONS

$$\bar{V}_s = 85.49 C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{T_{s(avg)}}{P_s M_s}}$$

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

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

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

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

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

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

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

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, °F
T_{std}	=	Standard absolute temperature, 528 °F (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

122893-G:\STACK\WPMETHODS\SEQ.M5

CALCULATION EQUATIONS

METHOD 3

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

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

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

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

CALCULATION EQUATIONS

METHOD 5

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

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

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

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

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

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

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

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

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

122893-GASTACKWP\METHODS\EQ.M5

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

122893-G:\STACK\WPMETHODS\EQ.M5

T_{wb}	=	Wet bulb temperature of stack gas, °F
$T_{m(avg)}$	=	Absolute average dry gas meter temperature, °R
$T_{s(avg)}$	=	Absolute average stack temperature, °R
T_{std}	=	Standard absolute temperature, 528 °F (68 °F)
θ	=	Total sampling time, min.
V_{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.

CALCULATION EQUATIONS

METHOD 10

$$CO\cdot PPM\cdot DRY = CO_{CO_2 - free, dry, avg} (1 - CO_2, d/100)$$

$$CO\cdot PPM\cdot WET = CO\cdot PPM\cdot DRY (1 - MC/100)$$

$$GR/DSCF = 5.0885 \times 10^{-4} (CO\cdot PPM\cdot DRY)$$

$$mg/dscm = 1.165 (CO\cdot PPM\cdot DRY)$$

$$\dot{m} = 8.5714 \times 10^{-3} (GR/DSCF) (Q_{s,d})$$

$$E = \frac{2.9857 \times 10^{-3} F_d (GR/DSCF)}{20.9 - O_{2,d}}$$

where:

$CO_{CO_2 - free, dry, avg}$

= average of two determinations of carbon monoxide on a dry, CO_2 - free integrated flue gas sample reported in ppm by volume

$CO_{2,d}$ = carbon dioxide concentration of flue gas on a dry percent by volume basis

$O_{2,d}$ = oxygen concentration of flue gas on a dry percent by volume basis

MC	=	moisture content of flue gas on a percent by volume basis
CO-PPM-DRY	=	carbon monoxide concentration in ppm by volume on a dry basis
CO-PPM-WET	=	carbon monoxide concentration in ppm by volume on a wet or actual basis
GR/DSCF	=	concentration of carbon monoxide in flue gas on a grains per dry standard cubic foot basis (68 °F, 29.92 IN. HG.)
mg/dscm	=	concentration of carbon monoxide in flue gas on a milligrams per dry standard cubic meter basis (60 °F, 29.92 IN. HG.)
$\dot{m}$	=	emissions or mass rate of carbon monoxide on a LB/HR basis
$Q_{s,d}$	=	volumetric flow rate of flue gas in dry standard cubic feet per minute
E	=	emission factor of carbon monoxide in pounds of carbon monoxide emitted per million BTU heat input (LB/MMBTU)
F_d	=	F-Factor of respective fuel in dry standard cubic feet of exhaust gas at 0% oxygen per million BTU of heat input (DSCF/MMBTU)

CALCULATION EQUATIONS

Chromotropic Acid Method for Formaldehyde

$$m_t = \frac{m_a V_{soln}}{V_{aliq}}$$

where:

m_t	=	mass of formaldehyde in total sample in ug
m_a	=	mass of formaldehyde in aliquot in ug
V_{soln}	=	volume of total sample in cc (500 cc normally)
V_{aliq}	=	volume of aliquot taken for analysis in cc
PPM·DRY	=	$\frac{0.0283 m_t}{V_{std}}$
PPM·WET	=	PPM·DRY (1-MC/100)
GR/DSCF	=	5.45×10^{-4} (PPM·DRY)
mg/dscm	=	1.249 (PPM·DRY)
$\dot{m}$	=	8.5714×10^{-3} (GR/DSCF) ($Q_{t,d}$)

where:

PPM·DRY	=	concentration of formaldehyde in parts per million by volume on a dry basis
PPM·WET	=	concentration of formaldehyde in parts per million by volume on an actual or wet basis
MC	=	moisture content of gas on a percent by volume basis
GR/DSCF	=	concentration of formaldehyde in gas on a grains per dry standard cubic foot basis (68 °F, 29.92 IN. HG.)
$\dot{m}$	=	emission or mass rate of formaldehyde in pounds per hour (LB/HR)
V_{std}	=	dry gas volume as measured by the dry gas meter, corrected to standard conditions (at 68 °F and 1 atmosphere) DSCF

031894-G:\STACK\WPMETHODS\S-EQ.03

METHOD 25A

Total Gaseous Organics Calculation Equation

$$\text{GR C/SCF} = 2.180 \times 10^{-4} \text{ (ppm, w)}$$

$$\text{GR C/DSCF} = 2.180 \times 10^{-4} \text{ (ppm, w)/(1-MC/100)}$$

$$\text{LB C/HR} = 8.5714 \times 10^{-3} \text{ (GR/DSCF) (DSCFM)}$$

where:

GR C/SCF = grains of total gaseous organics as carbon per actual (wet) standard cubic foot

GR C/DSCF = grains of total gaseous organics as carbon per dry standard cubic foot

LB C/HR = pounds of total gaseous organics as carbon emitted per hour

Note 1: The Ratfisch Model RS 55 Heated FID Analyzer as normally operated with a heated filter, sample line and heated detector oven gives ppm, w.

Note 2: ppm, C = ppm as carbon = 3(ppm propane)

4-255 α .THC

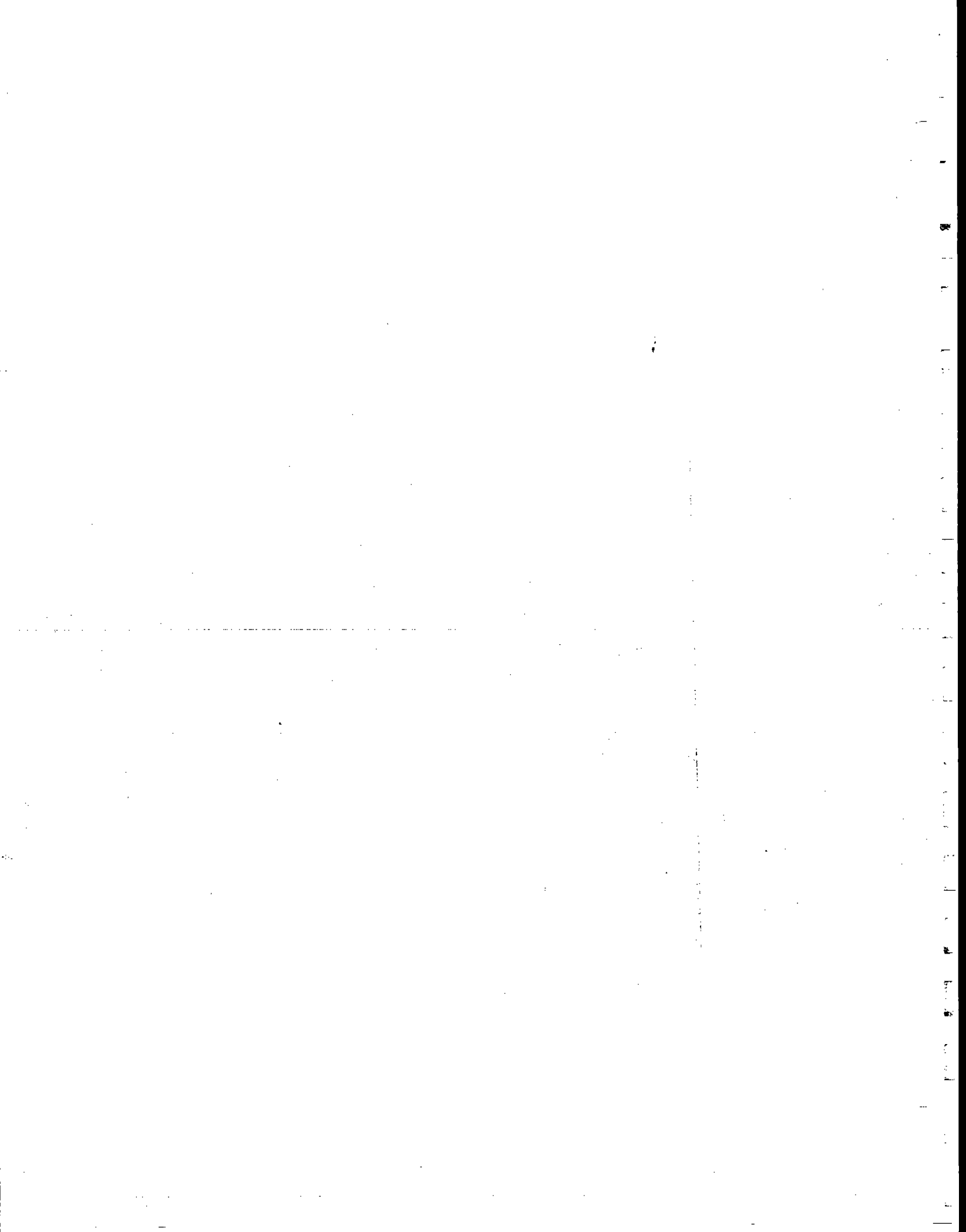
[illegible]

4-2558.MDI

[illegible]

APPENDIX M

SAMPLING TRAIN CALIBRATION DATA



INTERPOLL LABORATORIES
EPA Method 5 Gas Metering System
Quality Control Check Data Sheet

Job L.P. Montrose

Date 3/29/94

Operator JCH

Module No.

Instructions: Operate the control module at a flow rate equal to $\dot{V}_H$ for 10 minutes before attaching the umbilical. Record the following data:

Bar press 25.02 in. Hg. $\tau =$.9997 $\dot{V}_H$ 1.98 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
<u> </u>	<u>(256.10)</u>	<u> </u>	<u> </u>
2.5	<u>258.00</u>	<u>40</u>	<u>36</u>
5.0	<u>259.91</u>	<u>43</u>	<u>36</u>
7.5	<u>261.83</u>	<u>45</u>	<u>36</u>
10	<u>263.72</u>	<u>47</u>	<u>36</u>
<u> </u>	$V_m =$ <u>7.62</u>	$Avg(t_m) =$ <u>42.37</u> °F	

#5

573.6

575.67 47 37

577.72 53 38

579.81 56 38

581.84 59 39

8.24

45.87

59.87

0.97

Calculate Y_{cn} as follows:

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

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

$$Y_{cn} = \underline{\hspace{2cm}}$$

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

S-432

INTERPOLL LABORATORIES
EPA Method 5 Gas Metering System
Quality Control Check Data Sheet

Job L.P. Montrose

Date 3/31/94

Operator D. Van Hoever

Module No. 12

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 25.13 in. Hg. $T =$ 9997 ΔH 1.98 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(265.00)		
2.5	267.00	39	34
5.0	269.02	43	34
7.5	271.00	41	35
10	272.90	50	35
	$V_m = 7.90$	$Avg(t_m) = 39.62^\circ F$	

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(9997)(7.90)} \left[\frac{(39.62 + 460)}{(25.13)} \right]^{0.5}$$

$$Y_{cn} = \underline{1.008}$$

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

S-432

INTERPOLL LABORATORIES
EPA Method 5 Gas Metering System
Quality Control Check Data Sheet

Job L.P. / Manganese (C)

Date 3-31-94

Operator M. K. Miller

Module No. 14

Instructions: Operate the control module at a flow rate equal to ΔH_0 for 10 minutes before attaching the umbilical. Record the following data:

Bar press 25.13 in. Hg. $\tau =$ 9946 ΔH_0 1.90 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
<u>1.786</u>	<u>(819.50)</u>	<u>[REDACTED]</u>	
2.5	820.45	41	36
5.0	822.40	41	36
7.5	824.34	47	36
10	826.30	51	36
<u>[REDACTED]</u>	$V_m = 7.80$	$Avg(t_m) = 40.89^\circ F$	

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(9946)(7.80)} \left[\frac{(40.89) + 460}{(25.13)} \right]^{0.5}$$

$$Y_{cn} = \underline{1.028}$$

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

S-432

EPA Method 5 Gas Metering System
Quality Control Check Data Sheet

Job L.P. / Montrose, CO

Date 3-31-84

Operator M. Kuchler

Module No. 12

Instructions: Operate the control module at a flow rate equal to ΔH_0 for 10 minutes before attaching the umbilical. Record the following data:

Bar press 25.13 in. Hg. $\tau =$.9997 ΔH_0 1.98 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(426.40)		
2.5	428.50	75	75
5.0	430.54	75	75
7.5	432.60	75	75
10	434.66	75	75
	$V_m = 8.26$	Avg $(t_m) = 75.00$ °F	

Calculate Y_{en} as follows:

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

$$Y_{en} = \frac{1.786}{(.9997)(8.26)} \left[\frac{(75.00) + 460}{(25.13)} \right]^{0.5}$$

$$Y_{en} = \underline{.998}$$

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

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

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: April 7, 1994

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

Date of Last Calibration: March 24, 1994

Calibration Technician: E. Trowbridge

Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
March 29, 1994	4-2558	581.85	649.85	68.00	68.00

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: April 7, 1994

Meter Box No. : 14 (Rockwell Dry Test Meter Serial No. 1334119)

Date of Last Calibration: January 12, 1994

Calibration Technician: E. Trowbridge

Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
February 08, 1994	4-2239	43.31	405.13	361.82	361.82
March 22, 1994	4-2516	414.40	540.61	126.21	488.03
March 30, 1994	4-2558	550.97	1178.10	627.13	1115.16

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: April 7, 1994

Meter Box No. : 12 (Rockwell Dry Test Meter Serial No. 1334121)

Date of Last Calibration: February 17, 1994

Calibration Technician: E. Trowbridge

Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter		Final Meter		Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
		Reading		Reading			
March 31, 1994	4-2558	274.28		758.29		484.01	484.01

* Total volume through meter since last calibration.

Bar. Press. 28.14 in. Hg

INTERPOL LABORATORIES, INC.
METER CALIBRATION SHEET

Control Module No. 12
Serial No. DJM 1334121
Net Test Meter No. AL-20
Technician W. T. Edwards

[illegible]

Positive leak check performed by 127

☒ **Water was in tolerance**

Water was not in tolerance ☒: readjusted linkage

Water was not in tolerance ☒; changed dry test meters

Approved by *Carroll* Date 2/23/94

* Based on AL-20 wet test meter calibration in Nov. 1991 against Bell Prover (NBS Traceable) - Carl Poe Co.

SO102RA 11/91

Date 1-12-94

Bar. Press. 29.02 in. Hg

INTERPOL LABORATORIES, INC.
METER CALIBRATION SHEET

Control Module No.

Serial No. DTM 133 4114

Net Test Water No. AL-20

Technician

[illegible]

Positive leak check performed by
 Meter was in tolerance ☒
 Meter was not in tolerance ☐; readjusted linkage
 Meter was not in tolerance ☐; changed dry test meters

Approved by Dean R. Carr Date 1/14/64

DIFFERENTIAL PRESSURE AND PROOF CALIBRATION CURVE

WET TEST METER

PULSATION RANGE

DIFFERENTIAL - INCHES H₂O

0.30

0.20

0.10

0

Calibrated With a 10 Ft. American DeJl
Prover, Serial No. 3157. Traceable to
the Bureau of Standards. Reference No.
5249068, PI-TAPE.

AL-20 American Wet Test Meter

Serial No. P-711

Stainless Steel w/Removable Back

Calibrated w/Saturated Air

Water Temp. 74° F

Air Temp. 74° F

Inlet Pressure 2" H₂O Constant

Calibration Rate: 60 CFH Per/Hr.

Capacity Rate: 120 CFH Per/Hr.

Restricted Outlet for Rate Deviation

PROOF

101

100

99

CORRECT VOLUME * INDEX READING * PROOF + 100

20

40

60

80

100

120

DAVID BANKS

FLOW RATE - CUBIC FEET OF AIR PER HOUR

11/91

November, 1991

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 03-29-94

Nozzle Number Glass

Technician: Duane Van Hoever

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	.225
2	.225
3	.225
Average:	.225

Interpoll Laboratories, Inc.

(612) 786-6020

Nozzle Calibration

Data Sheet

Date of Calibration: 03-29-94

Nozzle Number 7-3

Technician: Duane Van Hoever

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	.186
2	.186
3	.185
Average:	.186

Interpoll Laboratories, Inc.

(612) 786-6020

Nozzle Calibration

Data Sheet

Date of Calibration: 03-31-94

Nozzle Number

Glass-3

Technician: Mark Kaehler

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	.188
2	.189
3	.190
Average:	.189

Interpoll Laboratories, Inc.

Temperature Measurement Device
Calibration Sheet

Unit under test:

Vendor Beckman
 Model HD110 T Serial Number PPT #18
 Range -4°F - 1999°F °F Thermocouple Type K
 Date of Calibration 2/16/94 Technician D. Van Hove

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 $\pm 0.1\%$ 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		0	0	0
100		96	4	.89
200		199	1	.15
300		298	2	.26
400		395	5	.58
500		495	5	.52
600		598	2	.19
700		698	2	.17
800		803	3	.24
900		906	6	.44
1000		1011	11	.75
1100		1114	14	.90
1200		1220	20	1.20
1300		1321	21	1.19
1400		1426	26	1.40
1500		1524	24	1.22
1600		1625	25	1.21
1700		1720	20	.92
1800		1819	19	.84
1900		1912	12	.57
2000		OL		
2100		OL		
		Averages:		.68

OF = off scale response by unit under test (°F)
 $\% \text{ dev} = 100 \Delta t / (460 + t)$

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

Interpoll Laboratories, Inc.

Temperature Measurement Device
Calibration Sheet

Unit under test:

Vendor Omega #31
Model HH81
Range 0-2100 °F
Date of Calibration 1-10-94
Serial Number 733X1495
Thermocouple Type K
Technician Mark Gachler

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 $\pm 0.1\%$ 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	0	7.6 -1	1	.22
100	100	97.7 99	1	0
200	200	201	1	0
300	300	299	1	0
400	400	398	2	0
500	500	499	1	0
600	600	600	0	0
700	700	699	1	0
800	800	802	2	0
900	900	900	0	0
1000	1000	1001	1	0
1100	1100	1099	1	0
1200	1200	1201	1	0
1300	1300	1299	1	0
1400	1400	1402	2	0
1500	1500	1499	1	0
1600	1600	1602	2	0
1700	1700	1700	0	0
1800	1800	1802	2	0
1900	1900	1899	1	0
2000	2000	2000	0	0
2100	2100	2097	3	0
Averages:			1.14	.01

OF = off scale response by unit under test (°F)
% dev = $100 \Delta t / (460 + t)$



S-Type Pitot Tube Inspection SheetPitot No. 23-5Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .455 IN.
3. Base to Side B opening plane (P_B) .460 IN.

Alignment:

4. $\alpha_1 < 10^\circ$ 1
5. $\alpha_2 < 10^\circ$ 1
6. $B_1 < 5^\circ$ 2
7. $B_2 < 5^\circ$ 2
8. $Z < .125"$.04
9. $W < .0625"$.02

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .760 IN.
11. Pitot to probe sheath 3.00 IN.
12. Pitot to thermocouple (parallel to probe) 3.00 IN.
13. Pitot to thermocouple (perpendicular to probe) .750 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:

Inspected by:

4-7-93G. Trawick

CFR Title 40 Part 60 Appendix A Method 2

S-Type Pitot Tube Inspection SheetPitot No. 23-6Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .460 IN.
3. Base to Side B opening plane (P_B) .461 IN.

Alignment:

4. $\alpha_1 < 10^\circ$ 1
5. $\alpha_2 < 10^\circ$ 1
6. $B_1 < 5^\circ$ 1
7. $B_2 < 5^\circ$ 2
8. $Z < .125"$.02
9. $W < .0625"$.02

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .750 IN.
11. Pitot to probe sheath 3.00 IN.
12. Pitot to thermocouple (parallel to probe) 3.00 IN.
13. Pitot to thermocouple (perpendicular to probe) .760 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:

Inspected by:

4-7-93[Signature]

CFR Title 40 Part 60 Appendix A Method 2

INTERPOLL LABORATORIES

(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration SheetDate 9-13-93Technician M. A. B. BoehlenMercury Column Barometer No. LAB-1Aneroid Barometer No. 560815

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjusted Mercury Barometer Read	Initial Aneroid Barometer Read	Difference (P _{ba} -P _{bm})
28.770	72	.114	28.656	28.760	.104

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.

S-312

INTERPOLL LABORATORIES

(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 2/16/94
Technician D. Van Hoever
Mercury Column Barometer No. 1
Aneroid Barometer No. _____

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjusted Mercury Barometer Read	Initial Aneroid Barometer Read	Difference (P _{ba} -P _{bm})
29.23	76	.124	29.11	29.10	.01

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.

S-312