

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.

50

4-97

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

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

**RESULTS OF THE DECEMBER 14-17, 1993
STATE-REQUIRED AIR EMISSION COMPLIANCE TESTS
AT THE LOUISIANA PACIFIC WAFERBOARD
PLANT IN DUNGANNON, VIRGINIA**

Submitted to:

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

Attention:

Sue Somers

Approved by:



Daniel J. Despen
Manager
Field Testing Division

Report Number 3-1906
January 21, 1994
KE/kce

TABLE OF CONTENTS

	ABBREVIATIONS	iii
1	INTRODUCTION	1
2	SUMMARY AND DISCUSSION	5
3	RESULTS	15
	3.1 Results of Orsat and Moisture Determinations	16
	3.2 Results of Particulate Determinations	25
	3.3 Results of PM-10 Determinations	28
	3.4 Results of Oxides of Nitrogen Determinations	30
	3.5 Results of Carbon Monoxide Determinations	34
	3.6 Results of Formaldehyde Determinations	36
	3.7 Results of Phenol Determinations	39
	3.8 Results of MDI Determinations	41
4	RESULTS OF FUEL ANALYSES	44

APPENDICES:

- A - Results of Volumetric Flow Rate Determinations
- B - Location of Test Ports
- C - Konus Field Data Sheets
- D - Press Vent Field Data Sheets
- E - Dryer Field Data Sheets
- F - Interpoll Laboratories Analytical Results
- G - Total Hydrocarbons Stripchart
- H - THC Analyzer Specifications
- I - Measurement Systems Performance Specifications
- J - Calibration Gas Certification Sheets
- K - Process Rate Information
- L - Procedures
- M - Calculation Equations
- N - 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 December 14 - 17, 1993 Interpoll Laboratories personnel conducted State-required air emission compliance tests on the Konus, Dryer and Press Vent at the Louisiana Pacific Corporation (LP) Waferboard Plant located in Dungannon, Virginia. On-site testing was performed by D. Van Hoever, E. Brennan and E. Trowbridge. Coordination between testing activities and plant operation was provided by Sue Somers of LP. The tests were witnessed by S. Faggert and G. Deihl of the Virginia Department of Environmental Quality.

The Konus Oil Heater tested was manufactured by Konus Kessel in 1985. It is equipped with two screw auger-type stokers and is fired with a mixture of bark and wood. The unit is equipped with an economizer and has a design heat input capacity of 31 10⁶BTU/HR. Particulate emissions from the Konus are controlled by a large diameter cyclone manufactured by Konus in series with a fabric filter dust collector manufactured by C.E. Preheater. The baghouse has a pulsed air cleaning system. Cleaned flue gas is emitted to the atmosphere by a 75-foot high radial steel stack which has a diameter of 41 inches.

The Wafer Dryer tested is a Model 1260 TNW/L dryer manufactured by MEC Company. 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 electrified filter bed unit manufactured by EFB, Inc. Cleaned flue gas is emitted to the atmosphere by a 150-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.

The oxides of nitrogen samples were collected at the Dryer test site during the particulate determinations using an all-glass Method 7 sampling train. A heated stainless steel probe was used to extract the samples from the exhaust stream. A plug of glass-wool was used in the end of the probe to remove particulate material.

The NO_x samples were collected in volume-calibrated two-liter all-glass flasks. An aliquot of 25 cc of absorbing solution was added to each flask on-site; the flask was closed; inserted into the sampling train; and evacuated. The probe was then purged and the sample collected over a 15 second interval. The flask was then closed; the flask removed from the sampling train; shook for two minutes and then secured for transport to the laboratory.

Upon arrival at the laboratory, the NO_x samples are logged in, placed in a designated area and maintained at 72 °F for 24 hours to allow completion of the conversion of NO to NO_2 and absorption in the acidified peroxide reagent. The flasks are then shook to complete absorption; attached to a mercury manometer and the static pressure and temperature recorded. The samples are then recovered and analyzed by ion chromatography.

PM-10 determinations were performed on the Konus Oil Heater in accordance with EPA Method 201A (Ibid, Part 51, Appendix M). An Interpoll Labs sampling train which meets or exceeds specifications in the above-cited reference was used to extract PM-10 samples by means of an Anderson PM-10 cyclone and a stainless steel probe. The cyclone used in this work meets or exceeds the specifications of Method 201A. Velocity pressure measurements were made prior to and during each run to determine the proper dwell times at each traverse point.

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.

Phenol concentrations were determined from the Press Vent using a Method 5 sampling train with neutral buffered absorbing reagent followed by extraction with methylene chloride and direct analysis by GC/MS with no concentration (EPA Method 8270). The samples were field spiked with 5.33 mg of phenol d5.

MDI concentrations were determined by two methods simultaneously. The first method was performed in accordance with Interpoll Laboratories Method II-8791 (Ver 1.2), which is based on NIOSH Method P&CAM 347 (N-p-nitrobenzyl-N-propylamine impregnated filters with analysis of the urea reaction product after solvent switch by normal phase HPLC/UV with full photodiode array wavelength data collection (190-720 nm). Exhaust gas samples were collected in such a manner as to collect both gaseous and aerosol phase MDI. An Interpoll Labs sampling train was used to extract MDI samples by means of a non-heated stainless steel probe and an out-stack filter assembly. The HPLC sample flow rate was reduced to 0.8 mL/min from the usual 2 mL/min at the request of the client to achieve better chromatographic resolution. In the second MDI method the sampling train was operated simultaneously at the Press Vent Stack using the 1,2-PP method as developed by Radian Corporation under contract to USEPA.

Integrated flue gas samples were extracted from the dryer and thermal oil heater exhaust gas streams using a specially designed gas sampling system. Integrated flue gas samples were collected in 44-liter Tedlar bags housed in a protective aluminum container. After sampling was complete, the bags were sealed and returned to the laboratory for Orsat analysis. Prior to sampling, the Tedlar bags are leak checked at 15 IN.HG. vacuum with an in-line rotameter. Bags with any detectable inleakage are discarded. The integrated flue gas samples collected at the dryer test site were analyzed for carbon monoxide in accordance with EPA Method 10 (NDIR).

Testing on the Dryer was conducted from two test ports oriented at 90 degrees on the stack. These test ports are located 5.5 stack diameters downstream of the nearest flow disturbance and 21.5 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 and formaldehyde sampling to give a total sampling time of sixty minutes per run.

Testing on the Konus was also conducted from two test ports oriented at 90 degrees on the stack. These test ports are located 6.0 stack diameters from the nearest flow disturbance and 2.87 diameters from the stack exit. A 16-point traverse was used to collect representative particulate samples. Each traverse point was sampled for 4 minutes for a total sampling time of 64 minutes per run. A 12-point traverse was used to collect the PM-10 samples. The PM-10 run times varied from 79 to 84 minutes.

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 2.0 stack diameters downstream of the nearest flow disturbance and 6.9 diameters upstream of the stack exit. A 24-point traverse was used to collect the particulate, formaldehyde, phenol and MDI samples. Each traverse point was sampled 2.5 minutes for a total sampling time of 60 minutes per run.

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

2 SUMMARY AND DISCUSSION

The important results of the particulate emission compliance tests are summarized in Tables 1-3. The particulate results have been calculated using the dry plus wet catch ("a" Tables) and again with the dry catch only ("b" Tables). The following emission rates and factors are based on the dry catch only results. As will be noted, the front half particulate emission factor for the Thermal Oil Heater averaged 0.023 LB/10⁶BTU. The front half particulate emission rate for the Dryer averaged 7.15 LB/HR. The PM-10 results are summarized in Table 3. The PM-10 emission factor averaged 0.0097 LB/10⁶BTU for the Thermal Oil Heater.

The oxides of nitrogen results for the Dryer are summarized in Table 4. The oxides of nitrogen emission rate averaged 8.7 LB/HR.

The carbon monoxide results are summarized in Table 5. The carbon monoxide emission rate averaged 24 LB/HR for the Dryer.

A summary of the formaldehyde results are presented in Table 6. The formaldehyde emission rate averaged 0.86 LB/HR for the Dryer and 0.97 LB/HR for the Press Vent.

The results of the Total Hydrocarbons tests are summarized in Table 7. The total hydrocarbon emission rate averaged 10.9 LB/HR for the Dryer and 2.94 LB/HR for the Press Vent.

Summaries of the phenol and MDI results for the Press Vent are presented in Tables 8 and 9. Phenol was not detected in any of the samples at a detection limit of 2.1 mg. The MDI emission rate averaged 0.11 LB/HR for the NP2 sampling train and 0.081 LB/HR for the 1,2-PP sampling train.

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 this fact and a complete review of the entire data and results, it is our opinion that the results reported herein are accurate and closely reflect the actual values which existed at the time the test was performed.

Table 1a. Summary of the Results of the December 14, 1993 Particulate Emission Compliance Test on the Thermal Oil Heater at the Louisiana Pacific Plant in Dunganon, Virginia.

ITEM	Run 1	Run 2	Run 3
Date of test	12-14-93	12-14-93	12-14-93
Time runs were done (HRS)	924/1039	1127/1239	1320/1446
Process rate (TONS/HR)	9.6	9.6	9.6
Volumetric flow actual (ACFM) standard (DSCFM)	19662 12471	19420 12407	19922 12748
Gas temperature (DEG-F)	282	282	282
Moisture content (%V/V)	6.36	5.61	5.55
Gas composition (%V/V, dry) carbon dioxide oxygen nitrogen	3.20 17.50 79.30	3.70 17.00 79.30	3.10 17.60 79.30
Isokinetic variation (%)	99.3	99.9	100.0
Particulate concentration actual (GR/ACF) standard (GR/DSCF)	.00537 .00847	.00439 .00688	.00333 .00520
Part. emission rate (LB/HR)	0.906	0.731	0.568
Part. emission factor (LB/MMBTU)	0.071	0.051	0.045

Note: Dry + Method 202 Condensible Particulate Material

Table 1b. Summary of the Results of the December 14, 1993 Particulate Emission Compliance Test on the Thermal Oil Heater at the Louisiana Pacific Plant in Dunganon, Virginia.

ITEM	Run 1	Run 2	Run 3
Date of test	12-14-93	12-14-93	12-14-93
Time runs were done (HRS)	924/1039	1127/1239	1320/1446
Process rate (TONS/HR)	9.6	9.6	9.6
Volumetric flow actual (ACFM) standard (DSCFM)	19662 12471	19420 12407	19922 12748
Gas temperature (DEG-F)	282	282	282
Moisture content (%V/V)	6.36	5.61	5.55
Gas composition (%V/V, dry) carbon dioxide oxygen nitrogen	3.20 17.50 79.30	3.70 17.00 79.30	3.10 17.60 79.30
Isokinetic variation (%)	99.3	99.9	100.0
Particulate concentration actual (GR/ACF) standard (GR/DSCF)	.00198 .00313	.00160 .00250	.00194 .00304
Part. emission rate (LB/HR)	0.334	0.266	0.332
Part. emission factor (LB/MMBTU)	0.026	0.018	0.026

Note: Dry Catch Only

Table 2a Summary of the Results of the December 15, 1993 Particulate Emission Compliance Test on the Dryer at the Louisiana Pacific Plant Located in Dungannon, Virginia.

ITEM	Run ² 1	Run ³ 2	Run ⁴ 3
Date of test	12-15-93	12-15-93	12-15-93
Time runs were done (HRS)	1248/1352	1455/1559	1700/1803
Process rate (TONS/HR)	9.5	9.5	9.5
Volumetric flow actual (ACFM) standard (DSCFM)	50332 31374	51037 31664	50520 30466
Gas temperature (DEG-F)	194	196	197
Moisture content (%V/V)	18.85	18.87	21.08
Gas composition (%V/V, dry) carbon dioxide oxygen nitrogen	2.90 17.80 79.30	2.80 17.90 79.30	3.30 17.40 79.30
Isokinetic variation (%)	96.2	98.4	102.2
Particulate concentration actual (GR/ACF) standard (GR/DSCF)	.0191 .0306	.0310 .0500	.0388 .0643
Part. emission rate (LB/HR)	8.23	13.58	16.80

All incorrect
based on
lab sheets

Note: Dry + Method 202 Condensible Particulate Material

Table 2b Summary of the Results of the December 15, 1993 Particulate Emission Compliance Test on the Dryer at the Louisiana Pacific Plant Located in Dungannon, Virginia.

ITEM	Run 1	Run 2	Run 3
Date of test	12-15-93	12-15-93	12-15-93
Time runs were done (HRS)			
Process rate (TONS/HR)	1248/1352	1455/1559	1700/1803
	9.5	9.5	9.5
Volumetric flow actual standard (ACFM) (DSCFM)	50332 31374	51037 31664	50520 30466
Gas temperature (DEG-F)	194	196	197
Moisture content (%V/V)	18.85	18.87	21.08
Gas composition (%V/V, dry) carbon dioxide oxygen nitrogen	2.90 17.80 79.30	2.80 17.90 79.30	3.30 17.40 79.30
Isokinetic variation (%)	96.2	98.4	102.2
Particulate concentration actual (GR/ACF) standard (GR/DSCF)	.0136 .0218	.0180 .0290	.0179 .0296
Part. emission rate (LB/HR)	5.87	7.88	7.74

Note: Dry Catch Only

Table 3. Summary of the Results of the December 14, 1993 PM-10 Determinations on the Thermal Oil Heater Stack at the Louisiana Pacific Plant Located in Dunganon, Virginia.

ITEM	Run 1	Run 2	Run 3
Date of test	12-14-93	12-14-93	12-14-93
Time runs were done (HRS)	923/1042	1125/1253	1320/1450
Process rate (TONS/HR)	9.6	9.6	9.6
Volumetric flow actual (ACFM) standard (DSCFM)	19726 12453	19939 12575	20203 12751
Gas temperature (DEG-F)	283	282	282
Moisture content (%V/V)	6.67	6.80	6.71
Gas composition (%V/V, dry) carbon dioxide oxygen nitrogen	3.50 17.20 79.30	3.30 17.40 79.30	3.30 17.40 79.30
Isokinetic variation (%)	100.2	98.6	95.7
PM-10 concentration actual (GR/ACF) standard (GR/DSCF)	.00066 .00104	.00088 .00139	.00088 .00140
PM-10 emission rate (LB/HR)	0.111	0.150	0.153
PM-10 emission factor (LB/MMBTU)	0.0081	0.011	0.011

Note: Dry Catch Only

Table 4. Summary of the December 15, 1993 Oxides of Nitrogen Emission Compliance Test on the Dryer at the Louisiana Pacific Waferboard Plant in Dungannon, Virginia.

Time	Concentration (ppm,d)	Emission Rate	
		(LB/HR)	(LB/TFP)
1248-1352	39	8.8	NA
1455-1559	38	8.7	NA
1700-1803	40	8.7	NA
Avg.	39	8.7	

Table 5. Summary of the December 15, 1993 Carbon Monoxide Emission Compliance Test on the Dryer at the Louisiana Pacific Waferboard Plant in Dungannon, Virginia.

Time	Concentration (ppm,d)	Emission Rate	
		(LB/HR)	(LB/TFP)
1248-1352	117	16	NA
1455-1559	122	17	NA
1700-1803	300	40	NA
Avg.	180	24	

Table 6.

Summary of the December 15 and 16, 1993 Formaldehyde Emission Compliance Tests at the Louisiana Pacific Waferboard Plant in Dungannon, Virginia.

Time	Concentration (ppm,d)	Emission Rate	
		(LB/HR)	(LB/TFP)
(Dryer 12/15/93)			
3/1	4.9	0.74	0.078
3/2	6.5	0.98	0.10
3/3	6.3	0.85	0.090
Avg.	5.9	0.86	0.089

0.95 (see results of test)

TFP = Ton Finished Product (9.47 TON/HR 12/15/93 for dryer)

(Press 12/16/93)			
6/1	3.0	1.06	0.11
6/2	2.4	0.86	0.090
6/3	2.8	0.99	0.10
Avg.	2.7	0.97	0.10

TFP = Ton Finished Product (9.50 TON/HR 12/16/93 for press)

Table 7.

Summary of the Results of the December 15 and 16, 1993 Total Hydrocarbon Determinations on the Dryer and Press Vent at the Louisiana Pacific Waferboard Plant Located in Dungannon, Virginia.

Test/Run	Time (HRS)	Concentration (ppmC.w)	Emission Rate	
			(LB/HR)	(LB/TFP)
(Dryer 12/15/93)				
5/2	1245-1352	130.5	9.43	0.99
5/3	1510-1610	174.4	12.7	1.34
5/5	1952-2052	147.9	10.7	1.13
Average		150.9	10.9	1.15
(Press Vent 12/16/93)				
8/1	1020-1120	20.7	3.02	NA
8/2	1145-1245	18.5	2.69	NA
8/3	1330-1430	21.3	3.10	NA
Average		20.2	2.94	

TFP = Ton Finished Product (9.5 TON/HR 12/15/93 and 12/16/93)

NA = Not Applicable

Table 8. Summary of the December 16, 1993 Phenol Emission Compliance Test on the Press Vent at the Louisiana Pacific Waferboard Plant in Dungannon, Virginia.

Test/Run	Time (HRS)	Concentration (ppm,d)	Emission Rate	
			(LB/HR)	(LB/TFP)
7/1	0925-1025	< 0.59	< 0.48	< 0.051
7/2	1038-1138	< 0.59	< 0.49	< 0.052
7/3	1152-1252	< 0.59	< 0.48	< 0.051
Avg.		< 0.59	< 0.48	< 0.051

TFP = Ton Finished Product (9.5 TON/HR 2/16/93)

Table 9. Summary of the December 17, 1993 MDI Emission Compliance Test on the Press Vent at the Louisiana Pacific Waferboard Plant in Dungannon, Virginia.

Test/Run	Time (HRS)	Concentration (ppm,d)	Emission Rate	
			(LB/HR)	(LB/TFP)
(NP2)				
9/1	1135-1246	0.031	0.094	0.0098
9/2	1407-1528	0.034	0.097	0.010
9/3	1628-1738	0.050	0.15	0.016
Avg.		0.038	0.11	0.012
(1,2-PP)				
10/1	1135-1246	0.021	0.066	0.0069
10/2	1407-1528	0.025	0.077	0.0080
10/3	1628-1738	0.034	0.10	0.010
Avg.		0.027	0.081	0.0083

TFP = Ton Finished Product (9.62 TON/HR 2/17/93)

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, PM-10, oxides of nitrogen, carbon monoxide, formaldehyde, phenol 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
Thermal Oil Heater Stack

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

	Run 1	Run 2	Run 3
Date of run	12-14-93	12-14-93	12-14-93

Dry basis (orsat)

carbon dioxide.....	3.50	3.30	3.30
oxygen.....	17.20	17.40	17.40
nitrogen.....	79.30	79.30	79.30

Wet basis (orsat)

carbon dioxide.....	3.27	3.08	3.08
oxygen.....	16.05	16.22	16.23
nitrogen.....	74.01	73.91	73.98
water vapor.....	6.67	6.80	6.71
Dry molecular weight.....	29.25	29.22	29.22
Wet molecular weight.....	28.50	28.46	28.47
Specific gravity.....	0.984	0.983	0.983
Water mass flow.....(LB/HR)	2495	2573	2572

FO	1.057	1.061	1.061
----	-------	-------	-------

Test No. 2
Thermal Oil Heater Stack

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

Date of run	Run 1 12-14-93	Run 2 12-14-93	Run 3 12-14-93
-------------	-------------------	-------------------	-------------------

Dry basis (orsat)

carbon dioxide.....	3.20	3.70	3.10
oxygen.....	17.50	17.00	17.60
nitrogen.....	79.30	79.30	79.30

Wet basis (orsat)

carbon dioxide.....	3.00	3.49	2.93
oxygen.....	16.39	16.05	16.62
nitrogen.....	74.26	74.85	74.90
water vapor.....	6.36	5.61	5.55

Dry molecular weight.....	29.21	29.27	29.20
Wet molecular weight.....	28.50	28.64	28.58
Specific gravity.....	0.984	0.989	0.987
Water mass flow.....(LB/HR)	2376	2068	2103

FO	1.062	1.054	1.065
----	-------	-------	-------

Test No. 3
Dryer Stack

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

	Run 1	Run 2	Run 3
Date of run	12-15-93	12-15-93	12-15-93

Dry basis (orsat)

carbon dioxide.....	3.00	3.00	3.30
oxygen.....	17.80	17.80	17.50
nitrogen.....	79.20	79.20	79.20

Wet basis (orsat)

carbon dioxide.....	2.42	2.39	2.61
oxygen.....	14.36	14.20	13.82
nitrogen.....	63.88	63.17	62.53
water vapor.....	19.34	20.24	21.05
Dry molecular weight.....	29.19	29.19	29.23
Wet molecular weight.....	27.03	26.93	26.86
Specific gravity.....	0.934	0.930	0.928

FO	1.033	1.033	1.030
----	-------	-------	-------

Test No. 4
Dryer Stack

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

	Run 1	Run 2	Run 3
Date of run	12-15-93	12-15-93	12-15-93

Dry basis (orsat)

carbon dioxide.....	2.90	2.80	3.30
oxygen.....	17.80	17.90	17.40
nitrogen.....	79.30	79.30	79.30

Wet basis (orsat)

carbon dioxide.....	2.35	2.27	2.60
oxygen.....	14.44	14.52	13.73
nitrogen.....	64.35	64.34	62.58
water vapor.....	18.85	18.87	21.08
Dry molecular weight.....	29.18	29.16	29.22
Wet molecular weight.....	27.07	27.06	26.86
Specific gravity.....	0.935	0.935	0.928
Water mass flow.....(LB/HR)	20443	20654	22827

FO	1.069	1.071	1.061
----	-------	-------	-------

Test No. 6
Press Vent Stack

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

	Run 1	Run 2	Run 3
Date of run	12-16-93	12-16-93	12-16-93

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.....	20.51	20.45	20.37
nitrogen.....	77.60	77.38	77.06
water vapor.....	1.86	2.14	2.55
Dry molecular weight.....	28.84	28.84	28.84
Wet molecular weight.....	28.64	28.61	28.56
Specific gravity.....	0.989	0.988	0.987

Test No. 7
Press Vent Stack

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

	Run 1	Run 2	Run 3
Date of run	12-16-93	12-16-93	12-16-93

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.....	20.53	20.61	20.54
nitrogen.....	77.66	77.98	77.73
water vapor.....	1.78	1.38	1.70
Dry molecular weight.....	28.84	28.84	28.84
Wet molecular weight.....	28.65	28.69	28.66
Specific gravity.....	0.990	0.991	0.990

Test No. 9
Press Vent Stack

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

	Run 1	Run 2	Run 3
Date of run	12-17-93	12-17-93	12-17-93

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.....	20.56	20.38	20.60
nitrogen.....	77.78	77.09	77.92
water vapor.....	1.63	2.50	1.46
Dry molecular weight.....	28.84	28.84	28.84
Wet molecular weight.....	28.66	28.57	28.68
Specific gravity.....	0.990	0.987	0.991

Test No. 10
Press Vent Stack

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

	Run 1	Run 2	Run 3
Date of run	12-17-93	12-17-93	12-17-93

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.....	20.56	20.38	20.60
nitrogen.....	77.79	77.09	77.92
water vapor.....	1.62	2.51	1.46
Dry molecular weight.....	28.84	28.84	28.84
Wet molecular weight.....	28.67	28.57	28.68
Specific gravity.....	0.990	0.987	0.991

3.2 Results of Particulate Determinations

Test No. 4
Dryer Stack

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

	Run 1 12-15-93	Run 2 12-15-93	Run 3 12-15-93
Date of run			
Time run start/end.....(HRS)	1248/1352	1455/1559	1700/1803
Static pressure.....(IN.WC)	0.50	0.50	0.50
Cross sectional area (SQ.FT)	12.57	12.57	12.57
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	222.0	220.0	259.0
desiccant.....(GRAMS)	14.0	24.0	21.0
total.....(GRAMS)	236.0	244.0	280.0
Total particulate material..			
.....collected(grams)	0.0950	0.1604	0.2061
Gas meter coefficient.....	0.9949	0.9949	0.9949
Barometric pressure..(IN.HG)	28.43	28.40	28.43
Avg. orif.pres.drop..(IN.WC)	2.14	2.32	2.29
Avg. gas meter temp..(DEF-F)	66.3	73.1	71.1
Volume through gas meter....			
at meter conditions...(CF)	50.25	52.60	52.30
standard conditions.(DSCF)	47.90	49.47	49.42
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.247	.247	.247
Avg.stack gas temp ..(DEG-F)	194	196	197
Volumetric flow rate.....			
actual.....(ACFM)	50332	51037	50520
dry standard.....(DSCFM)	31374	31664	30466
Isokinetic variation.....(%)	96.2	98.4	102.2
Particulate concentration...			
actual.....(GR/ACF)	0.01907	0.03102	0.03879
dry standard.....(GR/DSCF)	0.03060	0.05003	0.06434
Particle mass rate...(LB/HR)	8.229	13.577	16.802

Test No. 2
Thermal Oil Heater Stack

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

	Run 1 12-14-93	Run 2 12-14-93	Run 3 12-14-93
Date of run			
Time run start/end.....(HRS)	924/1039	1127/1239	1320/1446
Static pressure.....(IN.WC)	-0.15	-0.15	-0.15
Cross sectional area (SQ.FT)	9.17	9.17	9.17
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	50.0	44.0	47.0
desiccant.....(GRAMS)	14.0	12.0	10.0
total.....(GRAMS)	64.0	56.0	57.0
Total particulate material..			
.....collected(grams)	0.0244	0.0198	0.0154
Gas meter coefficient.....	0.9949	0.9949	0.9949
Barometric pressure..(IN.HG)	28.48	28.48	28.48
Avg. orif.pres.drop..(IN.WC)	1.59	1.62	1.72
Avg. gas meter temp..(DEF-F)	66.4	76.5	78.8
Volume through gas meter....			
at meter conditions...(CF)	46.60	47.50	49.05
standard conditions.(DSCF)	44.43	44.44	45.70
Total sampling time....(MIN)	64.00	64.00	64.00
Nozzle diameter.....(IN)	.307	.307	.307
Avg.stack gas temp ..(DEG-F)	282	282	282
Volumetric flow rate.....			
actual.....(ACFM)	19662	19420	19922
dry standard.....(DSCFM)	12471	12407	12748
Isokinetic variation.....(%)	99.3	99.9	100.0
Particulate concentration...			
actual.....(GR/ACF)	0.00537	0.00439	0.00333
dry standard.....(GR/DSCF)	0.00847	0.00688	0.00520
Particle mass rate...(LB/HR)	0.906	0.731	0.568

3.3 Results of PM-10 Determinations

Test No. 1
Thermal Oil Heater Stack

Results of PM-10 Determinations -----

	Run 1 12-14-93	Run 2 12-14-93	Run 3 12-14-93
Date of run			
Time run start/end.....(HRS)	923/1042	1125/1253	1320/1450
Static pressure.....(IN.WC)	-0.29	-0.29	-0.29
Cross sectional area (SQ.FT)	9.17	9.17	9.17
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	40.0	38.0	36.0
desiccant.....(GRAMS)	7.0	10.0	11.0
total.....(GRAMS)	47.0	48.0	47.0
Total PM-10 material.....			
.....collected(grams)	0.0021	0.0028	0.0028
Gas meter coefficient.....	0.9991	0.9991	0.9991
Barometric pressure..(IN.HG)	28.48	28.48	28.48
Avg. orif.pres.drop..(IN.WC)	0.59	0.59	0.60
Avg. gas meter temp..(DEF-F)	58.7	69.6	74.9
Volume through gas meter....			
at meter conditions...(CF)	32.01	32.69	32.79
standard conditions.(DSCF)	31.02	31.02	30.82
Total sampling time....(MIN)	77.68	78.19	78.91
Nozzle diameter.....(IN)	.232	.232	.232
Avg.stack gas temp ..(DEG-F)	283	282	282
Volumetric flow rate.....			
actual.....(ACFM)	19726	19939	20203
dry standard.....(DSCFM)	12453	12575	12751
Isokinetic variation.....(%)	100.2	98.6	95.7
PM-10 cutpoint.....(um)	10.17	10.20	10.33
PM-10 concentration.....			
actual.....(GR/ACF)	0.00066	0.00088	0.00088
dry standard.....(GR/DSCF)	0.00104	0.00139	0.00140
PM-10 mass rate.....(LB/HR)	0.111	0.150	0.153

3.4 Results of Oxides of Nitrogen Determinations

Test No. 4
Dryer Stack

Results of Oxides of Nitrogen (NOx) Determinations-----Method 7

	Run 1A	Run 1B	Run 1C	Run 1D
Date of run.....	12-15-93	12-15-93	12-15-93	12-15-93
Time of run.....(HRS)	1300	1315	1323	1340
Flask number.....	37	38	39	40
Volume of flask.....(ML)	2054	2056	2062	2093

Data: time of sampling

flask temperature..(DEG-F)	45.00	47.00	47.00	47.00
bar. press.....(IN.HG)	28.43	28.43	28.43	28.43
flask vacuum.....(IN.HG)	26.50	26.50	26.50	26.70
flask abs. press...(IN.HG)	1.93	1.93	1.93	1.73

Data: Time of Flask Opening

flask temperature..(DEG-F)	70.00	70.00	70.00	70.00
lab. bar. press....(IN.HG)	28.93	28.93	28.93	28.93
flask static press.(IN.HG)	1.30	-1.60	0.80	-1.40
flask abs. press...(IN.HG)	30.23	27.33	29.73	27.53
Volume gas sampled....(DSML)	1904	1711	1879	1770
Moisture content.....(%V/V)	18.85	18.85	18.85	18.85
Nitrate in gas sample...(JG)	192.0	193.0	164.0	184.0
NO2 in gas sample.....(JG)	142.5	143.2	121.7	136.5

NOx Concentration

(GR/DSCF).....	0.0327	0.0366	0.0283	0.0337
(MG/DSCM).....	75	84	65	77
(PPM-DRY).....	39	44	34	40
(PPM-WET).....	32	36	27	33
NOX Emission rate....(LB/HR)	8.79	9.84	7.61	9.06

Test No. 4
Dryer Stack

Results of Oxides of Nitrogen (NOx) Determinations-----Method 7

	Run 2A	Run 2B	Run 2C	Run 2D
Date of run.....	12-15-93	12-15-93	12-15-93	12-15-93
Time of run.....(HRS)	1503	1515	1632	1640
Flask number.....	41	42	25	26
Volume of flask.....(ML)	2076	2094	2100	2035

Data: time of sampling

flask temperature..(DEG-F)	50.00	50.00	50.00	50.00
bar. press.....(IN.HG)	28.43	28.43	28.43	28.43
flask vacuum.....(IN.HG)	26.90	26.80	26.50	26.70
flask abs. press...(IN.HG)	1.53	1.63	1.93	1.73

Data: Time of Flask Opening

flask temperature..(DEG-F)	70.00	70.00	70.00	70.00
lab. bar. press....(IN.HG)	28.93	28.93	28.93	28.93
flask static press.(IN.HG)	-1.20	1.20	-1.00	0.10
flask abs. press...(IN.HG)	27.73	30.13	27.93	29.03
Volume gas sampled....(DSML)	1784	1958	1790	1822
Moisture content.....(%V/V)	18.85	18.85	18.85	18.85
Nitrate in gas sample...(JG)	181.0	182.0	175.0	186.0
NO2 in gas sample.....(JG)	134.3	135.0	129.8	138.0

NOx Concentration

(GR/DSCF).....	0.0329	0.0301	0.0317	0.0331
(MG/DSCM).....	75	69	73	76
(PPM-DRY).....	39	36	38	40
(PPM-WET).....	32	29	31	32
NOX Emission rate....(LB/HR)	8.93	8.18	8.60	8.99

Test No. 4
Dryer Stack

Results of Oxides of Nitrogen (NOx) Determinations-----Method 7

	Run 3A	Run 3B	Run 3C	Run 3D
Date of run.....	12-15-93	12-15-93	12-15-93	12-15-93
Time of run.....(HRS)	1700	1711	1729	1746
Flask number.....	27	28	29	30
Volume of flask.....(ML)	2054	2031	2068	2071

Data: time of sampling

flask temperature..(DEG-F)	49.00	49.00	49.00	49.00
bar. press.....(IN.HG)	28.43	28.43	28.43	28.43
flask vacuum.....(IN.HG)	26.70	26.70	26.70	26.70
flask abs. press...(IN.HG)	1.73	1.73	1.73	1.73

Data: Time of Flask Opening

flask temperature..(DEG-F)	70.00	70.00	70.00	70.00
lab. bar. press....(IN.HG)	28.93	28.93	28.93	28.93
flask static press.(IN.HG)	-2.10	-2.10	1.70	-0.90
flask abs. press...(IN.HG)	26.83	26.83	30.63	28.03
Volume gas sampled....(DSML)	1690	1671	1960	1786
Moisture content.....(%V/V)	21.08	21.08	21.08	21.08
Nitrate in gas sample...(JG)	174.0	183.0	188.0	182.0
NO2 in gas sample.....(JG)	129.1	135.8	139.5	135.0

NOx Concentration

(GR/DSCF).....	0.0334	0.0355	0.0311	0.0330
(MG/DSCM).....	76	81	71	76
(PPM-DRY).....	40	42	37	40
(PPM-WET).....	32	34	29	31
NOX Emission rate....(LB/HR)	8.72	9.27	8.12	8.63

3.5 Results of Carbon Monoxide Determinations

Test No. 4
Dryer Stack

Results of CO Determinations -----Method 10

	Run 1	Run 2	Run 3
Date of run	12-15-93	12-15-93	12-15-93
Time run start/end.....(HRS)	1248/1352	1455/1559	1700/1803
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	18.87	18.87	21.08
O2 Concentration.....(%V/V)	17.80	17.90	17.40
Volumetric flow rate (DSCFM)	31374	31664	30466
CO concentration.....			
(GR/DSCF).....	0.0596	0.0619	0.1527
(MG/DSCM).....	136.42	141.78	349.50
(PPM-WET).....	95.00	98.74	236.76
(PPM-DRY).....	117.10	121.70	300.00
(PPM-DRY @ 7% O2).....	512.31	549.61	1166.67
CO emission rate.....(LB/HR)	16.023	16.807	39.862

CO = Carbon monoxide

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

3.6 Results of Formaldehyde Determinations

Test No. 3
Dryer Stack

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

	Run 1 12-15-93	Run 2 12-15-93	Run 3 12-15-93
Date of run			
Time run start/end.....(HRS)	1250/1352	1455/1600	1700/1805
Static pressure.....(IN.WC)	0.50	0.50	0.50
Cross sectional area (SQ.FT)	12.57	12.57	12.57
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	242.0	258.0	269.0
desiccant.....(GRAMS)	16.0	22.0	27.0
total.....(GRAMS)	258.0	280.0	296.0
Formaldehyde in sample..(uG)	8660	11800	11600
Gas meter coefficient.....	0.9991	0.9991	0.9991
Barometric pressure..(IN.HG)	28.43	28.43	28.43
Avg. orif.pres.drop..(IN.WC)	2.56	2.75	2.75
Avg. gas meter temp..(DEF-F)	62.0	66.1	66.1
Volume through gas meter....			
at meter conditions...(CF)	52.50	54.23	54.57
standard conditions.(DSCF)	50.73	52.02	52.34
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.249	.249	.249
Avg.stack gas temp ..(DEG-F)	195	194	196
Volumetric flow rate.....			
actual.....(ACFM)	52778	53010	53065
dry standard.....(DSCFM)	32671	32484	32078
Isokinetic variation.....(%)	96.2	99.2	101.1
CH2O concentration.....			
(GR/DSCF).....	0.0027	0.0035	0.0034
(MG/DSCM).....	6.07	8.07	7.88
(PPM-DRY).....	4.86	6.46	6.32
(PPM-WET).....	3.92	5.16	4.99
CH2O emission rate...(LB/HR)	0.74226	0.98117	0.94655

Test No. 6
Press Vent Stack

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

	Run 1 12-16-93	Run 2 12-16-93	Run 3 12-16-93
Date of run			
Time run start/end.....(HRS)	958/1059	1143/1245	1329/1431
Static pressure.....(IN.WC)	-0.37	-0.37	-0.37
Cross sectional area (SQ.FT)	19.31	19.31	19.31
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	9.0	13.0	5.0
desiccant.....(GRAMS)	9.0	8.0	20.0
total.....(GRAMS)	18.0	21.0	25.0
Formaldehyde in sample..(uG)	4680	3840	4420
Gas meter coefficient.....	0.9949	0.9949	0.9949
Barometric pressure..(IN.HG)	28.68	28.68	28.68
Avg. orif.pres.drop..(IN.WC)	1.84	1.87	1.87
Avg. gas meter temp..(DEF-F)	66.4	66.6	69.5
Volume through gas meter....			
at meter conditions...(CF)	46.64	47.10	47.20
standard conditions.(DSCF)	44.81	45.23	45.08
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.187	.187	.187
Avg.stack gas temp ..(DEG-F)	81	83	83
Volumetric flow rate.....			
actual.....(ACFM)	83496	83737	83782
dry standard.....(DSCFM)	76617	76241	75977
Isokinetic variation.....(%)	98.7	100.2	100.2
CH2O concentration.....			
(GR/DSCF).....	0.0016	0.0013	0.0015
(MG/DSCM).....	3.71	3.01	3.48
(PPM-DRY).....	2.97	2.41	2.79
(PPM-WET).....	2.91	2.36	2.72
CH2O emission rate...(LB/HR)	1.06296	0.85974	0.98951

3.7 Results of Phenol Determinations

Test No. 7
Press Vent Stack

Results of Phenol Determinations -----

	Run 1	Run 2	Run 3
Date of run	12-16-93	12-16-93	12-16-93
Time run start/end.....(HRS)	0925/1025	1038/1138	1152/1252
Barometric pressure...(IN.HG)	28.68	28.68	28.68
Meter temperature....(DEG-F)	59.87	73.45	75.37
Meter correction coefficient	0.9991	0.9991	0.9991
Volume through gas meter....			
at meter conditions...(CF)	45.170	45.040	45.990
standard conditions (DSCF)	44.149	42.902	43.649
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	1.86	2.14	2.55
Volumetric flow rate (DSCFM)	76617	76241	75977
Phenol in sample.....(MG)	2<	2<	2<
Phenol concentration.....			
(GR/DSCF).....	0.001<	0.001<	0.001<
(MG/DSCM).....	2<	2<	2<
(PPM-DRY).....	0.59<	0.59<	0.59<
(PPM-WET).....	0.58<	0.58<	0.58<
Phenol emission rate.(LB/HR)	0.48<	0.49<	0.48<

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

Analysis performed according to NIOSH Method 3502

3.8 Results of MDI Determinations

Test No. 9
Press Vent Stack

Results of MDI Determinations (NP2 Method)

	Run 1 12-17-93	Run 2 12-17-93	Run 3 12-17-93
Date of run			
Time run start/end.....(HRS)	1135/1246	1407/1528	1628/1738
Static pressure.....(IN.WC)	-0.37	-0.37	-0.37
Cross sectional area (SQ.FT)	19.31	19.31	19.31
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	0.0	0.0	0.0
desiccant.....(GRAMS)	16.0	24.0	14.0
total.....(GRAMS)	16.0	24.0	14.0
MDI in sample(UG)	420	438	658
Gas meter coefficient.....	0.9949	0.9949	0.9949
Barometric pressure..(IN.HG)	28.88	28.68	28.68
Avg. orif.pres.drop..(IN.WC)	1.84	1.77	1.82
Avg. gas meter temp..(DEF-F)	56.1	62.5	67.1
Volume through gas meter....			
at meter conditions...(CF)	46.23	45.62	46.50
standard conditions.(DSCF)	45.61	44.15	44.61
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.187	.187	.187
Avg.stack gas temp ..(DEG-F)	85	88	85
Volumetric flow rate.....			
actual.....(ACFM)	84163	82428	83094
dry standard.....(DSCFM)	77421	74166	75922
Isokinetic variation.....(%)	99.5	100.5	99.2
MDI concentration.....			
(PPMD)	0.031	0.034	0.050
(MG/NM3)	0.33	0.35	0.52
MDI emission rate.....(LB/HR)	0.094	0.097	0.15

Test No. 10
Press Vent Stack

Results of MDI Determinations (1,2-PP)

	Run 1 12-17-93	Run 2 12-17-93	Run 3 12-17-93
Date of run			
Time run start/end.....(HRS)	1135/1246	1407/1528	1625/1738
Static pressure.....(IN.WC)	-0.37	-0.37	-0.37
Cross sectional area (SQ.FT)	19.31	19.31	19.31
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	14.0	22.0	12.5
desiccant.....(GRAMS)	0.0	0.0	0.0
total.....(GRAMS)	14.0	22.0	12.5
MDI in sample.....(UG)	252	298	394
Gas meter coefficient.....	0.9991	0.9991	0.9991
Barometric pressure..(IN.HG)	28.88	28.88	28.88
Avg. orif.pres.drop..(IN.WC)	1.56	1.58	1.57
Avg. gas meter temp..(DEF-F)	61.7	70.9	72.7
Volume through gas meter....			
at meter conditions...(CF)	41.05	41.92	41.58
standard conditions.(DSCF)	40.21	40.35	39.89
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.173	.173	.173
Avg.stack gas temp ..(DEG-F)	85	88	86
Volumetric flow rate.....			
actual.....(ACFM)	86142	86597	85487
dry standard.....(DSCFM)	79251	78420	78619
Isokinetic variation.....(%)	100.1	101.5	100.1
MDI concentration.....			
(PPM)	0.021	0.025	0.034
(MG/NM3)	0.22	0.26	0.35
MDI emission rate.....(LB/HR)	0.066	0.077	0.10

4 RESULTS OF FUEL ANALYSES

INTERPOLL LABORATORIES, INC.

Fuel Laboratory

(612) 786-6020

1/5/94

Client : LOUISIANA-PACIFIC/DUNGANNON

Laboratory Log Number : 1906-15-5983

Source: THERMAL OIL HEATER

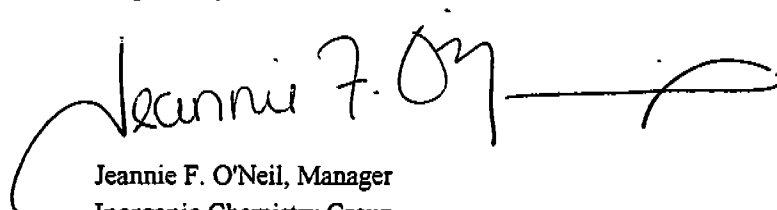
Sample Identification : BARK; TEST 2; RUNS 1,2,3; 12/14/93

3-1906

Short Proximate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			39.86
Ash		7.66	4.61
Sulfur	0.22	0.20	0.12
Heating Value, BTU/LB.	9534	8803	5294

Respectfully submitted,



Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

INTERPOLL LABORATORIES, INC.

Fuel Laboratory
(612) 786-6020

1/5/94

Client :

LOUISIANA-PACIFIC/DUNGANNON

Laboratory Log Number :

1906-71-5984

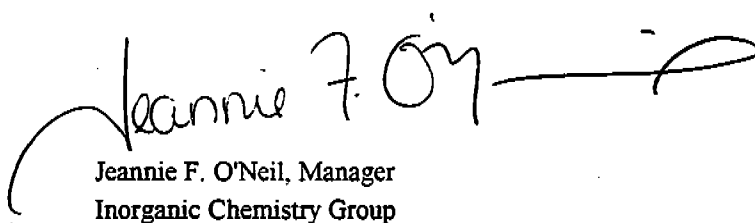
Sample Identification :

WOOD (DRY FUEL FOR McCONNEL BURNER)

Short Proximate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			2.80
Ash		1.92	1.87
Sulfur	0.20	0.20	0.19
Heating Value, BTU/LB.	8562	8397	8163

Respectfully submitted,


Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

APPENDIX A

RESULTS OF VOLUMETRIC FLOW RATE DETERMINATIONS

Test No. 1
Thermal Oil Heater Stack

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

Date of Determination.....	12-14-93
Time of Determination.....(HRS)	800
Barometric pressure.....(IN.HG)	28.48
Pitot tube coefficient.....	.84
Number of sampling ports.....	2
Total number of points.....	12
Shape of duct.....	Round
Stack diameter.....(IN)	41
Duct area.....(SQ.FT)	9.17
Direction of flow.....	UP
Static pressure.....(IN.WC)	-.29
Avg. gas temp.....(DEG-F)	280
Moisture content.....(% V/V)	6.67
Avg. linear velocity.....(FT/SEC)	44.7
Gas density.....(LB/ACF)	.05023
Molecular weight.....(LB/LBMOLE)	29.25
Mass flow of gas.....(LB/HR)	74043
Volumetric flow rate.....	
actual.....(ACFM)	24570
dry standard.....(DSCFM)	15563

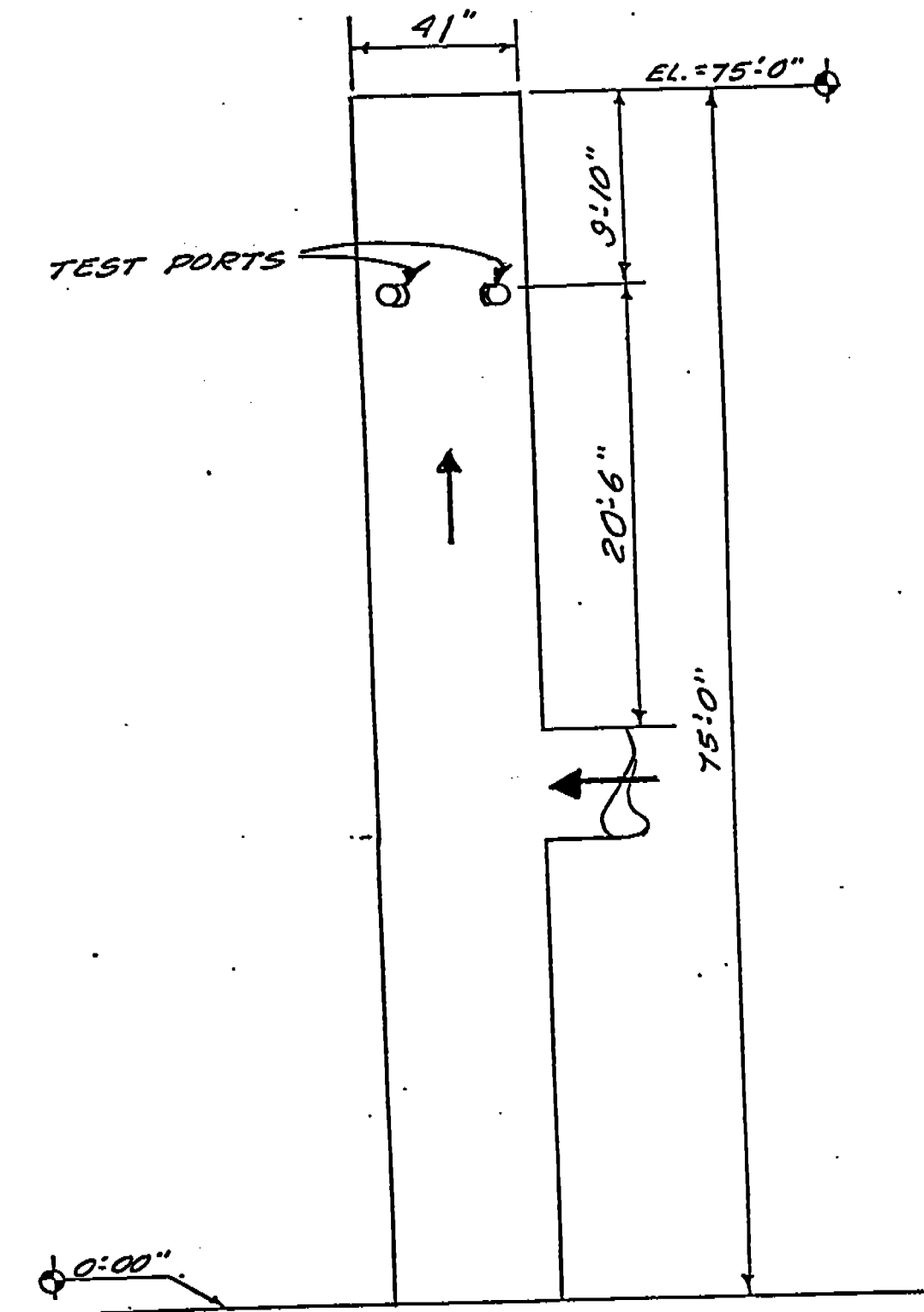
Test No. 3
Dryer Stack

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

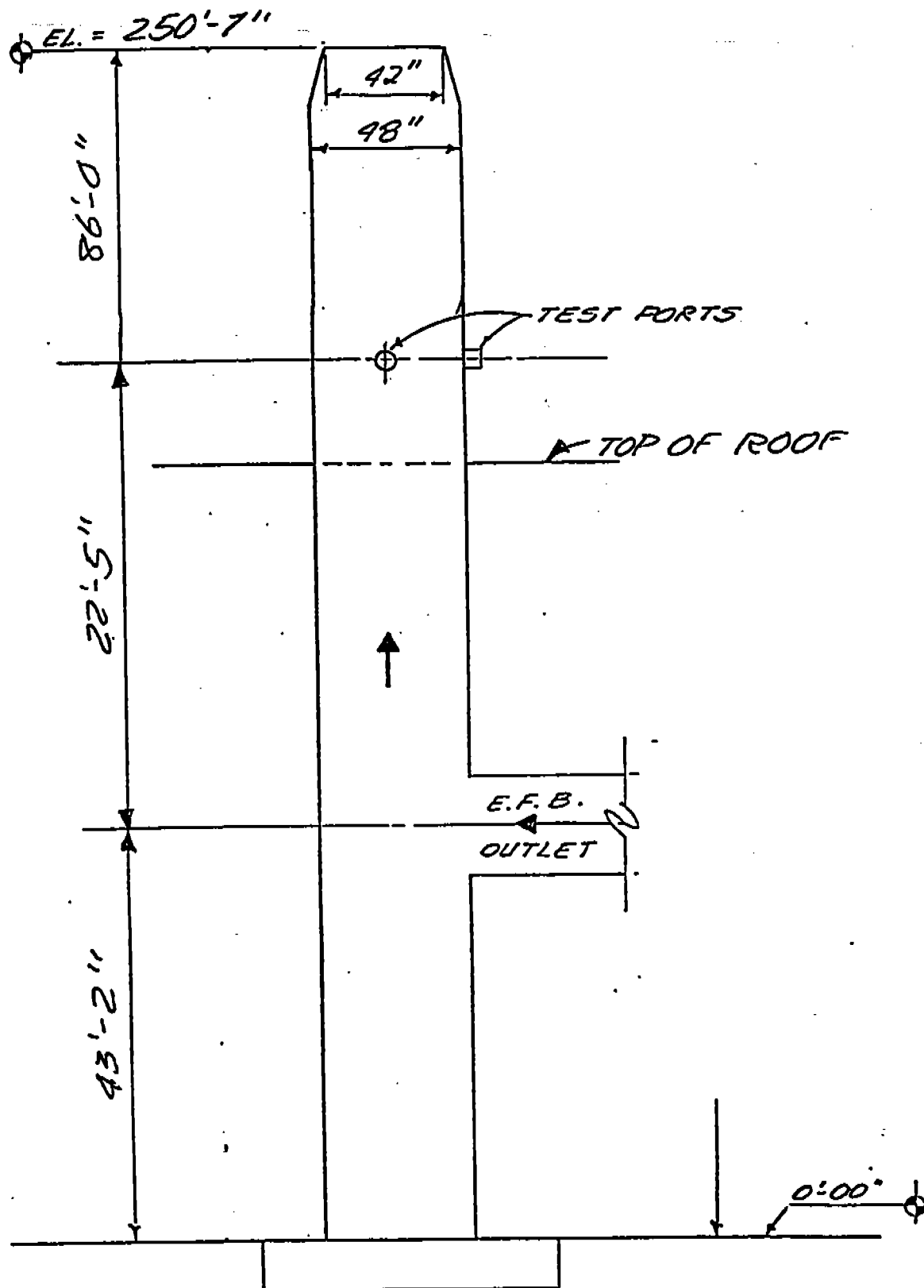
Date of Determination.....	12-15-93
Time of Determination.....(HRS)	850
Barometric pressure.....(IN.HG)	28.43
Pitot tube coefficient.....	.84
Number of sampling ports.....	2
Total number of points.....	24
Shape of duct.....	Round
Stack diameter.....(IN)	48
Duct area.....(SQ.FT)	12.57
Direction of flow.....	UP
Static pressure.....(IN.WC)	.5
Avg. gas temp.....(DEG-F)	193
Moisture content.....(% V/V)	19.34
Avg. linear velocity.....(FT/SEC)	69.3
Gas density.....(LB/ACF)	.05399
Molecular weight.....(LB/LBMOLE)	29.19
Mass flow of gas.....(LB/HR)	169267
Volumetric flow rate.....	
actual.....(ACFM)	52248
dry standard.....(DSCFM)	32420

APPENDIX B

LOCATION OF TEST PORTS

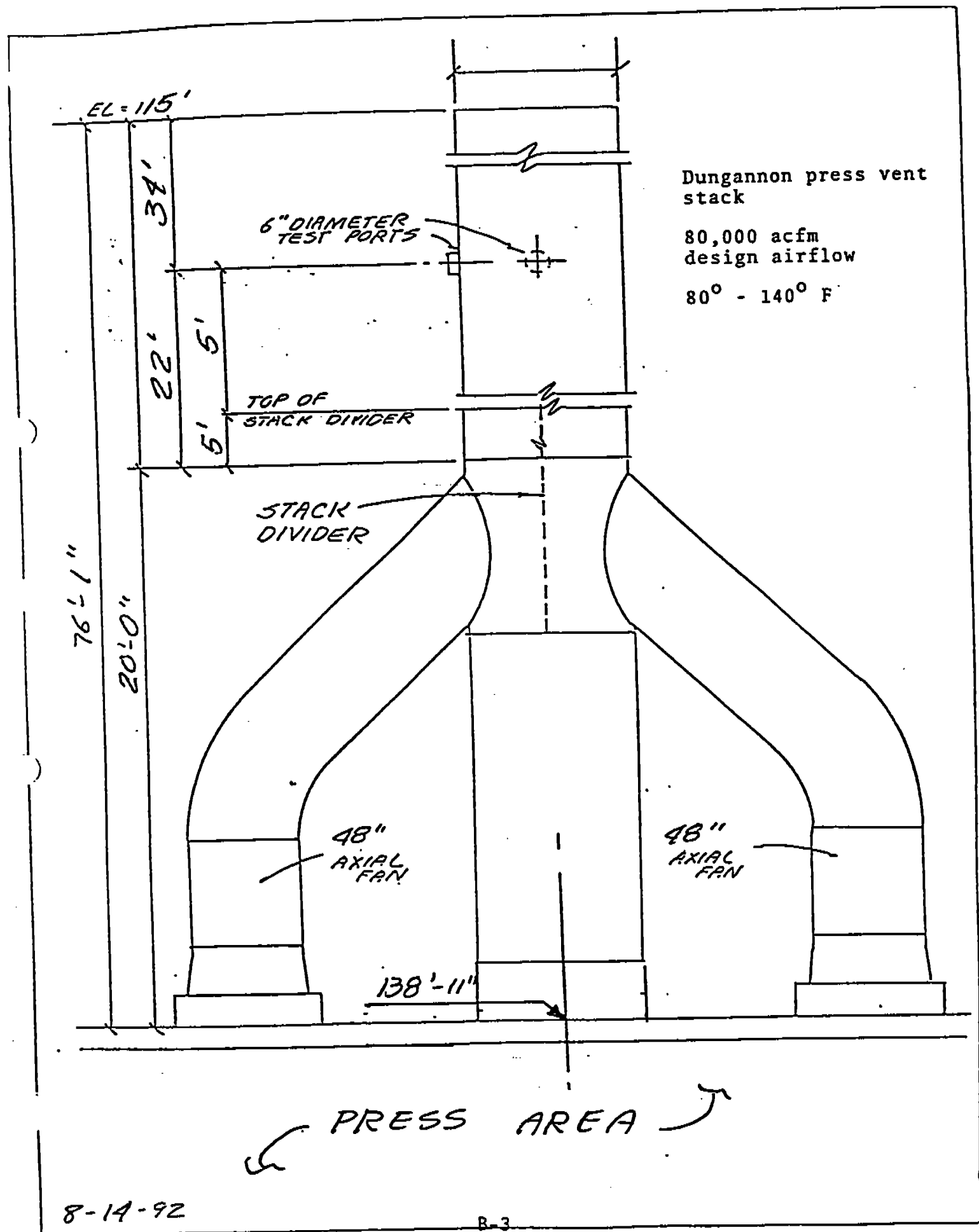


DUNGANNON
THERMAL OIL HEATER STACK
32,600 ACFM
250° - 350° f



DUNGANNON
 DRYER STACK
 DESIGN AIRFLOW 50,000 ACFM
 210° - 270° F

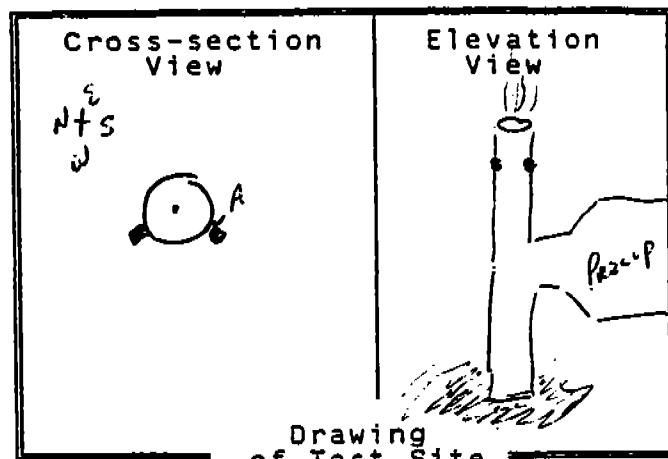
N.T.S.



APPENDIX C

KONUS FIELD DATA SHEETS

Job LOUISIANA PACIFIC CORP., DUNSMUNTON
Source THERMAL OIL HEATER - STACK
Test 1 Run 0 Date 12/14/93
Stack dimen. 41" IN.
Dry bulb °F Wet bulb °F
Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
Barometric pressure 28.45 in Hg
Static pressure - .29 in WC
Operators D. BRENNAN + DUANE VAN HORN
Pitot No. PM-10-5 Cp 34



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:				8 in.	Time start: 07 ⁰⁰ hrs
A	1	.044	1.80	9.80	.33 280
	2	.146	5.99	13.99	.42 280
	3	.296	12.14	20.14	.43 280
	4	.704	28.56	36.86	.45 280
	5	.854	35.01	43.01	.44 280
	6	.956	39.20	47.20	.43 280
B	1				.40 280
	2				.42 280
	3				.43 280
	4				.41 280
	5				.43 280
	6				.42 280
				FI/sec - 44.64	
				EIcfm - 24561	
				Oscfm - 15643	
Temp. meas. device & S/N: PT-23				Time end: 08 ¹⁵ hrs	

R or nothing = reg. manometer; S= expanded; E=electronic C-1 S-3921

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LP/DUNBARRON Date 12/14/83 Test 1 Run 1
 Source THERMAL OIL HEATER - STACK No. of traverse points 102
 Method PM-10 Filter holder: STAINLESS Filter type: 2.5" G.F.
STEEL

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: 0.00 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 1 Recovery solvent(s) acetone PM-10 Probe
6150 ☒ other(s) _____
 No. of probe wash bottles: 1
 Sample recovered by: D. BRENNAN

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	40	0	40.0
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1419	1412	7.0
Total			47.0

Integrated Gas Sampling Data:

Bag Pump No. 23B Box No. 14 Bag No. 1
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 15 in. Hg.
 Time start: 0923 (HRS) Time end: 1042 (HRS)
 Sampling rate: 400 cc/min Operator: D. BRENNAN
 S/N of O₂ Analyzer used to monitor train outlet: _____

CF-023

201A
INTERPOL LABORATORIES EPA METHOD ~~5417~~ SAMPLE LOG SHEET

Job LP/DUNHARMON Date 12/14/93 Test 1 Run 2
 Source THERMAL OIL HEATER - STACK No. of traverse points 12
 Method PM-10 Filter holder: STAINLESS Filter type: 2.5" 6.F.
STEEL

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: -0.00 cfm at 2 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 1 Recovery solvent(s) acetone PM-10 Pross
615L ☒ other(s) _____
 No. of probe wash bottles: 1
 Sample recovered by: D. BRENNAN

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1	238	200	38.0
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1440	1430	10.0
Total			48.0

Integrated Gas Sampling Data:

Bag Pump No. 238 Box No. 12 Bag No. 2
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 15 in. Hg.
 Time start: 1115 (HRS) Time end: 1253 (HRS)
 Sampling rate: 400 cc/min Operator: D. BRENNAN
 S/N of O₂ Analyzer used to monitor train outlet: _____

CF-023

FILED JAN 21 1961

Pital No. <u>PM-10-5</u> CP-8 Bar. Press. <u>17.45</u> 11114 1120 1.5X Nozzle No. <u>PM-10</u> Nozzle Dia. <u>13.14</u>

[illegible]

INTERPOL

Traverse Point No.	Sounding Time (min)	Supply Volume (cu)	Velocity Head (ft)	Drifted Meter (ft)	Obs. Vel. (ft)	VAC. in Hg	Temperature (°F)				Obs. in	Obs. out	Oxygen (xv/v)
							Block	Probe	Down	Temp.			
A-6	11.5	456.000	.28	.58	6.53	3.0	28.1	235	11	36	61	60	18.1
B-6	6.53	458.70	.275	.58	6.48	3.0	28.3	239	stack	36	61	61	17.8
C-6	13.01	461.38	.275	.58	6.48	3.0	28.1	240	face	37	67	63	18.0
D-6	19.49	464.09	.295	.59	6.71	3.0	28.2	244	no area	37	70	64	17.5
E-6	26.21	466.90	.30	.59	6.76	3.0	28.2	242	near	37	72	65	17.3
F-6	32.97	469.71	.28	.59	6.53	3.0	28.0	240	near	38	73	66	17.4
G-6	39.51	472.443	.28	.59	6.53	3.0	28.3	241		38	72	67	17.9
H-6	46.05	475.15	.285	.59	6.59	3.0	28.2	246		38	74	68	17.5
I-6	52.65	477.89	.27	.59	6.42	3.0	28.3	244		39	77	70	17.2
J-6	59.07	480.61	.30	.60	6.76	3.0	28.5	245		40	79	72	17.4
K-6	65.84	483.49	.27	.60	6.42	3.0	28.1	248		41	80	73	17.6
L-6	72.26	486.21	.23	.60	5.92	3.0	28.0	250		43	80	73	17.5
M-6	78.19	488.685											
N-6	12.53												
O-6													
P-6													
Q-6													
R-6													
S-6													
T-6													
U-6													
V-6													
W-6													
X-6													
Y-6													
Z-6													
A-7													
B-7													
C-7													
D-7													
E-7													
F-7													
G-7													
H-7													
I-7													
J-7													
K-7													
L-7													
M-7													
N-7													
O-7													
P-7													
Q-7													
R-7													
S-7													
T-7													
U-7													
V-7													
W-7													
X-7													
Y-7													
Z-7													
Avg. = 67.6													8000000
V = 32.685													8000000
12.53													8000000
28.19													8000000
S-0037R													8000000

201 P
INTERPOLL LABORATORIES EPA METHOD ~~504~~ SAMPLE LOG SHEET

Job L P DUNN GANNON Date 12/14/93 Test 1 Run 3
Source THERMAL OIL HEATER - STACK No. of traverse points 12
Method PM-10 Filter holder: STAINLESS Filter type: 2.5" 6.F.
STEEL

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac)
Posttest: .000 cfm at 7 in. Hg. (vac)

Particulate Catch Data:

No.s of filters used: 1 Recovery solvent(s) acetone PM-10 PROBE
61SB ☒ other(s) _____
No. of probe wash bottles: 1
Sample recovered by: D. BRENNAN

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	236	200	36
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1430	1419	11
Total			47

Integrated Gas Sampling Data:

Bag Pump No. 23B Box No. 12 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0 cc/min at 15 in. Hg.
Time start: 1320 (HRS) Time end: 1450 (HRS)
Sampling rate: 400 cc/min Operator: Duke Brennan
S/N of O₂ Analyzer used to monitor train outlet: _____

CF-023

4161
4162
4163
4164
4165
4166
4167
4168
4169
4170
4171
4172
4173
4174
4175
4176
4177
4178
4179
4180
4181
4182
4183
4184
4185
4186
4187
4188
4189
4190
4191
4192
4193
4194
4195
4196
4197
4198
4199
4200
4201
4202
4203
4204
4205
4206
4207
4208
4209
4210
4211
4212
4213
4214
4215
4216
4217
4218
4219
4220
4221
4222
4223
4224
4225
4226
4227
4228
4229
4230
4231
4232
4233
4234
4235
4236
4237
4238
4239
4240
4241
4242
4243
4244
4245
4246
4247
4248
4249
4250
4251
4252
4253
4254
4255
4256
4257
4258
4259
4260
4261
4262
4263
4264
4265
4266
4267
4268
4269
4270
4271
4272
4273
4274
4275
4276
4277
4278
4279
4280
4281
4282
4283
4284
4285
4286
4287
4288
4289
4290
4291
4292
4293
4294
4295
4296
4297
4298
4299
4300
4301
4302
4303
4304
4305
4306
4307
4308
4309
4310
4311
4312
4313
4314
4315
4316
4317
4318
4319
4320
4321
4322
4323
4324
4325
4326
4327
4328
4329
4330
4331
4332
4333
4334
4335
4336
4337
4338
4339
4340
4341
4342
4343
4344
4345
4346
4347
4348
4349
4350
4351
4352
4353
4354
4355
4356
4357
4358
4359
4360
4361
4362
4363
4364
4365
4366
4367
4368
4369
4370
4371
4372
4373
4374
4375
4376
4377
4378
4379
4380
4381
4382
4383
4384
4385
4386
4387
4388
4389
4390
4391
4392
4393
4394
4395
4396
4397
4398
4399
4400
4401
4402
4403
4404
4405
4406
4407
4408
4409
4410
4411
4412
4413
4414
4415
4416
4417
4418
4419
4420
4421
4422
4423
4424
4425
4426
4427
4428
4429
4430
4431
4432
4433
4434
4435
4436
4437
4438
4439
4440
4441
4442
4443
4444
4445
4446
4447
4448
4449
4450
4451
4452
4453
4454
4455
4456
4457
4458
4459
4460
4461
4462
4463
4464
4465
4466
4467
4468
4469
4470
4471
4472
4473
4474
4475
4476
4477
4478
4479
4480
4481
4482
4483
4484
4485
4486
4487
4488
4489
4490
4491
4492
4493
4494
4495
4496
4497
4498
4499
4500
4501
4502
4503
4504
4505
4506
4507
4508
4509
4510
4511
4512
4513
4514
4515
4516
4517
4518
4519
4520
4521
4522
4523
4524
4525
4526
4527
4528
4529
4530
4531
4532
4533
4534
4535
4536
4537
4538
4539
4540
4541
4542
4543
4544
4545
4546
4547
4548
4549
4550
4551
4552
4553
4554
4555
4556
4557
4558
4559
4560
4561
4562
4563
4564
4565
4566
4567
4568
4569
4570
4571
4572
4573
4574
4575
4576
4577
4578
4579
4580
4581
4582
4583
4584
4585
4586
4587
4588
4589
4590
4591
4592
4593
4594
4595
4596
4597
4598
4599
4600
4601
4602
4603
4604
4605
4606
4607
4608
4609
4610
4611
4612
4613
4614
4615
4616
4617
4618
4619
4620
4621
4622
4623
4624
4625
4626
4627
4628
4629
4630
4631
4632
4633
4634
4635
4636
4637
4638
4639
4640
4641
4642
4643
4644
4645
4646
4647
4648
4649
4650
4651
4652
4653
4654
4655
4656
4657
4658
4659
4660
4661
4662
4663
4664
4665
4666
4667
4668
4669
4670
4671
4672
4673
4674
4675
4676
4677
4678
4679
4680
4681
4682
4683
4684
4685
4686
4687
4688
4689
4690
4691
4692
4693
4694
4695
4696
4697
4698
4699
4700
4701
4702
4703
4704
4705
4706
4707
4708
4709
4710
4711
4712
4713
4714
4715
4716
4717
4718
4719
4720
4721
4722
4723
4724
4725
4726
4727
4728
4729
4730
4731
4732
4733
4734
4735
4736
4737
4738
4739
4740
4741
4742
4743
4744
4745
4746
4747
4748
4749
4750
4751
4752
4753
4754
4755
4756
4757
4758
4759
4760
4761
4762
4763
4764
4765
4766
4767
4768
4769
4770
4771
4772
4773
4774
4775
4776
4777
4778
4779
4780
4781
4782
4783
4784
4785
4786
4787
4788
4789
4790
4791
4792
4793
4794
4795
4796
4797
4798
4799
4800
4801
4802
4803
4804
4805
4806
4807
4808
4809
4810
4811
4812
4813
4814
4815
4816
4817
4818
4819
4820
4821
4822
4823
4824
4825
4826
4827
4828
4829
4830
4831
4832
4833
4834
4835
4836
4837
4838
4839
4840
4841
4842
48

[illegible]

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job LOUISIANA PACIFIC CORP, DUNSMUN
Source THERMAL OIL HEATER-STACK
Test 2 Run 1 Date 12-14-93
Stack dimen. 41 IN.
Dry bulb 260 °F Wet bulb 125 °F
Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
Barometric pressure 28.45 in Hg
Static pressure - .3715 in WC
Operators E. TROWBRIDGE
Pitot No. 24V-4 Cp .840

Elevation
View

Drawing
of Test Site

PM

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:	8 in.	Time start: 6:55 hrs	
A	1	.032	1.31	9.31	.27 .58
	2	.105	4.31	12.31	.29 .41
	3	.194	7.95	15.95	.24 .42
	4	.323	13.24	21.24	.29 .43
	5	.677	27.16	35.76	.29 .45 280
	6	.806	33.05	41.05	.27 .44
	7	.895	36.70	44.70	.27 .43
	8	.968	39.69	47.69	.26 .44
B	1				.39
	2				.40
	3				.41
	4				.40 280
	5				.41
	6				.42
	7				.42
	8				.40
		Ft/Lb 4087			
		Actm 24512			
		S-FPM 15309			
Temp. meas. device & S/N: PDT-12				Time end: 7:16 hrs	

R or nothing = reg. manometer; S= expanded; E=electronic C-8 S-3921

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LP/DUNHAM Date 12-14-93 Test 2 Run 1
 Source THERMAL OIL HEATER - STALK No. of traverse points 10
 Method 5 Filter holder: 4" GLASS Filter type: 4" GLASS FIBER

Sample Train Leak Checks:

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

Particulate Catch Data:

No. of filters used: 4131 Recovery solvent(s) acetone
☒ other(s) ET
 No. of probe wash bottles: 1
 Sample recovered by: ET

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		<u>100</u>	
Impinger No. 2	<u>250</u>	<u>100</u>	<u>50</u>
Impinger No. 3		<u>0</u>	
Condenser			
Desiccant	<u>1449</u>	<u>1435</u>	<u>14</u>
Total			<u>64</u>

Integrated Gas Sampling Data:

Bag Pump No. 246 Box No. 23 Bag No. 1
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 15 in. Hg.
 Time start: 1425 (HRS) Time end: 1038 (HRS)
 Sampling rate: 400 cc/min Operator: ET
 S/N of O₂ Analyzer used to monitor train outlet: 12

CF-023

[illegible][illegible]

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. DUNN GANNON Date 12-14-93 Test 2 Run 2
 Source THERMAL OIL HEATER - STACK No. of traverse points 16
 Method 5 Filter holder: 4" GLASS Filter type: 4" GLASS FIBER

Sample Train Leak Check:

Pretest: 0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: 101 cfm at 8 in. Hg. (vac) ☒

Particulate Catch Data:

No. of filters used: 6132 Recovery solvent(s) acetone
☒ other(s) _____
 No. of probe wash bottles: 1
 Sample recovered by: ET

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		<u>100</u>	
Impinger No. 2	<u>244</u>	<u>100</u>	<u>44</u>
Impinger No. 3		<u>0</u>	
Condenser			
Desiccant	<u>1293</u>	<u>1281</u>	<u>12</u>
Total			<u>56</u>

Integrated Gas Sampling Data:

Bag Pump No. 246 Box No. 23 Bag No. 2
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 15 in. Hg.
 Time start: 1128 (HRS) Time end: 1238 (HRS)
 Sampling rate: 400 cc/min Operator: ET
 S/N of O₂ Analyzer used to monitor train outlet: 12

CF-023

LP DUNBARREN
THIRDMAL DIE HEATER - STACK
RDH 8

141400303
X09 1414H
301734D

673631-1
11-5-57
47-214

Pat. P.
Bar. P.
No. 1, 2

CP 184
1044-1120
217 DIB 2

[illegible]

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LP/DUNBAR Date 12-14-93 Test 2 Run 3
 Source THERMAL OIL HEATER - STACK No. of traverse points 16
 Method 5 Filter holder: 4" GLASS Filter type: 4" GLASS FIBER

Sample Train Leak Check:

Pretest: { 0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: { 0 cfm at 8 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 4121 Recovery solvent(s) acetone
☒ acetone
☐ other(s) _____
 No. of probe wash bottles: 1
 Sample recovered by: ET

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1		<u>100</u>	
Impinger No. 2	<u>247</u>	<u>100</u>	<u>147</u>
Impinger No. 3		<u>0</u>	
Condenser			
Desiccant	<u>1459</u>	<u>1449</u>	<u>10</u>
Total			<u>57</u>

Integrated Gas Sampling Data:

Bag Pump No. 248 Box No. 23 Bag No. 3
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 15 in. Hg.
 Time start: 1321 (HRS) Time end: 1445 (HRS)
 Sampling rate: 400 cc/min Operator: ET
 S/N of O₂ Analyzer used to monitor train outlet: 12

CF-023

LP Pungannon
THIRMA L DZ HEATER - STACK
12-14-83 181 82 NOV 3

Operators
Meter Box No. ET-DVH
Computer coil. 5-111-1.7
1995p

2001-01-25

Pitt
Bur.
Hoxle

$$\begin{array}{r} 11-5-7 \\ 85.92 \\ \hline 26.48 \\ 12-11-12 \end{array}$$

CP 10H9 111020
111020 111020
111020 111020

[illegible]

APPENDIX D

PRESS VENT FIELD DATA SHEETS

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job 1/DUNBARNEW
 Source ROSS VENT STACK
 Test 6 Run Date 12-16-93
 Stack dimen. 59.5 IN.
 Dry bulb °F Wet bulb °F
 Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
 Barometric pressure 29.68 in Hg
 Static pressure -1.37 in WC
 Operators E. THORNTON - E. BLUMEN
 Pitot No 24V-6 C_p 1.840

Cross-section View	Elevation View
Drawing of Test Site	

FORMALDEHYDE

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>6.25</u> in.		Time start: <u>0430</u> hrs	
A	1	.1021	1.25	7.5	1.30
	2	.067	3.99	10.24	1.80
	3	.118	7.82	13.27	1.70
	4	.177	10.53	16.78	1.70
	5	.260	14.88	21.13	1.50
	6	.356	21.18	27.43	1.40
	7	.444	38.31	44.56	1.30
	8	.750	44.62	50.87	1.40
	9	.823	48.96	55.22	1.45
	10	.982	52.47	58.73	1.50
	11	.933	55.51	61.76	1.40
	12	.979	58.25	64.50	1.35
B	1				1.40
	2				1.50
	3				1.50
	4				1.40
	5				1.40
	6				1.40
	7				1.40
	8				1.50
	9				1.65
	10				1.90
	11				2.00
	12				2.10
Temp. meas. device & S/N: <u>PIT-12</u>				Time end: <u>0945</u> hrs	

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LP/DUNNANIN
 Source Press VENT STACK
 Method 50011 Filter holder:

Date 12-16-93 Test 4 Run 1
 No. of traverse points 24
 Filter type:

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)

No. of probe wash bottles:
 Sample recovered by:

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1		<u>1100</u>	
Impinger No. 2	<u>209</u>	<u>1100</u>	<u>9</u>
Impinger No. 3		<u>0</u>	
Condenser			
Desiccant	<u>1219</u>	<u>1210</u>	<u>9</u>
Total			<u>18</u>

Integrated Gas Sampling Data:

Bag Pump No. Box No. N/A 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

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LP1 DUNBANNON Date 12-16-93 Test 6 Run 2
 Source PRESS VENT STACK No. of traverse points 24
 Method SOOH Filter holder: Filter type:

Sample Train Leak Check:

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

Particulate Catch Data:

No.s of filters used: Recovery solvent(s)
 ☐ acetone
 ☒ other(s) MCCG
 No. of probe wash bottles: 2
 Sample recovered by: DVH

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		(100)	
Impinger No. 2	213	{ 100 }	13
Impinger No. 3		{ 0 }	
Condenser			
Desiccant	1460	1452	8
Total			21

Integrated Gas Sampling Data:

Bag Pump No. Box No. N/A 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

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LP/DUNBAR/NON
 Source Pine Point Stack
 Method 8-0011 Filter holder:

Date 12-16-83 Test 6 Run 3
 No. of traverse points 243
 Filter type:

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) MCL 2
 No. of probe wash bottles: 2
 Sample recovered by: DVT

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		{ 100 }	
Impinger No. 2	205	{ 100 }	5
Impinger No. 3		{ 0 }	
Condenser			
Desiccant	1340	1320	20
Total			25

Integrated Gas Sampling Data:

Bag Pump No. Box No. NA 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 PA METHOD 5 FIELD DATA SHEET

Job LP/PAWING TUNNEL
 Source ROSS 11007 STARK
 Date 12-16-93 6 Mon 3

Operator ET-DAB
 Water Box No. 5
 Gasometer Count. 9999

Pilot No. 244-6 CP
 Bur. Press. 25.22 inHg H₂O
 Nozzle No. 1-3 Nozzle Dia. 1.52 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cu)	Velocity Head (inHg)	Drifts Meter (inHg)	Dis. Vol. (cu)	VAC. inHg	Temperature (°F)					Oxygen (xv/v)
							Stack	Probe	Duct	Leaky	Gas Lin	Gas/Duct
8	132.9	483.70	1.80	2.19	5.82	8.0	82	248	245	420	63	61
12	2.5	485.83		2.53	8.10	10.0	83				66	61
11	5	498.02	2.10	2.17	1.21	9.0	84	232	242	40	68	61
10	7.5	490.21	1.80	1.93	3.20	8.0	85				69	61
9	10	492.20	1.60	1.76	4.10	7.2	83	240	245	110	71	61
8	12.5	494.12	1.45	1.69	5.97	7.0	85				73	61
7	15	496.00	1.40	1.71	7.85	7.0	82	242	244	17	75	61
6	17.5	497.86	1.40	1.77	9.77	7.2	82				76	62
5	20	499.80	1.45	1.71	1.66	7.0	83	245	248	46	77	62
4	22.5	501.66	1.40	1.71	3.61	7.5	82				78	63
3	25	503.00	1.50	1.84	5.57	7.5	82	247	250	46	78	63
2	27.5	505.59	1.50	1.84	7.46	7.1	80				78	63
1	30	507.47	1.40	1.59	9.24	7.0	83	248	251	44	78	63
12	32.5	509.30	1.30	1.84	1.24	7.2	82				78	64
11	35	511.24	1.50	1.83	3.20	7.2	86	245	249	44	79	64
10	37.5	513.21	1.50	1.71	5.09	7.0	85				79	64
9	40	515.10	1.40	1.59	6.91	7.0	86	247	250	44	79	64
8	42.5	516.95	1.30	1.59	8.73	7.0	87				79	65
7	45	518.80	1.30	1.59	10.62	7.0	83	245	251	45	80	65
6	47.5	520.63	1.40	1.71	2.58	7.1	82				80	65
5	50	522.55	1.50	1.97	4.61	7.5	82	247	250	45	80	65
4	52.5	524.60	1.60	2.21	6.76	9.0	85				80	65
3	55	526.80	1.80	2.20	8.90	9.0	85	250	249	46	80	66
2	57.5	528.87	1.80	1.97	1.94	8.0	81				80	66
1	60	530.90	1.60									
	143.1											
		Y = 47.20		11.87							Av. 29.5	

INTERFOLL LABORATORIES
EPA Method 4 and 6 Field Data Sheet

Job L.P. ID. 11461100 Operator(s) D. Law Hoover
Source PRESS VENT STACK Meter Box No. 6 Gas meter coef. 8881
Date 12/16/93 Test 7 Run 1 Δ Hg 1.93 in.WC Bar. press 28.68 in.Hg

PHENOL

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. ☒
Posttest: 0 cfm at 8 in. Hg. ☒

Trav. Point No.	Samp. Time (min)	Sample Volume (cf)	Orif. Meter (inWC)	VAC. inHg	Temperatures (°F)					Oxygen (%v/v)
					Probe	Oven	Impg.	Gas/In	Gas/Out	
	0925	723.40								
3	5	727.06	1.90	7	246	239	40	50	49	AMBIENT
3	10	730.77	1.90	7				53	50	AIR
3	15	734.56	1.90	7	242	243	41	57	52	
3	20	738.33	1.90	7				60	53	
2	25	742.14	1.90	7	249	246	44	62	55	
2	30	745.91	1.90	7				65	57	
2	35	749.59	1.90	7	268	238	42	67	64	-
2	40	753.50	1.90	7				67	59	
1	45	757.31	1.90	7			44	68	59	
1	50	761.03	1.90	7	255	260		69	60	
1	55	764.84	1.90	7				71	62	
1	60	768.57	1.90	7				71	62	
	1065									
	0-60	45.17	(Δ H) = 1.90					(t _m) = 59.87		

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impingers	200	200	—
Condenser			
Desiccant	1452	1435	17
		Total	17

Preliminary results of SO ₂ concentration determination	
V _{std}	= DSCF
Moisture	= 1.78 %v/v
SO ₂ , dry	= ppm
SO ₂ , wet	= ppm
LB/MMBtu	=

INTERPOL LABORATORIES
EPA Method 4 and 6 Field Data Sheet

Job A.P. / DUNNANON
Source PRESS VENT STACK
Date 12/16/93 Test 7 Run 2

Operator(s) D. VAN HOOPER
Meter Box No. 6 Gas meter coef. 1.9991
 ΔH_e 1.93 in.WC Bar. press 28.68 in.Hg

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. ☒
Posttest: 0 cfm at 10 in. Hg. ☒

Trav. Point No.	Samp. Time (min)	Sample Volume (cf)	Orif. Meter (inWC)	VAC. inHg	Temperatures (°F)					Oxygen (%v/v)
					Probe	Oven	Impg.	Gas/In	Gas/Out	
	1038	769.10								
3	5	773.04	1.90	7	271	237	45	62	61	AMBIENT
3	10	777.00	1.90	7				70	63	AIR
3	15	780.73	1.90	7				72	64	
3	20	784.59	1.90	7	275	239	46	74	66	
2	25	788.42	1.90	7				76	64	
2	30	792.15	1.90	7				76	67	
2	35	795.98	1.90	7	270	246	46	77	68	-
2	40	799.80	1.90	7				78	69	
1	45	803.62	1.90	7				78	69	
1	50	807.48	1.90	7	269	250	41	78	70	
1	55	811.30	1.90	7				79	70	
1	60	815.14	1.90	7				79	71	
	(1138)	818.91								
	$\theta = 60$	$V_m = 45.04$	$(\Delta H_e)_{avg} = 1.90$					$(t_m)_{avg} = 73.45$		

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impingers	200	200	0
Condenser			
Desiccant	1402	1389	13
	Total		13

Preliminary results of SO ₂ concentration determination	
V _{std}	= DSCF
Moisture	= 1.38 %v/v
SO ₂ , dry	= ppm
SO ₂ , wet	= ppm
LB/MMBtu	=

INTERROLL LABORATORIES
EPA Method 4 and 6 Field Data Sheet

Job L.P. / DUNGANNON
Source PRESS VENT STACK
Date 12/16/93 Test 7 Run 3

Operator(s) D. Van Hoever
Meter Box No. 6 Gas meter coef. .991
 Δ He 1.93 in.WC Bar. press 28.68 in.Hg

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. ☒
Posttest: 0 cfm at 8 in. Hg. ☒

Trav. Point No.	Samp. Time (min)	Sample Volume (cf)	Orif. Meter (inWC)	VAC. inHg	Temperatures (°F)					Oxygen (%v/v)
					Probe	Oven	Impg.	Gas/In	Gas/Out	
	1152	815.33								
3	5	819.12	1.90	7	275	240	41	72	68	AMBIENT
3	10	822.91	1.90	7				76	70	AIR
3	15	826.70	1.90	7	269	240	41	77	71	
3	20	830.63	1.90	7				78	71	
2	25	834.51	1.90	7				78	71	
2	30	838.32	1.90	7				79	72	
2	35	842.25	1.90	7	237	271	43	80	72	-
2	40	846.03	1.90	7				81	73	
1	45	849.85	1.90	7				81	74	
1	50	853.70	1.90	7	246	270	44	81	74	
1	55	857.52	1.90	7				81	74	
1	60	861.32	1.90	7				81	74	
	(1252)									
	$\theta = 60$	$V_m = 45.99$	$(\Delta H)_{avg} = 1.90$					$(t_m)_{avg} = 75.37$		

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impingers	200	200	0
Condenser			
Desiccant	1355	1339	16
		Total	16

Preliminary results of SO ₂ concentration determination	
V _{std}	= DSCF
Moisture	= 1.70 %v/v
SO ₂ , dry	= ppm
SO ₂ , wet	= ppm
LB/MMBtu	=

INTERPOL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job LOUISIANA PACIFIC CORP, DUNEGANNON
 Source PROCESS VENT - STACK
 Test 9 Run 0 Date 12-17-93
 Stack dimen. 59.5 IN.
 Dry bulb °F Wet bulb °F
 Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
 Barometric pressure 29.68 in Hg
 Static pressure -1.37 in WC
 Operators ETLOWBRIDGE - E. BLANKIN
 Pitot No. Cp 1840

Cross-section View	Elevation View
Drawing of Test Site <u> </u>	

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	.021				
2	.067				
3	.118				
4	.177				
5	.250				
6	.356				
7	.644				
8	.750				
9	.823				
10	.882				
11	.933				
12	.979				
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 LP/DUNBANNON
 Source TRUSS LENT STACK
 Method MDI-347 Filter holder: 2 1/2" SS

Date 12-16-93 Test 9 Run 1
 No. of traverse points 24
 Filter type: 2 1/2

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: 0 cfm at 5 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: _____ Recovery solvent(s) _____
 _____ ☐ acetone
 _____ ☒ other(s) MDCL-7
 No. of probe wash bottles: _____
 Sample recovered by: _____

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	<u>1446</u>	<u>1430</u>	<u>16</u>
Total			<u>16</u>

Integrated Gas Sampling Data:

Bag Pump No. _____ Box No. 14 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 TPA METHOD 5 FIELD DATA SHEET

Job L1 Dungenen Operator ET-DP Pitot No. 2246 CP 2246
 Source 12-15-93 Motor Box No. 5 Bar. Press. 28.88 inHg H₂O X
 Date 12-15-93 Fuel 9 Computer Conf. 1 Nozzle No. 1-3 H₂O D.B. 187 in.

Invertee Point No.	Supplying Time (min)	Sample Volume (cc)	Velocity Head (inHg)	Orifice Water (inHg)	Dis. Vol. (cc)	VAC. inHg	Temperature (°F)				Dwyer (XV/V)
							Stack	Probe	Dyn	Ingr.	Cat/Dat
7-12	11.5	549.10	1.60	1.92	9.27	3.5	81			45	51 48
11	2.5	531.10	1.70	1.99	3.27	3.7	83				51 48
10	5	553.15	1.90	2.22	5.17	4.0	83			45	52 48
9	7.5	555.22	1.80	2.10	7.23	3.9	86				53 48
8	10	557.28	1.70	1.99	9.23	3.9	84			45	56 48
7	12.5	559.29	1.55	1.83	1.14	3.8	82				58 48
6	15	561.20	1.55	1.83	3.06	3.8	82			45	58 48
5	17.5	563.10	1.40	1.65	4.88	3.4	82				59 49
4	20	564.90	1.45	1.71	6.74	3.5	83			45	61 49
3	22.5	566.84	1.40	1.66	8.58	3.0	82				62 50
2	25	568.60	1.40	1.66	1.41	3.4	84			45	63 50
1	27.5	570.41	1.40	1.66	2.25	3.4	82				64 51
12	30	572.21	1.5	1.79	4.15	3.4	82			45	58 51
11	32.5	574.18	1.70	2.01	6.17	4.0	83				61 51
10	35	576.14	1.70	1.99	8.18	4.0	89			47	62 52
9	37.5	578.70	1.70	2.00	1.19	4.0	88				63 52
8	40	580.20	1.65	1.94	2.18	4.0	88			49	65 52
7	42.5	582.23	1.70	2.00	4.20	4.0	88				66 52
6	45	584.23	1.60	1.89	6.16	3.9	88			49	66 52
5	47.5	586.18	1.50	1.79	8.07	3.8	84				67 53
4	50	588.06	1.50	1.79	9.98	3.8	87			49	68 53
3	52.5	589.98	1.50	1.55	1.76	3.2	87				69 54
2	55	591.74	1.30	1.55	3.54	3.2	87			49	69 54
1	57.5	593.54	1.4	1.68	5.40	3.4	83				70 55
1	60	595.33								49	70 55
V _s = 46.2-5											
0 = 60											
(1246)											
Avg. = 56.1											

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LP/DUNBARSON
 Source PRESS VENT STAIR
 Method MDI-347 Filter holder: 2 1/2 SS

Date 12-16-93 Test 9 Run 2
 No. of traverse points 24
 Filter type: 2 1/2

Sample Train Leak Check:

Pretest: { 0.02 cfm at 15 in. Hg. (vac)
 Posttest: { 0 cfm at 5 in. Hg. (vac)

Particulate Catch Data:

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

☐ acetone
☒ other(s) MeCL₂

No. of probe wash bottles: _____

Sample recovered by: _____

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	<u>1458</u>	<u>1434</u>	<u>24</u>
Total			

Integrated Gas Sampling Data:

Bag Pump No. _____ Box No. N/A 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

000	LI	13-134	RD	2
0001	13-134	RD	2	
0002	13-134	RD	2	
0003	13-134	RD	2	
0004	13-134	RD	2	
0005	13-134	RD	2	
0006	13-134	RD	2	
0007	13-134	RD	2	
0008	13-134	RD	2	
0009	13-134	RD	2	
0010	13-134	RD	2	
0011	13-134	RD	2	
0012	13-134	RD	2	
0013	13-134	RD	2	
0014	13-134	RD	2	
0015	13-134	RD	2	
0016	13-134	RD	2	
0017	13-134	RD	2	
0018	13-134	RD	2	
0019	13-134	RD	2	
0020	13-134	RD	2	
0021	13-134	RD	2	
0022	13-134	RD	2	
0023	13-134	RD	2	
0024	13-134	RD	2	
0025	13-134	RD	2	
0026	13-134	RD	2	
0027	13-134	RD	2	
0028	13-134	RD	2	
0029	13-134	RD	2	
0030	13-134	RD	2	
0031	13-134	RD	2	
0032	13-134	RD	2	
0033	13-134	RD	2	
0034	13-134	RD	2	
0035	13-134	RD	2	
0036	13-134	RD	2	
0037	13-134	RD	2	
0038	13-134	RD	2	
0039	13-134	RD	2	
0040	13-134	RD	2	
0041	13-134	RD	2	
0042	13-134	RD	2	
0043	13-134	RD	2	
0044	13-134	RD	2	
0045	13-134	RD	2	
0046	13-134	RD	2	
0047	13-134	RD	2	
0048	13-134	RD	2	
0049	13-134	RD	2	
0050	13-134	RD	2	
0051	13-134	RD	2	
0052	13-134	RD	2	
0053	13-134	RD	2	
0054	13-134	RD	2	
0055	13-134	RD	2	
0056	13-134	RD	2	
0057	13-134	RD	2	
0058	13-134	RD	2	
0059	13-134	RD	2	
0060	13-134	RD	2	
0061	13-134	RD	2	
0062	13-134	RD	2	
0063	13-134	RD	2	
0064	13-134	RD	2	
0065	13-134	RD	2	
0066	13-134	RD	2	
0067	13-134	RD	2	
0068	13-134	RD	2	
0069	13-134	RD	2	
0070	13-134	RD	2	
0071	13-134	RD	2	
0072	13-134	RD	2	
0073	13-134	RD	2	
0074	13-134	RD	2	
0075	13-134	RD	2	
0076	13-134	RD	2	
0077	13-134	RD	2	
0078	13-134	RD	2	
0079	13-134	RD	2	
0080	13-134	RD	2	
0081	13-134	RD	2	
0082	13-134	RD	2	
0083	13-134	RD	2	
0084	13-134	RD	2	
0085				

Traverse Point No.	Sampling Time (min)	Supply Volume (cf)	Velocity Head (ft/mc)	Drifted Meter (ft/mc)	VAC. in Hg	Temperature (°F)						Oxygen (%)
						Stack	Probe	Dyn	Inpy.	Cas/in	Cas/Dut	
B	1407	595.52	1.60	1.92	8.41	82				57	55	
	2.5	597.50	1.60	1.91	8.44	86				60	55	
	5	599.48	1.50	1.79	8.25	88				61	55	
	7.5	601.40	1.50	1.79	8.25	88				62	55	
	10	603.30	1.60	1.91	8.23	87				64	55	
	12.5	605.25	1.60	1.91	8.20	89				65	55	
	15	607.25	1.60	1.91	8.18	89				67	56	
	17.5	609.24	1.30	1.57	8.21	90			45	68	56	
	20	611.40	1.30	1.55	8.24	91				69	57	
	22.5	612.40	1.2	1.44	8.28	90			45	70	57	
	25	614.60	1.30	1.57	8.21	90				71	57	
	27.5	616.35	1.50	1.80	8.24	87				66	58	
	30	618.28	1.65	2.00	8.28	89			47	68	58	
	32.5	620.35	1.70	2.04	8.39	90				70	58	
	35	622.35	1.80	2.16	8.38	87			48	71	58	
	37.5	624.42	1.60	1.93	8.32	87				66	59	
	40	626.38	1.50	1.82	8.18	88			47	67	59	
	42.5	628.40	1.40	1.69	8.04	87				70	59	
	45	630.23	1.40	1.69	8.04	87			48	72	59	
	47.5	632.10	1.30	1.57	7.84	87				72	59	
	50	633.84	1.30	1.57	7.65	90				72	59	
	52.5	635.67	1.30	1.57	7.45	89				73	59	
	55	637.46	1.30	1.57	7.22	86				73	59	
	57.5	639.35	1.50	1.82	7.16	87				75	60	
	60	641.12	1.50	1.82	7.16	87						
	(1528)									Avg. = 62.5		

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LP/DUNNAN/HEN Date 12-17-53 Test 9 Run 3
 Source PRISS VENT STACK No. of traverse points 24
 Method MDI-307 Filter holder: 2 1/2 SS Filter type: 2 1/2

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: 0 cfm at 5 in. Hg. (vac) ☐

Particulate Catch Data:

No.s of filters used: _____ Recovery solvent(s) _____
 _____ ☐ acetone
 _____ ☒ other(s) MDC 2
 No. of probe wash bottles: 1
 Sample recovered by: DUH

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	<u>1460</u>	<u>1446</u>	<u>14</u>
Total			<u>14</u>

Integrated Gas Sampling Data:

Bag Pump No. _____ Box No. N/A 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

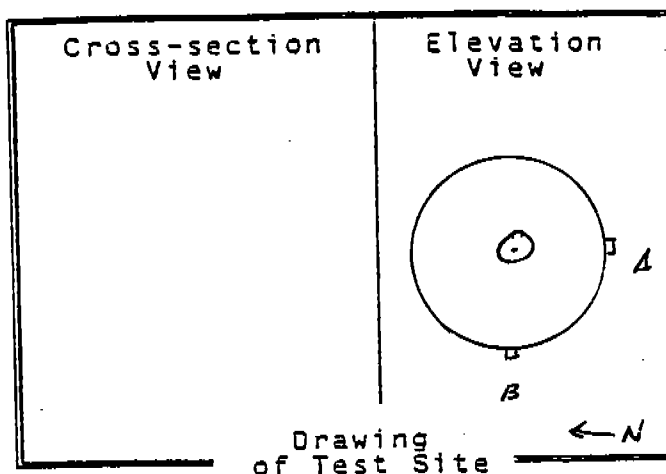
INTERPOL LABORATORIES CPA METHOD 5 FIELD DATA SHEET

Job LI Pumpdown Date 12-11-83 Operator 3 Meter Box No. 3 Computer Code 3 Pitot No. 23-V-6 Bar. Pressure 28.38 in Hg. H₂O 182 in. Nozzle No. 1-3 Nozzle Dia. 1/8 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (in Hg)	Drifts Meter (in Hg)	Des. Vol. (cf)	VAC. in Hg	Temperature (°F)				Gas In	Gas Out	Oxygen (xv/v)
							Stack	Probe	Duct	Inlet			
A	12	643.42	1.70	2.06	3.37	3.7	85				62	59	
	11	645.50	1.80	2.15	5.46	3.9	83				64	59	
	10	647.50	1.71	2.02	7.50	3.5	86				66	59	
	9	649.47	1.60	1.91	9.48	3.5	86				68	60	
	8	651.37	1.50	1.78	11.39	3.2	89				70	60	
	7	653.30	1.50	1.80	13.32	3.1	85				73	61	
	6	655.19	1.41	1.69	15.19	3.1	84				73	61	
	5	657.00	1.30	1.57	17.00	3.0	84				74	61	
	4	658.78	1.30	1.57	18.80	3.0	86				74	61	
	3	660.57	1.30	1.57	20.60	3.0	85				75	61	
	2	662.30	1.20	1.45	22.34	3.0	85				76	61	
	1	664.30	1.50	1.81	24.28	3.5	85				77	62	
15	12	666.10	1.70	2.06	26.35	3.7	85				68	62	
	11	668.40	1.70	2.04	28.40	3.7	86				69	62	
	10	670.43	1.60	1.92	30.40	3.5	87				71	62	
	9	672.38	1.60	1.93	32.38	3.5	85				75	62	
	8	674.45	1.70	2.05	34.44	3.7	86				75	62	
	7	676.48	1.70	2.05	36.50	3.7	85				75	62	
	6	678.50	1.60	1.93	38.50	3.5	86				75	62	
	5	680.14	1.50	1.81	40.45	3.4	86				74	63	
	4	682.31	1.40	1.70	42.33	3.2	85				76	63	
	3	684.10	1.30	1.57	44.14	3.1	85				76	63	
	2	685.95	1.30	1.57	45.95	3.1	85				76	63	
	1	687.80	1.30	1.58	47.74	3.1	84				77	63	
(1738)													
Total		665.0 = 60		4.52							Avg. = 67.1		

INTERPOL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job LOUISIANA PACIFIC CORP, DUNBAR
 Source PROCESS VENT - STACK
 Test 10 Run Date 12/17/93
 Stack dimen. 59.5 IN.
 Dry bulb °F Wet bulb °F
 Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
 Barometric pressure 28.88 in Hg
 Static pressure -37 in WC
 Operators D. VAN HOOVER & D. BRENNER
 Pitot No. V23-6 Co. .84



MDI (1,2-PP METHOD)

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: 6.25 in.	Time start: hrs		
A 1	.1021	1.25	7.50		
2	.067	3.99	10.24		
3	.118	7.02	13.27		
4	.177	10.53	16.78		
5	.250	14.88	21.13		
6	.356	21.18	27.43		
7	.644	38.31	44.56		
8	.750	44.62	50.87		
9	.823	48.96	55.22		
10	.882	52.47	58.72		
11	.933	55.51	61.76		
12	.979	58.25	64.50		
B 1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
Temp. meas. device & S/N: PDI #18				Time end: hrs	

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

S-3921

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / Duncannon Date 12/17/93 Test 10 Run 1
 Source Press Vent Stack No. of traverse points 24
 Method IMDE-12P Filter holder: NA Filter type: 4-125 NA

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: _____ cfm at _____ 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: DWH + DB

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		{ 700	
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant			
Total			17

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

Sub LP Burgarden
 Source Press Kent Staff
 Date 12/17/93

Operators Duffy DB
 Water Box No. 6 IN 192 IN NC
 Computer Code 9991

Pilot No. 423-6 CP 84
 Bar. Press. 22.86 IN HG H2O 2
 Nozzle No. 423 Nozzle Dio 113 IN

[illegible]

D-20

LEAK
CHECK
change
enclosed
(-27)
volume
change

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / D. H. G. W. G. L. Date 12/17/93 Test 10 Run 2
 Source PRESS VENT STACK No. of traverse points 24
 Method MOI-1-22 Filter holder: NA Filter type: NA

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: 0 cfm at 10 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: DDA + PB

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant			
Total			<u>22</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

Unit LP Dungenannon
 Country IRELAND PRESS VENT STAKE
 Date 12/17/93 1991 HUN 2
 Operators DH & DB
 Water Box No. 6 KIP 6 IN UC
 Computer Code 9991
 Pilot No. V23-6 CP 504
 Bar. Press. 25.58 INHG H2O 2
 Nozzle No. 6455 NOZZLE DIA. .173 IN.

Traverse Point No.	Sampling Time (min)	Supply Volume (cf)	Velocity Hood (inHG)	Orifice Meter (inHG)	Des. Vol. (cf)	VAC. inHg	Temperature (°F)					Oxygen (xv/v)		
							Stack	Probe	Duct	Inpy.	Gas/Ln		Gas/Dut	
A 12	1407	910.30	1.3	1.25	1.82	10	82	244	251	35	62	62	AMBIENT	
11	5	913.45	1.6	1.53	3.51	11	86				61	62	AIR	
10	7.5	915.10	1.50	1.43	5.55	11	88				68	63		
9	10	916.76	1.45	1.39	6.76	11	88				67	63		
8	12.5	918.52	1.80	1.73	8.56	12	87				69	64		
7	15	920.14	1.35	0.12	0.12	8	89	232	251	3-1	70	64		
6	17.5	921.80	1.50	1.44	1.76	8	89				71	65		
5	20	923.43	1.70	1.63	3.51	9	90				72	65		
4	22.5	925.31	1.75	1.68	5.29	9	91	237	254	3-1	74	66		
3	25	927.00	1.80	1.73	7.10	9	90				75	67		
2	27.5	928.75	1.75	1.69	8.89	9	88				76	68		
1	30	930.55	1.60	1.55	0.61	9	90				77	68		
B 12	32.5	932.53	2.2	2.14	2.62	10	87	245	257	3-1	73	67		
11	35	934.41	2.10	2.02	4.58	10	89				74	68		
10	37.5	936.41	1.90	1.83	6.44	10	90				76	69		
9	40	938.08	1.60	1.57	8.18	8	90	264	256	3-1	78	70		
8	42.5	939.10	1.50	1.45	9.85	8	90				72	69		
7	45	941.96	1.50	1.46	1.51	9	86				74	69		
6	47.5	943.56	1.55	1.50	3.20	9	87	266	257	3-1	77	70		
5	50	945.21	1.55	1.51	4.89	9	87				78	71		
4	52.5	946.96	1.55	1.50	6.57	9	90				80	72		
3	55	948.70	1.60	1.56	8.32	9	89	264	255	3-1	81	72		
2	57.5	950.50	1.60	1.57	0.05	9	86				82	73		
1	60	952.22	1.50	1.47	1.73		87				83	74		
												Avg. = 70.9		
V = 1192														
O = 60														

Stop Test
Leak
Check
Volume
Change
(-50)
DHA

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. Duggan Date 12/17/93 Test 10 Run 3
 Source PRESS VENT STACK No. of traverse points 21
 Method MDE-1220 Filter holder: NA Filter type: NA

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: .00 cfm at 15 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: DVT + DB

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1		<u>500</u>	
Impinger No. 2		<u>200</u>	
Impinger No. 3			
Condenser			
Desiccant			
Total			<u>12.5</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

JOB LP Dungenannon
 SUFFED PRESS VENT STACK
 0014 10 1011 10
 0014 12/17/93

Operators DETA DB IN UC
 Water Box No. 6 411 193 IN UC
 Casemaker coil. 9991

Pilot No. 123-6 Cp. 84
 Bar. Press. 28.88 IN Hg 120 2 X
 Nozzle No. CLASS Nozzle Dia. 17.3 IN.

Traverse Point No.	Sampling Time (min)	Supply Volume (cf)	Velocity Head (in H ₂ O)	Drifts Meter (in H ₂ O)	VAC. in Hg	Temperature (°F)					Gas In	Gas Out	Oxygen (xv/v)
						Stack	Probe	Duct	Leaky				
B 12	1625	955.47	2.2	2.13	5.47	88	246	251	31	72	72	AMBIENT	
11	2.5	957.46	2.15	2.10	7.47	83				72	71	AIR	
10	7.5	959.30	1.80	1.75	9.29	86	244	233	33	73	72		
9	10	960.91	1.50	1.46	0.96	86				74	72		
8	12.5	962.57	1.50	1.45	2.62	89				74	72		
7	15	964.19	1.50	1.47	4.29	85				75	72		
6	17.5	965.93	1.55	1.52	5.99	84				76	73		
5	20	967.75	1.55	1.52	7.70	84	246	249	33	76	73		
4	22.5	969.43	1.55	1.52	9.40	86				77	73		
3	25	971.14	1.55	1.52	1.10	85				77	73		
2	27.5	972.87	1.55	1.52	2.81	86				78	73		
1	30	974.61	1.55	1.52	4.51	85	248	251	34	77	73		
A 12	32.5	976.40	1.20	1.17	6.01	86				72	70		
11	35	977.90	1.50	1.46	7.67	86				72	70		
10	37.5	979.52	1.55	1.50	9.36	87	233	240	34	73	70		
9	40	981.40	1.50	1.46	1.03	85				73	70		
8	42.5	982.86	1.40	1.36	2.64	86				74	70		
7	45	984.44	1.40	1.36	4.25	85				74	70		
6	47.5	986.40	1.50	1.40	5.91	86	243	241	34	74	70		
5	50	987.77	1.60	1.56	7.63	86				74	70		
4	52.5	989.43	1.70	1.65	9.41	86				74	70		
3	55	991.35	1.70	1.66	1.18	85				74	70		
2	57.5	993.25	1.80	1.75	3.01	85				74	70		
1	60	995.05	1.80	1.76	4.83	84				74	70		
Avg. = 72.7													
V = 41.88													
θ = 60													
(1738)													

Stop Test →
 took check
 change
 has with
 - (35)
 volume

APPENDIX E

DRYER FIELD DATA SHEETS

INTERPOL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job LOUISIANA PACIFIC CORP, DUMGANNON
 Source DEJER STALK
 Test 3 Run 0 Date 12/15/93
 Stack dimen. 48" IN.
 Dry bulb 193 °F Wet bulb °F
 Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
 Barometric pressure 28.43 in Hg
 Static pressure 4.50 in WC
 Operators DIKE BRENNAN & DUANE VAN HOUTE
 Pitot No. 23-5 Cp 54

Cross-section
View

Elevation
View

Drawing
of Test Site

FORMALDEHYDE

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>0850</u> hrs	
<u>A</u> 1	<u>.021</u>	<u>1.01</u>	<u>7.01</u>	<u>.79</u>	<u>193</u>
2	<u>.067</u>	<u>3.22</u>	<u>9.22</u>	<u>.86</u>	
3	<u>.118</u>	<u>5.66</u>	<u>11.66</u>	<u>.95</u>	
4	<u>.177</u>	<u>8.50</u>	<u>14.50</u>	<u>1.10</u>	
5	<u>.250</u>	<u>12.00</u>	<u>18.00</u>	<u>1.20</u>	
6	<u>.356</u>	<u>17.09</u>	<u>23.09</u>	<u>1.25</u>	
7	<u>.644</u>	<u>30.91</u>	<u>36.91</u>	<u>1.35</u>	
8	<u>.750</u>	<u>36.00</u>	<u>42.00</u>	<u>1.40</u>	
9	<u>.823</u>	<u>39.50</u>	<u>45.50</u>	<u>1.35</u>	
10	<u>.882</u>	<u>42.34</u>	<u>48.34</u>	<u>1.30</u>	
11	<u>.933</u>	<u>44.78</u>	<u>50.78</u>	<u>1.10</u>	
12	<u>.979</u>	<u>46.99</u>	<u>52.99</u>	<u>.83</u>	
<u>B</u> 1				<u>.65</u>	
2				<u>.81</u>	
3				<u>.94</u>	
4				<u>1.10</u>	
5				<u>1.18</u>	
6				<u>1.25</u>	
7				<u>1.32</u>	
8				<u>1.40</u>	
9			<u>FT/SEC 69.82</u>	<u>1.30</u>	
10			<u>ACFM - 52650</u>	<u>1.25</u>	
11			<u>DSCFM - 31187</u>	<u>1.00</u>	
12				<u>.92</u>	
				<u>AVG 1.11</u>	<u>193</u>
Temp. meas. device & S/N:				Time end: <u> </u> hrs	

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

S-3921

COIL
INTERPOLL LABORATORIES EPA METHOD ~~5417~~ SAMPLE LOG SHEET

Job L.P. / DUBLINNOON Date 12/15/93 Test 3 Run 1
Source DRYER STACK No. of traverse points 24
Method COIL Filter holder: N/A Filter type: N/A

Sample Train Leak Check:

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

Particulate Catch Data:

No.s of filters used: _____ Recovery solvent(s)
N/A ☐ acetone
☒ other(s) MELB - DI H₂O
No. of probe wash bottles: 1
Sample recovered by: D. BRENNAN

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1472	1460	
Total			

Integrated Gas Sampling Data:

Bag Pump No. 23B Box No. 4 Bag No. 1
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: .000 cc/min at 22 in. Hg.
Time start: _____ (HRS) Time end: _____ (HRS)
Sampling rate: 400 cc/min Operator: D. BRENNAN
S/N of O₂ Analyzer used to monitor train outlet: 12

CF-023

LP ABORTED RUN

Sub	LF Bengannan			
Source	92828 STAC			
Date	12/15/84	1981	2	Run
Operator	Bennan + Van Haren			
Water Box No.	2	193	IN	NC
Computer cost.	9991			
Pilot No.	23-5	CP	81	
Bar. Press.	28.43	10Hg	RED	23X
Nozzle No.	7-2	Nozzle	Dia	2.44 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (ft)	Orifice Meter (inHg)	Des. Vol. (cf)	VAC. inHg	Temperature (°F)						Obs'dn (xv/v)
							Stack	Frobb	Dvbn	Lapq.	Cas/in	Ces/Dut	
B-12	2.5	532.600	.72	1.62	4.34	3.5	192	237	243		43	47	18.2
"	5	534.30	.91	1.99	6.25	4.5	200					47	18.0
"	7.5	536.19	1.02	2.24	8.28	5.0	200	237	243		42	48	18.0
"	10	538.22	1.05	2.31	6.34	5.0	201					48	18.1
"	12.5	540.31	1.30	2.64	2.55	5.5	199	240	245		42	49	18.0
"	15	542.50	1.30	2.87	4.55	6.5	199					50	18.2
"	17.5	544.81	1.33	2.94	7.18	6.5	200	243	245		40	50	18.1
"	20	547.17	1.32	2.92	9.51	6.5	199					51	18.3
"	22.5	549.54	1.35	3.00	1.57	6.5	199	247	245		40	53	17.7
"	25	551.87	1.30	2.91	4.20	6.5	198					54	17.9
"	27.5	554.18	1.10	2.47	6.35	5.5	198	247	246		39	54	18.1
"	30	556.32	1.10	2.48	8.50	5.5	196					54	18.4
A-12	32.5	558.448						246	246		39		
"	35	ABORT											
"	37.5							240	246		39		
"	40												
"	42.5												
"	45												
"	47.5												
"	50												
"	52.5												
"	55												
"	57.5												
"	60												
													Avq. =

LP ABORTED RUN

0011
INTERPOLL LABORATORIES EPA METHOD ~~5417~~ SAMPLE LOG SHEET

Job L.P. / DUNBAR Date 12/15/93 Test 3 Run 2
Source DRYER STACK No. of traverse points 24
Method 001 Filter holder: N/A Filter type: N/A

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) D
Posttest: 1.000 cfm at 12 in. Hg. (vac) I

Particulate Catch Data:

No.s of filters used: N/A Recovery solvent(s)
☐ acetone
☒ other(s) MEL + D.I. H₂O
No. of probe wash bottles: 1
Sample recovered by: D. BRENNAN

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			242
Impinger No. 3			-
Condenser			
Desiccant	1436	1420	16
Total			258

Integrated Gas Sampling Data:

Bag Pump No. 238 Box No. 4 Bag No. 1
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: .00 cc/min at 21 in. Hg.
Time start: 1250 (HRS) Time end: 1352 (HRS)
Sampling rate: 400 cc/min Operator: D. BRENNAN
S/N of O₂ Analyzer used to monitor train outlet: 12

CF-023

INTERPOL LABORATORIES TPA METHOD FIELD DATA SHEET

Job LI Engineering Operator Benson + Van Haven Pilot No. 23-5 CP 23-5
 Source Bayou Street Water Box No. 6 No. 2997 IN MC Bar. Press. 23-13 IN HG H2O 23-13
 Date 12/15/82 Estimator 3 Run 2 Nozzle No. 23-13 Dia. 23-13

Traverse Point No.	Sampling Time (min)	Supply Volume (cf)	Velocity Head (ft)	Drifted Meter (ft)	Det. Vol. (ft)	VAC. IN HG	Temperature (°F)				Dye	Oxygen (Kv/v)
							Block	Probe	Dye	Temp.	Gas/Dye	
12	2.5	558.400	75	1.71	0.39	3.5	192	253	253	43	51	18.4
11	5	560.39	76	1.69	2.16	3.5	194	246	255	42	54	18.0
10	7.5	562.20	1.03	2.30	4.23	5.0	195	242	252	41	56	18.0
9	10	564.23	1.30	2.89	6.54	5.5	197	239	250	41	59	17.7
8	12.5	566.51	1.40	3.14	8.96	6.5	196	237	252	40	61	17.7
7	15	568.87	1.40	3.14	1.35	6.5	193	240	251	40	62	17.8
6	17.5	571.34	1.25	2.93	3.69	5.5	196	242	250	40	63	17.9
5	20	573.71	1.30	2.93	6.02	5.5	196	240	252	40	64	17.8
4	22.5	575.96	1.30	2.94	8.37	5.5	195	239	250	39	65	16.8
3	25	578.31	1.20	2.72	0.63	5.5	196	240	248	39	66	16.7
2	27.5	580.63	1.10	2.50	2.81	5.0	194	239	243	38	67	17.0
1	30	582.76	1.07	2.44	4.95	5.0	194	243	248	38	68	17.5
12	32.5	584.92	.71	1.64	6.71	3.5	195	246	247	38	64	17.2
11	35	586.65	.76	1.72	8.51	3.5	196	245	245	38	66	16.7
10	37.5	588.43	.92	2.08	0.50	4.5	198	244	243	38	67	16.8
9	40	590.43	1.10	2.50	2.67	5.0	197	247	242	38	68	16.7
8	42.5	592.64	1.20	2.74	4.95	5.5	194	254	242	38	69	16.7
7	45	594.90	1.20	2.74	7.23	5.5	193	255	245	38	70	16.7
6	47.5	597.22	1.40	3.20	9.70	6.5	195	255	243	37	71	16.7
5	50	599.73	1.40	3.21	2.17	6.5	193	251	253	37	71	16.4
4	52.5	602.14	1.35	3.10	4.59	6.0	192	249	250	37	72	16.2
3	55	604.60	1.20	2.76	6.89	5.5	192	250	250	36	72	16.3
2	57.5	606.89	.98	2.26	8.97	5.0	191	249	251	36	72	16.5
1	60	608.99	1.00	2.31	1.07	5.0	190	251	255	36	72	16.3
	135.2											
V = 34.498							Avg. = 62.0					

S-0037R

001
INTERPOLL LABORATORIES EPA METHOD ~~3007~~ SAMPLE LOG SHEET

Job L.P. / DUNBANNON Date 12/15/93 Test 3 Run 3
 Source CORAL STAIR No. of traverse points 24
 Method 0011 Filter holder: N/A Filter type: N/A

Sample Train Leak Check:

Pretest: { 0.02 cfm at 15 in. Hg. (vac) ☒
 Posttest: { .000 cfm at 12 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: N/A Recovery solvent(s)
☐ acetone
☒ other(s) M2 CL2
 No. of probe wash bottles: 1
 Sample recovered by: D. BRENNAN

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			258
Impinger No. 3			
Condenser			
Desiccant	1458	1436	22
Total			280

Integrated Gas Sampling Data:

Bag Pump No. 23B Box No. 4 Bag No. 2
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: .00 cc/min at 21 in. Hg.
 Time start: _____ (HRS) Time end: _____ (HRS)
 Sampling rate: 400 cc/min Operator: D. BRENNAN
 S/N of O₂ Analyzer used to monitor train outlet: 12

CF-023

L.P. BURGESS

Operator		Pilot No.	23-5'	Cp	.84
Box No.	6	Bar. Press.	29.43	In Hg	H ₂ O
Case #	9997.93 TN NC	Nozzle No.	7-1	Nozzle Dia	2 1/8 IN

Traveler Point No.	Sampling Time (min)	Sample Volume (cc)	Velocity Head (in H ₂ O)	Orificed Meter (in H ₂ O)	Obs. Vel. (ft)	VAC. in Hg	Temperature (°F)				Oxygen (xv/v)		
							Stack	Probe	Oven	Inq.			
8-12	2.5	613.14	.58	1.33	3.11	3.5	195	273	258	45	57	57	17.8
11	5	614.89	.76	1.78	4.44	4.0	198	270	255	43	58	57	17.6
10	7.5	617.00	1.02	2.38	7.05	5.0	200	264	251	41	60	58	17.9
9	10	619.13	1.10	2.59	9.25	5.5	196	255	232	40	61	58	18.0
8	12.5	621.54	1.25	2.94	1.59	6.0	197	257	232	40	60	60	17.6
7	15	623.87	1.25	2.97	3.96	6.0	194	258	254	40	67	61	17.5
6	17.5	626.35	1.35	3.21	6.42	6.5	195	249	253	39	68	61	17.6
5	20	628.81	1.40	3.33	8.93	6.5	195	243	255	39	70	62	17.5
4	22.5	631.35	1.35	3.23	1.71	6.5	192	238	254	39	70	62	17.5
3	25	633.92	1.40	3.36	3.93	6.5	193	238	255	39	71	63	17.5
2	27.5	636.00	.98	2.36	6.05	5.0	192	241	252	38	71	63	17.7
1	30	638.22	.87	2.08	8.04	5.0	196	246	251	38	71	64	17.2
A-12	32.5	640.15	.95	2.29	0.13	5.0	190	260	250	36	68	63	17.4
11	35	642.23	1.04	2.49	2.31	5.0	193	257	254	35	70	64	17.2
10	37.5	644.50	1.10	2.63	4.54	5.5	195	268	251	35	71	64	17.5
9	40	646.82	1.20	2.88	6.29	6.0	193	264	251	35	72	64	17.1
8	42.5	649.15	1.25	3.00	9.28	6.0	193	260	250	36	73	65	17.2
7	45	651.66	1.30	3.13	1.72	6.5	193	262	254	37	73	66	16.9
6	47.5	654.13	1.40	3.36	4.25	6.5	195	250	252	37	73	66	17.0
5	50	656.68	1.35	3.25	6.75	6.5	192	254	246	37	74	66	17.2
4	52.5	659.08	1.30	3.13	9.20	6.5	193	252	246	37	74	67	17.3
3	55	661.64	1.20	2.90	1.55	6.0	192	253	250	38	75	67	17.5
2	57.5	663.68	.98	2.38	3.69	5.0	190	248	252	38	74	67	17.2
1	60	665.730	.87	2.11	5.71	5.0	190	251	251	38	75	68	17.0

Oil
INTERFOLL LABORATORIES EPA METHOD ~~504~~ SAMPLE LOG SHEET

Job L.P. / DUNBANDLOW Date 12/15/93 Test 3 Run 4
Source DRYER STEEL No. of traverse points 24
Method Oil Filter holder: G N/A Filter type: N/A

Sample Train Leak Check:

Pretest: { 0.02 cfm at 15 in. Hg. (vac) ☒
Posttest: { .000 cfm at 12 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: N/A Recovery solvent(s)
☐ acetone
☒ other(s) Methanol + 0.2 H₂O
No. of probe wash bottles: 1
Sample recovered by: D. BARNHART

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			<u>269</u>
Impinger No. 3			
Condenser			
Desiccant	<u>1440</u>	<u>1413</u>	<u>27</u>
Total			<u>296</u>

Integrated Gas Sampling Data:

Bag Pump No. 238 Box No. 4 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: .00 cc/min at 22 in. Hg.
Time start: 1700 (HRS) Time end: 1805 (HRS)
Sampling rate: 400 cc/min Operator: D. BARNHART
S/N of O₂ Analyzer used to monitor train outlet: 12

CF-023

INTERPOL LABORATORIES 'A' METHOD OF FIELD DATA SHEET

Job _____
Source _____
Date _____

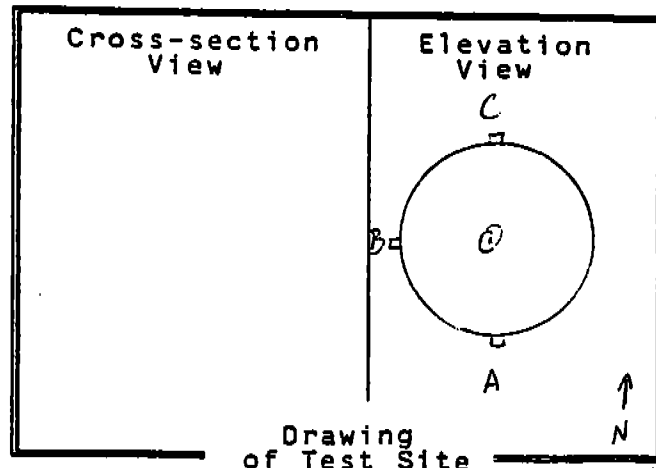
L.P. / Doughton
12/15/93 1951 3 Run A

Operator Barnes & Van Hoven
Water Box No. 6 88 193 TN HC
Generator coil. _____ _____ _____

Pilot No. 23-5 CP 84
Bar. Press. 28.43 inHg H2O 20 x
Nozzle No. 1-4 Nozzle Dio 179 in.

[illegible]

Job L.P. / Dugannon
Source Dryer Stack
Test 4 Run Date 12/15/93
Stack dimen. 48 IN.
Dry bulb °F Wet bulb °F
Manometer: ☒ Reg. ☐ Exp. ☐ Elec.
Barometric pressure 28.43 in Hg
Static pressure in WC
Operators J. Van Hoever
Pitot No. C_p



Drawing
of Test Site

No.

"D" PORT UNDER A PORT

[illegible]

Interpoll Laboratories
(612)786-6020

EPA Method 7 Sample Collection
Field Data Sheet

Job L.P. Duggannon Date 12/15/93 Bar. Pressure 28.43 IN.HG.
Test Location DAVER STALK Fuel Type WOOD Sample Train No. 1
Technician D. Van Hoever Pump No. 12

No.	Test Run Point	Flask No.	Time (HRS)	Vacuum (IN.HG.)	Flask Temp. (°F)	Leak Rate <0.4 IN.HG./MIN.	
1	4/1/1	37	13.00	26.5	45	☒ Yes	☐ No
2	4/1/2	38	13.15	26.5	47	☒ Yes	☐ No
3	4/1/3	39	13.23	26.5	47	☒ Yes	☐ No
4	4/1/1	40	13.40	26.7	47	☒ Yes	☐ No
5	4/2/2	41	15.03	26.9	50	☒ Yes	☐ No
6	4/2/3	42	15.15	26.8	50	☒ Yes	☐ No
7	4/2/1	25	16.32	26.5	50	☒ Yes	☐ No
8	4/2/2	26	16.40	26.7	50	☒ Yes	☐ No
9	4/3/3	27	17.00	26.7	49	☒ Yes	☐ No
10	4/3/1	28	17.11	26.7	49	☒ Yes	☐ No
11	4/3/2	29	17.29	26.7	49	☒ Yes	☐ No
12	4/3/3	30	17.46	26.7	49	☒ Yes	☐ No
13						☐ Yes	☐ No
14						☐ Yes	☐ No
15						☐ Yes	☐ No
16						☐ Yes	☐ No
17						☐ Yes	☐ No
18						☐ Yes	☐ No
19						☐ Yes	☐ No
20						☐ Yes	☐ No
21						☐ Yes	☐ No
22						☐ Yes	☐ No
23						☐ Yes	☐ No
24						☐ Yes	☐ No
25						☐ Yes	☐ No
26						☐ Yes	☐ No
27						☐ Yes	☐ No

INTERPOL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job LOUISIANA PACIFIC CORP, DUNSMITHSource DRYER STACKTest 4 Run 0 Date 12-15-93Stack dimen. 48" IN.Dry bulb °F Wet bulb °FManometer: ☒ Reg. ☐ Exp. ☐ Elec.Barometric pressure 28.43 in HgStatic pressure +.5 in WCOperators ED TRAUBER & DORIS VAN HOUTERPitot No. 21-5' C_p .84

PM CO

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:	6 in.	Time start:	hrs
A	1	.1021	1.01	7.01	
	2	.067	3.22	9.22	
	3	.118	5.46	11.66	
	4	.177	8.50	14.50	
	5	.250	12.00	18.00	
	6	.356	17.09	23.09	
	7	.644	30.91	36.91	
	8	.750	36.00	42.00	
	9	.823	39.50	45.50	
	10	.882	42.34	48.34	
	11	.933	44.78	50.78	
	12	.979	46.99	52.99	
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. / DUNBANNON Date _____ Test 4 Run 1
 Source DRYER STACK No. of traverse points 24
 Method 5 Filter holder: STAINLESS Filter type: 4" G.F.
STEEL

Sample Train Leak Check:

Pretest: { 0.02 cfm at 15 in. Hg. (vac) ☐
 Posttest: { _____ cfm at _____ in. Hg. (vac) ☐

Particulate Catch Data:

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

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			78
Condenser			
Desiccant			7
Total			

Integrated Gas Sampling Data:

Bag Pump No. 243 Box No. 19 Bag No. 1
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: .00 cc/min at 22 in. Hg.
 Time start: _____ (HRS) Time end: _____ (HRS)
 Sampling rate: 400 cc/min Operator: ED Thompson
 S/N of O₂ Analyzer used to monitor train outlet: 12

CF-023

LP ABORTED RUN

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / DUNGANNON Date 12-15-93 Test 4 Run 2
 Source Dryer Stack No. of traverse points 21
 Method 5 Filter holder: GLASS Filter type: Y'G.F.

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ~~X~~
 Posttest: 0 cfm at 15 in. Hg. (vac) ~~X~~

Particulate Catch Data:

No.s of filters used: 6123 Recovery solvent(s)
☒ acetone Probe & Nozzle
☐ other(s) _____
 No. of probe wash bottles: 1
 Sample recovered by: ET

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	<u>422</u>	<u>100</u>	<u>222</u>
Impinger No. 3		<u>0</u>	
Condenser			
Desiccant	<u>1338</u>	<u>1324</u>	<u>14</u>
Total			<u>236</u>

Integrated Gas Sampling Data:

Bag Pump No. 2413 Box No. 19 Bag No. 2
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 15 in. Hg.
 Time start: 1244 (HRS) Time end: 1351 (HRS)
 Sampling rate: 400 cc/min Operator: ET
 S/N of O₂ Analyzer used to monitor train outlet: 12

CF-023

Job	LP/Engineering	Stack	
Source	Day 26	1061	4
Date	12-15-93	1061	4
Run	2		
Operators	5-1-2014		
Water Box No.	5	1.78	11111111
Compressor Code	29.75		
Pilot No.	24-5	CP	84
Bar. Press.	28.05	11111111	11111111
Nozzle No.	2-4	Nozzle Dia	2.25 IN.

[illegible]

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job L.P. / DUNBARWON Date 12-15-93 Test 4 Run 3
 Source DRYER STACK No. of traverse points 24
 Method 5 Filter holder: GLASS Filter type: 4" G.F.

Sample Train Leak Check:

Pretest: (0.02 cfm at 15 in. Hg. (vac) ~~X~~
 Posttest: 0 cfm at 15 in. Hg. (vac) ~~X~~

Particulate Catch Data:

No.s of filters used: 6104 Recovery solvent(s)
☒ acetone PROB2 + NO2202
☐ other(s) _____
 No. of probe wash bottles: 1
 Sample recovered by: _____

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1		<u>100</u>	
Impinger No. 2	<u>120</u>	<u>100</u>	<u>20</u>
Impinger No. 3		<u>0</u>	
Condenser			
Desiccant	<u>1362</u>	<u>1338</u>	<u>24</u>
Total			<u>244</u>

Integrated Gas Sampling Data:

Bag Pump No. 2413 Box No. 19 Bag No. 3
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: .00 cc/min at 21 in. Hg.
 Time start: 1456 (HRS) Time end: 1558 (HRS)
 Sampling rate: 400 cc/min Operator: ET
 S/N of O₂ Analyzer used to monitor train outlet: 12

CF-023

INTERPOL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job LP/Dungeness Operator E. J. D. V. H. Pitot No. 24-5' CP 84
 Source Offshore Meter Box No. 3 Bar. Press. 28.4 inHg H₂O
 Date 12-15-84 Sampler Code 1 H₂O 3 Nozzle No. 2-2 Nozzle Dia. 2.24 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cu)	Velocity Head (inHg)	Drifted Meter (inHg)	Dis. Vol. (cu)	VAC. inHg	Temperature (°F)					Oxygen (xv/v)	
							Stack	Probe	Dry	Wet	Calc/Dul		
A	14.55	281.80											
	2.5	283.95	1.00	2.28	3.96	10	198	248	235	42	66	65	17.9
	5	286.20	1.10	2.38	6.19	11	197	253	235	42	69	65	17.9
	7.5	288.51	1.30	2.82	8.61	14	197				70	66	17.8
	10	291.00	1.30	2.82	1.03	14.2	197	254	242	44	71	66	17.5
	12.5	293.40	1.30	2.82	3.46	14.5	197				72	67	17.5
	15	295.75	1.35	2.94	5.94	14.8	197	250	249	45	73	67	17.3
	17.5	298.20	1.20	2.61	8.28	14.0	198				73	67	17.3
	20	300.40	1.10	2.39	0.52	14.0	198	259	251	45	73	67	17.3
	22.5	302.50	.95	2.07	2.60	13.0	198				75	67	17.2
	25	304.48	.90	1.75	4.52	12.0	197	258	260	46	74	67	17.2
	27.5	306.35	.70	1.53	6.31	9.0	196				75	68	17.1
B	30	308.05	.64	1.40	8.03	8.0	196	255	258	46	78	68	17.1
	32.5	309.90	.70	1.54	9.83	8.0	196				80	70	17.0
	35	311.70	.72	1.59	16.7	6.1	195	256	261	47	82	70	17.0
	37.5	313.75	.90	2.00	3.73	10.0	192				83	71	16.9
	40	316.00	1.05	2.34	5.96	12.0	192	254	260	47	83	71	16.9
	42.5	318.24	1.10	2.44	8.24	12.5	195				83	71	16.9
	45	320.70	1.25	2.78	8.66	13.5	193	252	261	48	83	71	16.8
	47.5	323.10	1.30	2.87	5.13	14.2	196				82	72	16.7
	50	325.75	1.30	2.86	5.59	14.5	198	250	258	48	82	73	16.7
	52.5	328.00	1.40	3.09	8.15	14.8	198				81	73	16.8
	55	330.50	1.30	2.87	0.02	14.1	197	252	255	48	80	74	16.9
	57.5	332.50	.90	1.94	2.68	12.5	197				80	74	17.0
	60	334.48	.70	1.55	4.44	10.1	195	250	253	50	80	74	17.0
(1554)													
V = 62.40												Avg. = 75.1	
O = 60													

INTERFOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job LP/DUNBAR Date 12-15-93 Test 4 Run ✓
 Source DRYER STACK No. of traverse points 24
 Method 5722 Filter holder: 4" GLASS Filter type: 4" GLASS FIBER

Sample Train Leak Checks:

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

Particulate Catch Data:

No. of filters used: 6105 Recovery solvent(s) acetone
☒ acetone
☐ other(s) _____
 No. of probe wash bottles: 1
 Sample recovered by: ET

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1		<u>136</u>	
Impinger No. 2	<u>459</u>	<u>60</u>	<u>259</u>
Impinger No. 3		<u>0</u>	
Condenser			
Desiccant			<u>21</u>
Total			<u>280</u>

Integrated Gas Sampling Data:

Bag Pump No. 24B Box No. 19 Bag No. 3
 Bag Material: 5-layer Aluminized Tedlar Size: 44 L
 Pretest leak check: 0 cc/min at 15 in. Hg.
 Time start: 1701 (HRS) Time end: 1802 (HRS)
 Sampling rate: 400 cc/min Operator: ET
 S/N of O₂ Analyzer used to monitor train outlet: 12

CF-023

S-0046RR

INTERPOL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job 2 P1 DUNBARSON Operator ET-DVH Pitot No. 24V-5 CP 1840
 Source DRYER STACK Meter Box No. 19949 Bar. Press. 28.43 inHg H₂O
 Date 12-15-93 Computer Code 1 Run 3 Nozzle No. 2-4 Nozzle Dia 2.37 in.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inHg)	Orifice Meter (inHg)	Des. Vol. (cf)	VAC. inHg	Temperatures (°F)					Oxygen (xv/v)
							Stack	Probe	Oven	Ingh.	Gas In	Gas Out
17	2.5	334.80	1.88	2.01	1.87	9.0	144	247	253	42	44	63
11	5	336.87	1.00	2.21	4.01	10.0	194				45	63
10	7.5	334.10	1.20	2.44	1.34	12.5	197	267	252	42	46	65
9	10	341.30	1.35	2.48	3.83	14.0	197				47	65
6	12.5	343.80	1.35	2.97	6.31	14.2	198	253	250	44	68	66
7	15	346.25	1.30	2.87	8.76	14.3	198				70	66
6	17.5	348.65	1.20	2.65	1.11	4.4	199	255	252	45	72	68
5	20	351.02	1.10	2.44	3.37	14.5	199				73	48
4	22.5	353.28	1.05	2.34	5.58	13.0	198	254	255	45	74	49
3	25	355.10	.85	1.90	7.58	12.0	198				75	49
2	27.5	357.55	.60	1.34	9.27	11.0	196	252	253	46	74	49
1	30	359.30	.55	1.23	0.88	8.0	145				76	49
12	32.5	360.90	.88	1.97	2.92	11.5	146	250	254	45	76	49
11	35	362.90	1.10	2.46	5.20	12.0	197				76	49
10	37.5	365.30	1.30	2.90	7.67	14.5	198	252	251	46	76	49
9	40	367.70	1.35	3.01	1.18	14.8	198				76	49
8	42.5	370.20	1.40	3.12	2.74	15.0	199	253	250	48	76	49
7	45	372.70	1.50	2.90	5.21	15.0	199				76	49
6	47.5	375.20	1.70	2.45	7.48	14.9	199	254	252	48	76	70
5	50	377.50	1.00	2.23	9.65	14.0	199				77	71
4	52.5	379.70	.85	1.90	1.65	12.0	200	252	249	48	79	72
3	55	381.70	.70	1.57	3.48	8.5	200				79	72
2	57.5	383.60	.67	1.51	5.27	8.0	197	250	252	45	79	72
1	60	385.30	.65	1.47	7.04	8.0	145				79	72
	(1803)											
Σ		52.30		2.29								
Avg.		71.1										

APPENDIX F

INTERPOLL LABORATORIES ANALYTICAL DATA

TABLE OF CONTENTS

Orsat	1
Particulate	5
PM-10	13
Oxides of Nitrogen	15
Carbon Monoxide	17
Formaldehyde	18
Phenol	19
MDI	21
Sample Deposition Sheets	22

C

T

T

T

T

T

T

T

T

T

T

T

T

T

T

T

T

T

T

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job L.P. Dunsannon Source Thermal Oil Heater
 Team Leader DB Test Site Stack
 Date Submitted 12-20-93 Date of Test 12-14-93
 Test No. 1 No. of Runs Completed 3
 Date of Analysis 12-23-93 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			
1/1	1906-05 B B F	1	0.00	3.50	20.90	3.50	17.20	1.06
		2	0.00	3.50	20.70	3.50	17.20	1.06
		Avg				3.50	17.20	
1/2	-06 B B F	1	0.00	3.30	20.70	3.30	17.40	1.06
		2	0.00	3.30	20.70	3.30	17.40	1.06
		Avg				3.30	17.40	
1/3	-07 B B F	1	0.00	3.30	20.70	3.30	17.40	1.06
		2	0.00	3.30	20.70	3.30	17.40	1.06
		Avg				3.30	17.40	
	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 $F_o = \frac{20.9 - O_2}{CO_2}$

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

EPA Method 3 Guidelines
Fuel Type F_o Range

Coal:	
Anthracite/Lignite	1.016-1.130
Bituminous	1.083-1.250
Oil:	
Distillate	1.260-1.413
Residual	1.210-1.370
Gas:	
Natural	1.600-1.936
Propane	1.434-1.586
Butane	1.405-1.553
Wood/Wood Bark	1.000-1.130

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job L.P. Dunsannon

Team Leader C.T.

Date Submitted 12-20-93

Test No. 2

Date of Analysis 12-23-93

Source Thermal Oil Heater

Test Site Stack

Date of Test 12-14-93

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	1406-12 ☒ B ☐ F	1	0.00	3.20	20.70	3.20	17.50	1.06
		2	0.00	3.20	20.70	3.20	17.50	1.06
		Avg				3.20	17.50	
2/2	-13 ☐ B ☐ F	1	0.00	3.70	20.70	3.70	17.00	1.05
		2	0.00	3.70	20.70	3.70	17.00	1.05
		Avg				3.70	17.00	
2/3	-14 ☐ B ☐ F	1	0.00	3.10	20.70	3.10	17.60	1.06
		2	0.00	3.10	20.70	3.10	17.60	1.06
		Avg				3.10	17.60	
	☐ 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 $F_o = \frac{20.9 - O_2}{CO_2}$

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

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	1.600-1.936
Propane	1.434-1.596
Butane	1.405-1.553
F-2 Wood/Wood Bark	1.000-1.150

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Lab L.P. Duggan
im Leader DB
Date Submitted 12-20-93
Test No. 3
Date of Analysis 12-23-93
Source Dryer
Test Site Stack
Date of Test 12-15-93
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 ₀
			Zero Pt.	After CO ₂	After O ₂			
	☐ B ☐ F	1						
		2						
		Avg						
3/2	1906-24 ☒ B ☐ F	1	0.00	3.00	20.80	3.00	17.80	1.03
		2	0.00	3.00	20.80	3.00	17.80	1.03
		Avg				3.00	17.80	
3/3	-25 ☒ B ☐ F	1	0.00	3.00	20.80	3.00	17.80	1.03
		2	0.00	3.00	20.80	3.00	17.80	1.03
		Avg				3.00	17.80	
2/4	-26 ☒ B ☐ F	1	0.00	3.30	20.80	3.30	17.50	1.03
		2	0.00	3.30	20.80	3.30	17.50	1.03
		Avg				3.30	17.60	
	☐ 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
☐ F₀ Within EPA M-3 Guidelines
for fuel type.

Where $F_0 = \frac{20.9 - O_2}{CO_2}$

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

F-3

EPA Method 3 Guidelines	
Fuel Type	F ₀ 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

LSC-04-BR

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job L.P. Duggan

Team Leader G.T.

Date Submitted 12-20-93

Test No. 4

Date of Analysis 12-23-93

Source Dryer

Test Site Stack

Date of Test 12-15-93

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 ₀
			Zero Pt.	After CO ₂	After O ₂			
	☐ B ☐ F	1						
		2						
		Avg						
4/2	1906-45 ☒ B ☐ F	1	0.00	2.90	20.70	2.90	17.80	1.07
		2	0.00	2.90	20.70	2.90	17.80	1.07
		Avg				2.90	17.80	
4/3	-46 ☒ B ☐ F	1	0.00	2.80	20.70	2.80	17.90	1.07
		2	0.00	2.80	20.70	2.80	17.90	1.07
		Avg				2.80	17.90	
4/4	-47 ☒ B ☐ F	1	0.00	3.30	20.70	3.30	17.40	1.06
		2	0.00	3.30	20.70	3.30	17.40	1.06
		Avg				3.30	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						

- ☒ Ambient Air QA Check
☒ Orsat Analyzer System Leak Check
☐ F₀ Within EPA M-3 Guidelines
for fuel type.

Where $F_0 = \frac{20.9 - O_2}{CO_2}$

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

EPA Method 3 Guidelines	
Fuel Type	F ₀ 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

EPA Method 202 Calculations

3-1906.LP

Job: Louisiana-Pacific/Dungannon

Date: December 14 and 15

Thermal Oil Heater

RUN	Vic (ml)	Sulfate (mg/ml)	Mc (mg)	Mr (mg)	Mi (mg)	Mo (mg)	Mb (mg)	CPM (mg)
1	250	0.0395	1.82	15.9	14.08	1.8	0.5	15.38
2	250	0.0323	1.49	12	10.51	2.6	0.5	12.61
3	250	0.0299	1.38	7.4	6.02	0.9	0.5	6.42

EPA Method 5/202 Totals

RUN	Probe (mg)	Filter (mg)	CPM (mg)	Total (mg)
1	8.8	0.2	15.38	24.38
2	6.1	1.1	12.61	19.81
3	3	6	6.42	15.42

Dryer

RUN	Vic (ml)	Sulfate (mg/ml)	Mc (mg)	Mr (mg)	Mi (mg)	Mo (mg)	Mb (mg)	CPM (mg)
1	275	0.00311	0.16	19	18.84	8.9	0.5	27.24
2	425	0.000826	0.06	48.7	48.64	19.2	0.5	67.34
3	425	0.000447	0.03	66.5	66.47	23.1	0.5	89.07
3	475	0.000732	0.06	82.3	82.24	29.5	0.5	111.24

EPA Method 5/202 Totals

RUN	Probe (mg)	Filter (mg)	CPM (mg)	Total (mg)
1	6.6	19	27.24	52.8
2	20	47.8	67.34	135.1
3	22.7	70.4	89.07	182.2
3	23	71.9	111.24	206.1

Interpoll Laboratories, Inc.
(612) 786-6020

Ion Chromatography Laboratory

DIONEX MODEL 40001 WITH ANION MICRO MEMBRANE SUPPRESSION

Analyst: AMS

Date of Analysis: 1-3-94/1-10

Job: C.P. DUNNEN

Source: _____

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

(Final Conc (mg/L))

Sample Name	Interpoll Log Number	Tot. Sample Volume (ml)	Dilution	Solution Conc. (ug/ml)	Total ug Sulfate	meq of Sulfate
Test 4 Dryer ^{aborted} Run 1	1906-41 I		1	3.11	3.11	
" Run 2	-42 I		1	0.826	0.826	
" Run 3	-43 I		1	0.447	0.447	
" Run 4	-44 I		1	0.732	0.732	
Test 2 Krus Blank	-08 I		1	0.208	0.208	
" Run 1	-09 I		10	3.95	39.5	
" Run 2	-10 I		10	3.23	32.3	
" Run 3	-11 I		10	2.99	29.9	

Total ug = (Sample Vol.) x (Dilution) x (Solution Conc.)
meq = Total ug / 48000

Method 202

Note Run 1 Sample 42: Run was aborted, Analysis is on hold.

LSC-08RR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Impinger Catch/Wisconsin Protocol

method 202

Job L.P. Duggan Source Thermal Oil Heater
Team Leader CT Test Site Stack
Date Submitted _____ Date of Test 12-14-93
Test No. 2 No. of Runs Completed 3
Date of Analysis 12-14-93 Technician C. Helgeson

	Solvent Phase	Aqueous Phase
0	Test <u>2</u> Run <u>0</u> Field Blank Log Number <u>1906-08I</u> Comments _____ Dish No. <u>66</u> Dish Tare Wt. <u>48.3105</u> g Dish+Sample Wt. <u>48.3107</u> g Sample Wt. <u>0.0002</u> g	Dish No. <u>208</u> Dish Tare Wt. <u>52.7979</u> g Dish+Sample Wt. <u>52.7982</u> g Sample Wt. <u>0.0003</u> g
1	Test <u>2</u> Run <u>1</u> Log Number <u>-09I</u> Comments _____ Dish No. <u>84</u> Dish Tare Wt. <u>49.1004</u> g Dish+Sample Wt. <u>49.1024</u> g Sample Wt. <u>0.0020</u> g	Dish No. <u>209</u> Dish Tare Wt. <u>43.2108</u> g Dish+Sample Wt. <u>43.2270</u> g Sample Wt. <u>0.0162</u> g
2	Test <u>2</u> Run <u>2</u> Log Number <u>-10I</u> Comments _____ Dish No. <u>115</u> Dish Tare Wt. <u>45.0689</u> g Dish+Sample Wt. <u>45.0717</u> g Sample Wt. <u>0.0028</u> g	Dish No. <u>212</u> Dish Tare Wt. <u>50.3569</u> g Dish+Sample Wt. <u>50.3692</u> g Sample Wt. <u>0.0123</u> g
3	Test <u>2</u> Run <u>3</u> Log Number <u>-11I</u> Comments _____ Dish No. <u>117</u> Dish Tare Wt. <u>47.3722</u> g Dish+Sample Wt. <u>47.3733</u> g Sample Wt. <u>0.0011</u> g	Dish No. <u>311</u> Dish Tare Wt. <u>43.8125</u> g Dish+Sample Wt. <u>43.8202</u> g Sample Wt. <u>0.0077</u> g
4	Test _____ Run _____ Log Number _____ Comments _____ Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
5	Test _____ Run _____ Log Number _____ Comments _____ Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g

Results Solvent Phase:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5	Blank Solvent Wt. _____ g
	0.0018	0.0026	0.0009			

Results Aqueous Phase:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5	
	0.0159	0.0120	0.0014			LSC-03WYR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job L.P. Duggan Source Thermal oil Heater
Team Leader ET Test Site Stack
Date Submitted _____ Date of Test 12-14-93
Test No. 2 No. of Runs Completed 3
Date of Analysis 12-28-93 Technician C. Helgeson
Transport Leakage None ☐ ml Solvent Acetone

0	Test <u>2</u> Run <u>0</u> Field Blank Log Number <u>1906-08D</u> Vol. of Solvent <u>100</u> ml *Solvent Residue <u>3.00</u> ug/ml	Dish No. <u>316</u> Dish Tare Wt. <u>44.8248</u> g Dish+Sample Wt. <u>44.8251</u> g Sample Wt. <u>0.0003</u> g
	Test <u>2</u> Run <u>1</u> Vol. of Solvent <u>150</u> ml Log Number <u>-09P</u> Comments _____	Dish No. <u>317</u> Dish Tare Wt. <u>46.9542</u> g Dish+Sample Wt. <u>46.9835</u> g Sample Wt. <u>0.0093</u> g
	Test <u>2</u> Run <u>2</u> Vol. of Solvent <u>170</u> ml Log Number <u>-10P</u> Comments _____	Dish No. <u>400</u> Dish Tare Wt. <u>47.1017</u> g Dish+Sample Wt. <u>47.1083</u> g Sample Wt. <u>0.0066</u> g
	Test <u>2</u> Run <u>3</u> Vol. of Solvent <u>130</u> ml Log Number <u>-11P</u> Comments _____	Dish No. <u>502</u> Dish Tare Wt. <u>46.9012</u> g Dish+Sample Wt. <u>46.9046</u> g Sample Wt. <u>0.0034</u> g
	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) (10⁶)] / 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

	0.0088	0.0061	0.0030	F-8	
--	--------	--------	--------	-----	--

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job L.P. Dunganen Source Thermal Oil Heater
Team Leader ET Test Site Stack
Date Submitted _____ Date of Test 12-14-93
Test No. 2 No. of Runs Completed 3
Date of Analysis 12-28-93 Technician C. Helgeson

0	Test <u>2</u> Run <u>0</u>	Filter No. <u>6120</u>	
	Field Blank	Filter Type <u>4" GF</u>	
	Log Number <u>1906-08F</u>	Filter Tare Wt. <u>.8685</u>	g
	Comments _____	Filter+Sample Wt. <u>.8685</u>	g
		Sample Wt. _____	g
1	Test <u>2</u> Run <u>1</u>	Filter No. <u>6131</u>	
	Log Number <u>-09F</u>	Filter Type <u>4" GF</u>	
	Comments _____	Filter Tare Wt. <u>.8757</u>	g
		Filter+Sample Wt. <u>.8759</u>	g
		Sample Wt. <u>0.0002</u>	g
2	Test <u>2</u> Run <u>2</u>	Filter No. <u>6132</u>	
	Log Number <u>-10F</u>	Filter Type <u>4" GF</u>	
	Comments _____	Filter Tare Wt. <u>.8718</u>	g
		Filter+Sample Wt. <u>.8729</u>	g
		Sample Wt. <u>0.0011</u>	g
3	Test <u>2</u> Run <u>3</u>	Filter No. <u>6121</u>	
	Log Number <u>-11F</u>	Filter Type <u>4" GF</u>	
	Comments _____	Filter Tare Wt. <u>.8699</u>	g
		Filter+Sample Wt. <u>.8759</u>	g
		Sample Wt. <u>0.0060</u>	g
4	Test _____ Run _____	Filter No. _____	
	Log Number _____	Filter Type _____	
	Comments _____	Filter Tare Wt. _____	g
		Filter+Sample Wt. _____	g
		Sample Wt. _____	g
5	Test _____ Run _____	Filter No. _____	
	Log Number _____	Filter Type _____	
	Comments _____	Filter Tare Wt. _____	g
		Filter+Sample Wt. _____	g
		Sample Wt. _____	g

Results:

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

	0.0002	0.0011	0.0060		
--	--------	--------	--------	--	--

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

	0.0267	0.0218	0.0173		
--	--------	--------	--------	--	--

LSC-02PR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Impinger Catch/Wisconsin Protocol

method 202

Job L.P. Duggan Source Dryer
Team Leader ET Test Site Stack
Date Submitted _____ Date of Test 12-15-93
Test No. 4 No. of Runs Completed 4
Date of Analysis 12-30-93 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>4</u> Run <u>1</u> Log Number <u>1906-41T</u> Comments <u>Void</u>	Dish No. <u>152</u> Dish Tare Wt. <u>49.8065</u> g Dish+Sample Wt. <u>49.8156</u> g Sample Wt. <u>0.0091</u> g
2	Test <u>4</u> Run <u>2</u> Log Number <u>~42T</u> Comments _____	Dish No. <u>313</u> Dish Tare Wt. <u>46.4585</u> g Dish+Sample Wt. <u>46.5075</u> g Sample Wt. <u>0.0490</u> g
3	Test <u>4</u> Run <u>3</u> Log Number <u>~43T</u> Comments _____	Dish No. <u>314</u> Dish Tare Wt. <u>44.0350</u> g Dish+Sample Wt. <u>44.1018</u> g Sample Wt. <u>0.0668</u> g
4	Test <u>4</u> Run <u>4</u> Log Number <u>~44T</u> Comments _____	Dish No. <u>315</u> Dish Tare Wt. <u>42.6425</u> g Dish+Sample Wt. <u>42.7251</u> g Sample Wt. <u>0.0826</u> 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	Run 4	Run 5
	0.0089	0.0192	0.0231	0.0295	

Results Aqueous Phase:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0190	0.0487	0.0665	0.0823	

E-10

LSC-03WYR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job L.P. Duggan Source Dryer
Team Leader ET Test Site Stack
Date Submitted _____ Date of Test 12-15-93
Test No. 4 No. of Runs Completed 4
Date of Analysis 12-28-93 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>4</u> Run <u>1</u> Vol. of Solvent <u>175</u> ml Log Number <u>1906-41P</u> Comments _____	Dish No. <u>508</u> Dish Tare Wt. <u>46.5061</u> g Dish+Sample Wt. <u>46.5132</u> g Sample Wt. <u>0.0071</u> g
2	Test <u>4</u> Run <u>2</u> Vol. of Solvent <u>130</u> ml Log Number <u>-42P</u> Comments _____	Dish No. <u>509</u> Dish Tare Wt. <u>47.6212</u> g Dish+Sample Wt. <u>47.6416</u> g Sample Wt. <u>0.0204</u> g
	Test <u>4</u> Run <u>3</u> Vol. of Solvent <u>125</u> ml Log Number <u>-43P</u> Comments _____	Dish No. <u>512</u> Dish Tare Wt. <u>49.3569</u> g Dish+Sample Wt. <u>49.3800</u> g Sample Wt. <u>0.0231</u> g
4	Test <u>4</u> Run <u>4</u> Vol. of Solvent <u>140</u> ml Log Number <u>-44P</u> Comments _____	Dish No. <u>621</u> Dish Tare Wt. <u>49.9355</u> g Dish+Sample Wt. <u>49.9589</u> g Sample Wt. <u>0.0234</u> 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) (10⁶)] / 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

	0.0066	0.0200	0.0227	0.0230	
--	--------	--------	--------	--------	--

E-11

LSC-01YR

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job L. P. Duggan Source Dryer
Team Leader ET Test Site Stack
Date Submitted _____ Date of Test 12-15-93
Test No. 4 No. of Runs Completed 4
Date of Analysis 12-28-93 Technician C. Helgeson

0	Test <u>Run 0</u> Field Blank Log Number _____ Comments _____	Filter No. _____ Filter Type _____ Filter Tare Wt. _____ g Filter+Sample Wt. _____ g Sample Wt. _____ g
1	Test <u>4</u> Run <u>1</u> Log Number <u>1906-41F</u> Comments _____	Filter No. <u>6122</u> Filter Type <u>4"6F</u> Filter Tare Wt. <u>.8747</u> g Filter+Sample Wt. <u>.8937</u> g Sample Wt. <u>0.0190</u> g
2	Test <u>4</u> Run <u>2</u> Log Number <u>-42F</u> Comments _____	Filter No. <u>6123</u> Filter Type <u>4"6F</u> Filter Tare Wt. <u>.8663</u> g Filter+Sample Wt. <u>.9141</u> g Sample Wt. <u>0.0478</u> g
3	Test <u>4</u> Run <u>3</u> Log Number <u>-43F</u> Comments _____	Filter No. <u>6104</u> Filter Type <u>4"6F</u> Filter Tare Wt. <u>.8730</u> g Filter+Sample Wt. <u>.9434</u> g Sample Wt. <u>0.0704</u> g
4	Test <u>4</u> Run <u>4</u> Log Number <u>-44F</u> Comments _____	Filter No. <u>6105</u> Filter Type <u>4"6F</u> Filter Tare Wt. <u>.8813</u> g Filter+Sample Wt. <u>.9532</u> g Sample Wt. <u>0.0719</u> g
5	Test _____ Run _____ Log Number _____ Comments _____	Filter No. _____ Filter Type _____ Filter Tare Wt. _____ g Filter+Sample Wt. _____ g Sample Wt. _____ g

Results:

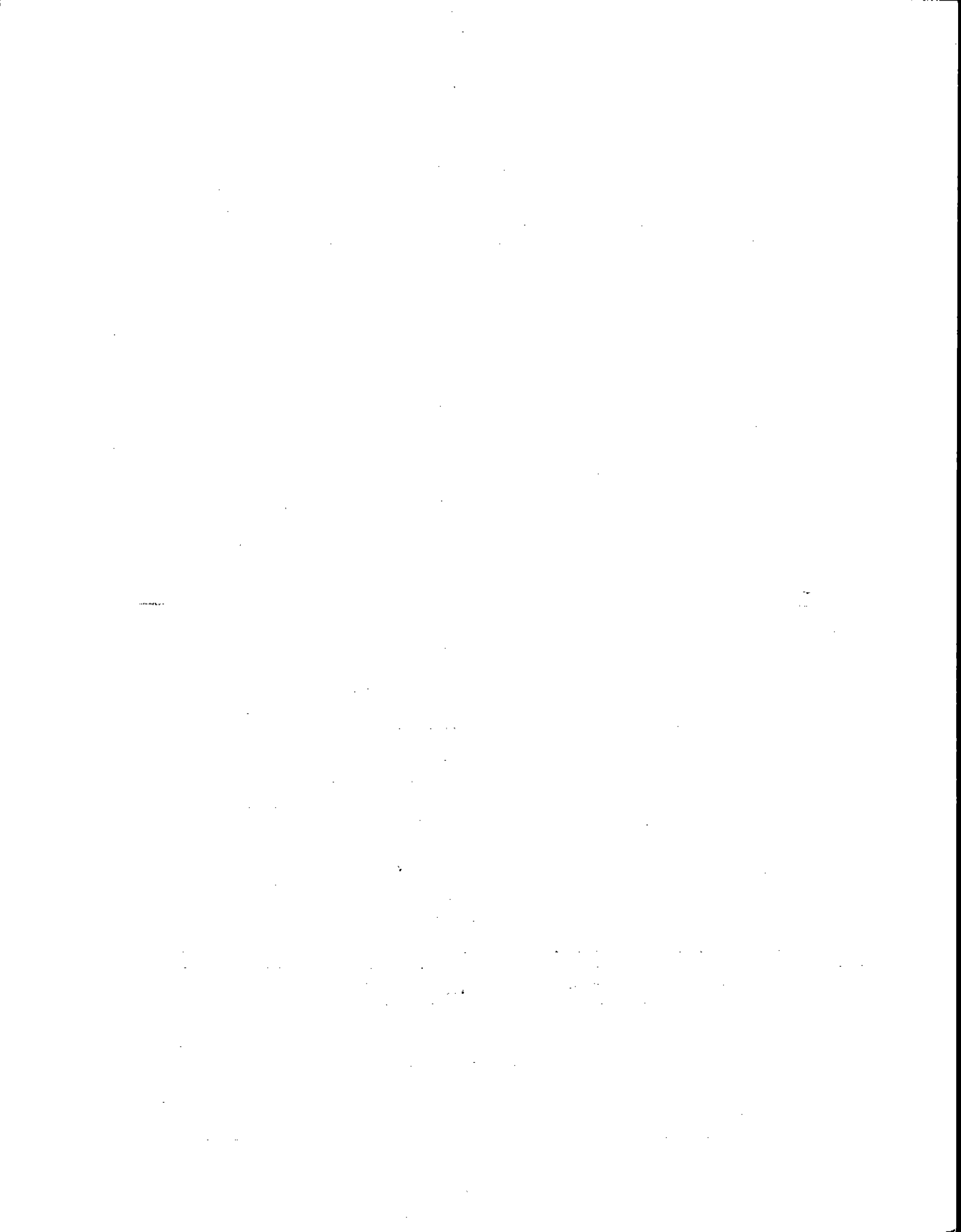
Field Blk. Run 1 Run 2 Run 3 Run 4 Run 5

	0.0190	0.0478	0.0704	0.0719	
--	--------	--------	--------	--------	--

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

	0.0535	0.1357	0.1827	0.2067	
--	--------	--------	--------	--------	--

LSC-02PR



Interpoll Laboratories
(612) 796-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash
PM-10

Job L.P. Duggan Source Thermal Oil Heater
Team Leader DB Test Site Stack
Date Submitted _____ Date of Test 12-14-93
Test No. 1 No. of Runs Completed 3
Date of Analysis 12-28-93 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>1</u> Run <u>1</u> Vol. of Solvent <u>45</u> ml Log Number <u>1906-02P</u> Comments _____	Dish No. <u>320</u> Dish Tare Wt. <u>44.3906</u> g Dish+Sample Wt. <u>44.3915</u> g Sample Wt. <u>0.0009</u> g
2	Test <u>1</u> Run <u>2</u> Vol. of Solvent <u>30</u> ml Log Number <u>-03P</u> Comments _____	Dish No. <u>321</u> Dish Tare Wt. <u>45.4952</u> g Dish+Sample Wt. <u>45.4960</u> g Sample Wt. <u>0.0009</u> g
3	Test <u>1</u> Run <u>3</u> Vol. of Solvent <u>55</u> ml Log Number <u>-04P</u> Comments _____	Dish No. <u>322</u> Dish Tare Wt. <u>44.2308</u> g Dish+Sample Wt. <u>44.2319</u> g Sample Wt. <u>0.0011</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) (10⁶)] / Vol. of Sol. _____ ml
EPA-MS Acetone Residue Blank Spec. { 7.3 ug/ml

Results:

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

	0.0008	0.0008	0.0010	F-13	
--	--------	--------	--------	------	--

LSC-01YR

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics
PM-10

Job L.P. Duggannon Source Thermal Oil Heater
Team Leader DB Test Site Stack
Date Submitted _____ Date of Test 12-14-93
Test No. 1 No. of Runs Completed 3
Date of Analysis 12-28-93 Technician C. Helgeson

0	Test <u>1</u> Run <u>0</u> Field Blank Log Number <u>1906-01F</u> Comments _____	Filter No. <u>6147</u> Filter Type <u>2.5"6F</u> Filter Tare Wt. <u>.2613</u> g Filter+Sample Wt. <u>.2613</u> g Sample Wt. <u>0.0000</u> g
1	Test <u>1</u> Run <u>1</u> Log Number <u>-02F</u> Comments _____	Filter No. <u>6150</u> Filter Type <u>2.5"6F</u> Filter Tare Wt. <u>.2632</u> g Filter+Sample Wt. <u>.2645</u> g Sample Wt. <u>0.0013</u> g
2	Test <u>1</u> Run <u>2</u> Log Number <u>-03F</u> Comments _____	Filter No. <u>6152</u> Filter Type <u>2.5"6F</u> Filter Tare Wt. <u>.2546</u> g Filter+Sample Wt. <u>.2566</u> g Sample Wt. <u>0.0020</u> g
3	Test <u>1</u> Run <u>3</u> Log Number <u>-04F</u> Comments _____	Filter No. <u>6155</u> Filter Type <u>2.5"6F</u> Filter Tare Wt. <u>.2601</u> g Filter+Sample Wt. <u>.2619</u> g Sample Wt. <u>0.0018</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

	0.0013	0.0020	0.0018		
--	--------	--------	--------	--	--

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

	0.0021	0.0028	0.0028		
--	--------	--------	--------	--	--

LSC-02PR

Interpoll Laboratories
(612)786-6020

EPA Method 7A Recovery and Analysis Data Sheet (1)

*****SOURCE*****
Job L.P. Duhgahnan
Source Dryer Stack
Date of Sampling 12-15-93
Test No(s) 4

*****RECOVERY*****
Date of Recovery 12-21-93
Recovered by C. Helgeson
Recovery volume 500 ml
Barometric at time 26.926 IN.HG.

*****ANALYTICAL*****
Date of Analysis 12-22-93
Analyst ONS
Eluent ASHA
Chromatograph: Dionex System 4000i

Samples collected in accordance with EPA Method 7, CFR Title 40, Part 60, Appendix A. Samples analyzed in accordance with EPA Method 7A by ion chromatography. Mercury manometers used to measure flask pressures/vacuums in sampling and in recovery. Thommen Model TX 19 jewel barometer calibrated against laboratory mercury in glass barometer used to measure field barometric pressure. Three field blanks are prepared and the average used to correct measured nitrate concentrations. All samples are analyzed as a batch using a Dionex Model 4270 Chromatograph Data Integrator. The integrator is programmed to give the actual concentration of the 500 ml recovered sample even if a subsequent dilution was made. The dilution is indicated here as well as on the chromatogram.

$$C_{RS} = DF(C_{DS}) \quad M_{NO_3} = (C_{RS} - \bar{C}_B)V_R \quad \bar{C}_B = (C_{B1} + C_{B2} + C_{B3})/3$$

where:

C_{RS} = concentration of nitrate in 500 ml recovered sample in ug/ml

DF = dilution factor

C_{DS} = concentration of nitrate of a 500 ml recovered sample which has been diluted by a factor of DF to bring it into the proper range for the ion chromatograph. This value is an intermediate number and is not outputted by the electronic integrator which is programmed to output the concentration of the original undiluted 500 ml recovered sample.

M_{NO_3} = total mass of nitrate in micrograms in the 500 ml recovered sample and/or in the 2L flask.

C_B = average conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

C_{B1}, C_{B2}, C_{B3} = conc. of nitrate in 500 ml recovered samples from the three field blanks (ug/ml)

V_R = recovery volume for samples and field blanks in ml

Interpoll Laboratories
(612)786-6020

EPA Method 7A Recovery and Analysis Data Sheet (2)

Sample Log ID No.	Flask No.	Test/Run	Final Flask Conditions			Chrom Run No.	DF	Nitrate Concentration (ug/ml)		Total nitrate in Sample (ug) (M _{NO3})
			t _f (°F)	+	-			Uncorr. for blank CRS	Corr. for blank (CRS - C _B)	
1	37	4/1/1	70°	✓			1	0.384	0.384	192
2	38	4/1/2		✓	1.6		1	0.380	0.380	190
3	39	4/1/3		✓	0.8		1	0.327	0.327	164
4	40	4/1/1		✓	1.4		1	0.308	0.308	154
5	41	4/2/2		✓	1.2		1	0.301	0.301	151
6	42	4/2/3		✓	1.2		1	0.304	0.304	152
7	25	4/2/1		✓	1.0		1	0.350	0.350	175
8	26	4/2/2		✓	0.1		1	0.372	0.372	186
9	27	4/3/3		✓	2.1		1	0.348	0.348	174
10	28	4/3/1		✓	2.1		1	0.302	0.302	151
11	29	4/3/2		✓	1.7		1	0.372	0.372	186
12	30	4/3/3		✓	0.9		1	0.304	0.304	152
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
Blank 1							1	CB1		
Blank 2							1	CB2		
Blank 3							1	CB3		

C_B =

S-340(2) R-9/85

EPA Method 10 NDIR Analysis

Job Name L.P. Duggan
Source Dyer Stack
Date of Analysis 12-23-93
Technician C. Hefner

NDIR Analyzer: ☐ Fugl ACS Model 3300
☐ Mon. Lab Model 8310
☒ Dasibi Model 3003
Range: 0 - 200 ppm
Flow rate: 1000 cc/min

Pretest Calibration				Post-test Calibration			
Sample Description Test/Run	Conc.	Reading	Vendor	Cyl. Number	Conc.	Reading	Vendor
Zero gas:	0	ppm	0	ppm	0	ppm	T.C.Ox
Upscale gas:	40	ppm	40	ppm	40	ppm	Scott
Upscale gas:	144	ppm	144	ppm	144	ppm	National
Upscale gas:		ppm		ppm		ppm	

Sample Description Test/Run	Sample Log Number	CO Conc. (ppm, Dry)		
		Dilution Factor	Reading	Actual ppm
4/2	1906-45	1	117.1	117.1
4/3	-46	1	121.7	121.7
4/4	-47	10	30.1	300

Sample Description Test/Run	Sample Log Number	CO Conc. (ppm, Dry)		
		Dilution Factor	Reading	Actual ppm

Note 1: If sample dilution is required the sample is diluted with CO-free gas prior to analysis.

Note 2: The Fugl ACS model 3300 has a rejection ratio for CO to CO₂ greater than 100,000: 1 and the Mon. Lab Model 8310 and Dasibi Model 3003 have rejection ratios greater than 200,000: 1 and thus CO₂ removal prior to analysis is not required.

Note 3: The analyzer must be zeroed and spanned immediately before and after sample analysis. Additional checks may be performed between sample analyses if required.

INTERPOLL LABORATORIES INC.

Formaldehyde Results By EPA Method 0011 For LP/Dungannon Collected 12/20/94

Sample Name	Field Spike*			Test 3			
	Actual	Found	% Recovery	F. Blank	Run 1	Run 2	Run 3
Source							
Log #				1906-16	1906-19	1906-21	1906-23
Date Analyzed				1/18/94	1/18/94	1/18/94	1/18/94
Mass (ug)**				2.29	8660	11800	11600

Sample Name	Field Spike*			Test 6			
	Actual	Found	% Recovery	F. Blank	Run 1	Run 2	Run 3
Source							
Log #		1906-63			1906-60	1906-61	1906-62
Date Analyzed		1/18/94			1/18/94	1/18/94	1/18/94
Mass (ug)**	750	643	86		4680	3840	4420

* = Trip blank contained a total of 1.50 ug of formaldehyde
which has been subtracted from the field spike only.

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

Interpoll Laboratories
(612) 786-6020

IMPINGER CATCHES

Project Name: ZP Dungenon #1906

Order Date: 12/10/93

Date Required: 12/10/93

Delivery Date: 12/10/93

Nature of Spiking Material	Spike Concentration	Spike Volume	Total Mass of Spike
2-fluorophenol	49.8 mg/mL	1.2 mL	59.8 mg
D ₆ phenol	5.33 mg/mL	1.0 mL	5.33 mg

SPECIAL REQUIREMENTS

spikes added to the "A" bottles of each "A/B" pair of absorbing solutions consisting of phosphate buffer. (10/10)

**Please return this form with the samples.

INTERPOLL LABORATORIES INC.

Phenol Results By EPA Method 8270 For LP/Dungannon Collected 12/19/94

Item	Test 7		
	Run 1	Run 2	Run 3
<i>Press Vent Stack</i>			
Log #	1906-65	1906-67	1906-69
Date Analyzed	1/10/94	1/10/94	1/10/94
Mass (mg)*	< 2.1	< 2.1	< 2.1
<i>Field Surrogates</i>	<i>% Recovery</i>		
2-Fluorophenol	35.6	41.3	42
Phenol - d6	37	43.7	38.1

* = Total mass of phenol in the sample in mg.

INTERPOLL LABORATORIES INC.

4,4-Methylenebis (phenylisocyanate) Results For LP/Dungannon Collected 12/17/93

Item	ICI Field Spike			Field Spike			Samples			
	Actual	Found	% Recovery	Actual	Found	% Recovery	F. Blank	Run 1	Run 2	Run 3
NIOSH Method 347 (NP2) Filter										
Log #					(1906-27)		(1906-28)	(1906-29)	(1906-30)	(1906-31)
Date Analyzed					12/30/93		12/31/93	12/31/93	12/31/93	12/24/93
Mass (ug)*				215	201	93	< 0.75	420	438	658
EPA Draft Method 1.2-PP Impingers 1&2										
Log #		(1906-38)			(1906-39)		(1906-40)	(1906-32)	(1906-34)	(1906-36)
Date Analyzed		1/4/94			1/4/94		1/4/94	1/4/94	1/4/94	1/4/94
Mass (ug)*	280	288	103	215	202	94	< 2.5	248	292	382
Impinger 3										
Log #								(1906-33)	(1906-35)	(1906-37)
Date Analyzed								1/4/94	1/4/94	1/4/94
Mass (ug)*								3.7	6.3	11.6
Total Mass (ug)**								252	298	394

NP2 = Normal Phase, 0.8mL/min flow rate
 * = Total Mass of MDI in the Sample in ug.
 ** = Total mass of impingers 1, 2, & 3 in ug.

1906 (01-07)

Interpoll Laboratories

(612) 786-6020

Sample Deposition

Job C.P.I. DUNHAM
 Field Engineer DUKE BRENNAN
 Date Submitted 12/20/93
 Test No. 1

Source THERMAL OIL HEATER
 Test Site STACK
 Date of Test 12/14/93
 No. of Runs Completed 3

No.	Sample Type	Analysis	Comments
3 +	Probe Wash: ☒ Acetone ☐ MeCl ₂ ☐ DI Water ☐ _____	☐ As per EPA M-5 ☐ As per EPA M-29 ☒ As per EPA M-201A ☐ Other _____	
3 +	Filter: ☐ 4" Glass ☐ SS Thimble ☒ 2.5" Glass ☐ Pallflex	☐ As per EPA M-5 ☐ As per EPA M-29 ☒ As per EPA M-201A ☐ As per EPA M-17 ☐ Other _____	
0 +	Impingers: ☒ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☐ KOH (Cr VI) ☐ H ₂ SO ₄ (HCl) ☐ 2,4-DNPH ☐ _____ ☐ _____	☐ MN Protocol ☐ WI Protocol ☐ As per EPA M-202 ☐ As per EPA M-6,8 ☐ Acid Gases ☐ Formaldehyde ☐ As per EPA M-29 ☐ As per EPA M-26 ☐ Other _____	<u>NO. BAK HOLT</u>
3	Integrated Gas Sample ☐ Tedlar Bag ☐ _____	☒ As per EPA M-3 ☐ As per EPA M-10 ☐ Other _____	
0	Oxides of Nitrogen (NO _x)	☐ As per EPA M-7A ☐ Other _____	
0 +	☒ Fuel Sample ☐ Aggregate	☐ Attached Form S-0163	<u>SHORT PROXIMITY</u>
0	Particle Size	☐ X-Ray Sedigraph ☐ Cascade Impactor ☐ Other _____	
0	Misc Samples ☐ _____ ☐ _____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other _____	

Type of Source: THERMAL OIL HEATER

Fuel Type:

Coal: ☐ Bituminous
☐ Anthracite
☐ Lignite

Wood: ☐ Wood Waste
☐ Dust
☒ Bark

Oil: ☐ Waste Oil
☐ No. 2
☐ No. 6

☐ Natural Gas
☐ RDF
☐ Other _____

S-278

G:\STACK\WP\FORMS\S-278.LAS

Received from Eugene Brennan
 Sub Day 12/20/93 10:00

Interpoll Laboratories
(612) 786-6020

Sample Deposition

Job LP/DUNNANNON
Field Engineer E TROWBRIDGE
Date Submitted _____
Test No. 2

Source THRMAL OIL HEATER
Test Site STACK
Date of Test 12-14-93
No. of Runs Completed 3

No.	Sample Type	Analysis	Comments
✓ 4	Probe Wash: ☒ Acetone ☐ MeCl ₂ ☐ DI Water ☐ _____	☒ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ Other _____	_____
✓ 4	Filter: ☒ 4" Glass ☐ SS Thimble ☐ 2.5" Glass ☐ Pallflex	☒ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ As per EPA M-17 ☐ Other _____	_____
✓ 4	Impingers: ☒ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☐ KOH (Cr VI) ☐ H ₂ SO ₄ (HCl) ☐ 2,4-DNPH ☐ _____ ☐ _____	☐ MN Protocol ☐ WI Protocol ☐ As per EPA M-202 ☐ As per EPA M-6,8 ☐ Acid Gases ☐ Formaldehyde ☐ As per EPA M-29 ☐ As per EPA M-26 ☒ Other <u>VIRGINIA</u>	_____
✓ 3	Integrated Gas Sample ☒ Tedlar Bag ☐ _____	☒ As per EPA M-3 ☐ As per EPA M-10 ☐ Other _____	_____
✓	Oxides of Nitrogen (NO _x)	☐ As per EPA M-7A ☐ Other _____	_____
✓ 1	☒ Fuel Sample ☐ Aggregate	☒ Attached Form S-0163	_____
	Particle Size	☐ X-Ray Sedigraph ☐ Cascade Impactor ☐ Other _____	_____
	Misc Samples ☐ _____ ☐ _____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other _____	_____

Type of Source: THERMAL OIL HEATER
Fuel Type:
Coal: ☐ Bituminous ☐ Anthracite ☐ Lignite
Wood: ☐ Wood Waste ☐ Dust ☒ Bark
Oil: ☐ Waste Oil ☐ No. 2 ☐ No. 6
☐ Natural Gas ☐ RDF ☐ Other _____

Received from
Eugene Brenner
12/26/93 1300

1906 (16-26)

ABOVE 1ST RUN 1/2 ON
THROUGH. POSSIBLY MIGHT NOT
SAMPLE RECOVERED. SEE K.E.

Interpoll Laboratories
(612) 786-6020

Sample Deposition

Job L.P.1 DUNBANNON Source DRYER
Field Engineer DUNC BRENNAN Test Site STALK
Date Submitted 12/20/93 Date of Test 12/15/93
Test No. 3 No. of Runs Completed 3

No.	Sample Type	Analysis	Comments
3 + BLANK	Probe Wash: + Impinger Rinse ☐ Acetone ☒ MeCl ₂ ☒ DI Water ☐ _____	☐ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☒ Other <u>METHOD 8011</u>	1 extra probe wash + rinse and Blank Half combined - 1 Bottle
0	Filter: ☐ 4" Glass ☐ SS Thimble ☐ 2.5" Glass ☐ Pallflex	☐ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ As per EPA M-17 ☐ Other _____	
3 + FIELD BLANK (TRAIN)	Impingers: ☐ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☐ KOH (Cr VI) ☐ H ₂ SO ₄ (HCl) ☒ 2,4-DNPH ☐ _____ ☐ _____	☐ MN Protocol ☐ WI Protocol ☐ As per EPA M-202 ☐ As per EPA M-6,8 ☐ Acid Gases ☐ Formaldehyde ☐ As per EPA M-29 ☐ As per EPA M-26 ☒ Other <u>METHOD 1001</u>	
3	Integrated Gas Sample ☒ Tedlar Bag ☐ _____	☒ As per EPA M-3 ☐ As per EPA M-10 ☐ Other _____	
0	Oxides of Nitrogen (NO _x)	☐ As per EPA M-7A ☐ Other _____	
0	☐ Fuel Sample ☐ Aggregate	☐ Attached Form S-0163	
0	Particle Size	☐ X-Ray Sedigraph ☐ Cascade Impactor ☐ Other _____	
0	Misc Samples ☐ _____ ☐ _____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other _____	

Type of Source: DRYER

Fuel Type:

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

Received for
Engineer Brennan

Bobby 12/30/93 1200

S-278

GASTACKIWPFORMSIS-278.LAS

1906 (41-59)

Run #1 was

ABORTED 1/2 way THROUGH

we saved sample!

Interpoll Laboratories

(612) 786-6020

Sample Deposition

Job LOUISIANA PACIFIC / DUNBARSource DRYERField Engineer ETROWBRIDGETest Site STOCKDate Submitted 12/20/93Date of Test 12-15-93Test No. 4No. of Runs Completed 3

No.	Sample Type	Analysis	Comments
✓ 4	Probe Wash: ☒ Acetone ☐ MeCl ₂ ☐ DI Water ☐ _____	☒ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ Other _____	
✓ 5	Filter: ☒ 4" Glass ☐ SS Thimble ☐ 2.5" Glass ☐ Pallflex	☒ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ As per EPA M-17 ☐ Other _____	
✓ 4	Impingers: ☒ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☐ KOH (Cr VI) ☐ H ₂ SO ₄ (HCl) ☐ 2,4-DNPH ☐ _____ ☐ _____	As per EPA M-202 ☐ WI Protocol ☒ As per EPA M-202 ☐ As per EPA M-6,8 ☐ Acid Gases ☐ Formaldehyde ☐ As per EPA M-29 ☐ As per EPA M-26 ☐ Other _____	<u>NITROGEN</u>
3	Integrated Gas Sample ☒ Tedlar Bag ☐ _____	☒ As per EPA M-3 ☒ As per EPA M-10 ☐ Other _____	<u>(RAGS 2, 3 & 4)</u> <u>Runs - 2, 3 & 4</u>
14	Oxides of Nitrogen (NO _x)	☒ As per EPA M-7A ☐ Other _____	
	☐ Fuel Sample ☐ Aggregate	☐ Attached Form S-0163	
	Particle Size	☐ X-Ray Sedigraph ☐ Cascade Impactor ☐ Other _____	
	Misc Samples ☐ _____ ☐ _____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other _____	

Type of Source: Dryer

Fuel Type:

Coal: ☐ BituminousWood: ☐ Wood WasteOil: ☐ Waste Oil☐ Natural Gas☐ Anthracite☐ Dust☐ No. 2☐ RDF☐ Lignite☐ Bark☐ No. 6☐ Other _____

Received 12/20/93 B. H. 1200

S-278

CASTACKWPF00MSS-278-LAS

1406 (60-63)

Interpoll Laboratories
(612) 786-6020

Sample Deposition

Job LP/DUNGANNONSource Press VentField Engineer ETRONBIDARTest Site STAIRDate Submitted 12-10-93Date of Test 12-10-93Test No. 6No. of Runs Completed 3

No.	Sample Type	Analysis	Comments
	Probe Wash: ☐ Acetone ☐ MeCl ₂ ☐ DI Water ☐ _____	☐ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ Other _____	
	Filter: ☐ 4" Glass ☐ SS Thimble ☐ 2.5" Glass ☐ Pallflex	☐ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ As per EPA M-17 ☐ Other _____	
6	Impingers: ☐ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☐ KOH (Cr VI) ☐ H ₂ SO ₄ (HCl) ☒ 2,4-DNPH ☐ _____ ☐ _____	☐ MN Protocol ☐ WI Protocol ☐ As per EPA M-202 ☐ As per EPA M-6,8 ☐ Acid Gases ☒ Formaldehyde ☐ As per EPA M-29 ☐ As per EPA M-26 ☐ Other _____	
0	Integrated Gas Sample ☐ Tedlar Bag ☐ _____	☐ As per EPA M-3 ☐ As per EPA M-10 ☐ Other _____	
	Oxides of Nitrogen (NO _x)	☐ As per EPA M-7A ☐ Other _____	
	☐ Fuel Sample ☐ Aggregate	☐ Attached Form S-0163	
	Particle Size	☐ X-Ray Sedigraph ☐ Cascade Impactor ☐ Other _____	
	Misc Samples ☐ _____ ☐ _____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other _____	

Type of Source: Press Vent

Fuel Type:

Coal: ☐ Bituminous
☐ Anthracite
☐ LigniteWood: ☐ Wood Waste
☐ Dust
☐ BarkOil: ☐ Waste Oil
☐ No. 2
☐ No. 6☐ Natural Gas
☐ RDF
☐ Other _____Received from
Eugene Brenner
12/10/93 1200 BTH

S-278

GASTACKWPF00MSS-378.LAS

1906 (64-70)

7 Jars

Interpoll Laboratories

(612) 786-6020

Sample Deposition

Job L.P./DUNGANNONSource PRESS VENTField Engineer DWHTest Site STACKDate Submitted 12/19/93Date of Test 12/16/93Test No. 7No. of Runs Completed 3

No.	Sample Type	Analysis	Comments
	Probe Wash: ☐ Acetone ☐ MeCl ₂ ☐ DI Water ☐	☐ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ Other	
	Filter: ☐ 4" Glass ☐ SS Thimble ☐ 2.5" Glass ☐ Pallflex	☐ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ As per EPA M-17 ☐ Other	
4. Pairs	Impingers: ☐ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☐ KOH (Cr VI) ☐ H ₂ SO ₄ (HCl) ☐ 2,4-DNPH ☒ <u>Neutral Buffer</u> ☒ <u>Reagent</u>	☐ MN Protocol ☐ WI Protocol ☐ As per EPA M-202 ☐ As per EPA M-6,8 ☐ Acid Gases ☐ Formaldehyde ☐ As per EPA M-29 ☐ As per EPA M-26 ☒ Other <u>Phenols</u>	<u>Note: One of</u> <u>the bottles was</u> <u>broke upon arrival</u> <u>to jobsite. NEED TO</u> <u>HAVE A NEW Blank</u>
	Integrated Gas Sample ☐ Tedlar Bag ☐	☐ As per EPA M-3 ☐ As per EPA M-10 ☐ Other	<u>poured. Pay No</u> <u>Attention to</u>
	Oxides of Nitrogen (NO _x)	☐ As per EPA M-7A ☐ Other	<u>Writing on top</u> <u>of bottle.</u>
	☐ Fuel Sample ☐ Aggregate	☐ Attached Form S-0163	
	Particle Size	☐ X-Ray Sedigraph ☐ Cascade Impactor ☐ Other	
	Misc Samples ☐ ☐	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other	

Type of Source:

Fuel Type:

Coal: ☐ Bituminous
☐ Anthracite
☐ Lignite

Wood: ☐ Wood Waste
☐ Dust
☐ Bark

Oil: ☐ Waste Oil
☐ No. 2
☐ No. 6

☐ Natural Gas
☐ RDF
☐ Other

Received for
Engine Breuer
12/30/93 1200

S-278

GASTACKWPFORMS-278.LAS

Interpoll Laboratories

(612) 786-6020

Sample Deposition

Job 2P/DUNHAMMAN
 Field Engineer E. T. [Signature]
 Date Submitted _____
 Test No. 9

Source Press Vent
 Test Site Stack
 Date of Test 12-17-93
 No. of Runs Completed 3

No.	Sample Type	Analysis	Comments
✓ 4	Probe Wash: ☐ Acetone ☒ MeCl ₂ ☐ DI Water ☐ _____	☐ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☒ Other <u>MDI</u> <u>ICAM 347</u>	<u>Plus 1 Field SPIRE (NITRO)</u>
✓ 4	Filter: ☐ 4" Glass ☐ SS Thimble ☒ 2.5" Glass ☐ Pallflex	☐ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ As per EPA M-17 ☒ Other <u>ICAM 347 - MDI</u>	<u>See Probe Wash</u>
0	Impingers: ☐ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☐ KOH (Cr VI) ☐ H ₂ SO ₄ (HCl) ☐ 2,4-DNPH ☐ _____ ☐ _____	☐ MN Protocol ☐ WI Protocol ☐ As per EPA M-202 ☐ As per EPA M-6,8 ☐ Acid Gases ☐ Formaldehyde ☐ As per EPA M-29 ☐ As per EPA M-26 ☐ Other _____	
0	Integrated Gas Sample ☐ Tedlar Bag ☐ _____	☐ As per EPA M-3 ☐ As per EPA M-10 ☐ Other _____	
	Oxides of Nitrogen (NO _x)	☐ As per EPA M-7A ☐ Other _____	
	☐ Fuel Sample ☐ Aggregate	☐ Attached Form S-0163	
	Particle Size	☐ X-Ray Sedigraph ☐ Cascade Impactor ☐ Other _____	
	Misc Samples ☐ _____ ☐ _____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other _____	

Type of Source: _____

Fuel Type:

Coal: ☐ Bituminous
☐ Anthracite
☐ Lignite

Wood: ☐ Wood Waste
☐ Dust
☐ Bark

Oil: ☐ Waste Oil
☐ No. 2
☐ No. 6

☐ Natural Gas
☐ RDF
☐ Other _____

Received from
Engene Brenner
12/15/93 1200

S-278

C:\STACK\WP\FORMS\S-278.LAS

1906 (32-40)

Interpoll Laboratories
(612) 786-6020
Sample Deposition

Job L.P. / DUNGENNON Source PRESS VENT
Field Engineer D.H. Test Site Stack
Date Submitted 12/19/93 Date of Test 12/17/93
Test No. 10 No. of Runs Completed 3

No.	Sample Type	Analysis	Comments
3	Probe Wash: ☐ Acetone ☐ MeCl ₂ ☐ DI Water ☒ <u>Stu Toluene + Acetone</u>	☐ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ Other _____	
N/A	Filter: ☐ 4" Glass ☐ SS Thimble ☐ 2.5" Glass ☐ Pallflex	☐ As per EPA M-5 ☐ As per EPA M-29 ☐ As per EPA M-201A ☐ As per EPA M-17 ☐ Other _____	
4	Impingers: ☐ DI Water ☐ 3% H ₂ O ₂ ☐ 1N NaOH ☐ KOH (Cr VI) ☐ H ₂ SO ₄ (HCl) ☐ 2,4-DNPH ☒ <u>1-2 PP IN TOLUENE</u>	☐ MN Protocol ☐ WI Protocol ☐ As per EPA M-202 ☐ As per EPA M-6,8 ☐ Acid Gases ☐ Formaldehyde ☐ As per EPA M-29 ☐ As per EPA M-26 ☒ Other <u>MDS - 12 PP</u>	<u>See P.L. or G.H.</u> <u>INCLUDES 1 BLANK</u> <u>& 2 Spikes</u> <u>including 1 from</u> <u>ICI</u>
	Integrated Gas Sample ☐ Tedlar Bag ☐ _____	☐ As per EPA M-3 ☐ As per EPA M-10 ☐ Other _____	<u>Probe wash is</u> <u>included in imp</u>
	Oxides of Nitrogen (NO _x) ☐ _____	☐ As per EPA M-7A ☐ Other _____	<u>1 & 2 samples</u>
	☐ Fuel Sample ☐ Aggregate	☐ Attached Form S-0163	
	Particle Size ☐ _____	☐ X-Ray Sedigraph ☐ Cascade Impactor ☐ Other _____	
	Misc Samples ☐ _____ ☐ _____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other _____	

Type of Source: Process Vent

Fuel Type:

Coal: ☐ Bituminous ☐ Anthracite ☐ Lignite
Wood: ☐ Wood Waste ☐ Dust ☐ Bark
Oil: ☐ Waste Oil ☐ No. 2 ☐ No. 6
☐ Natural Gas ☐ RDF ☐ Other _____

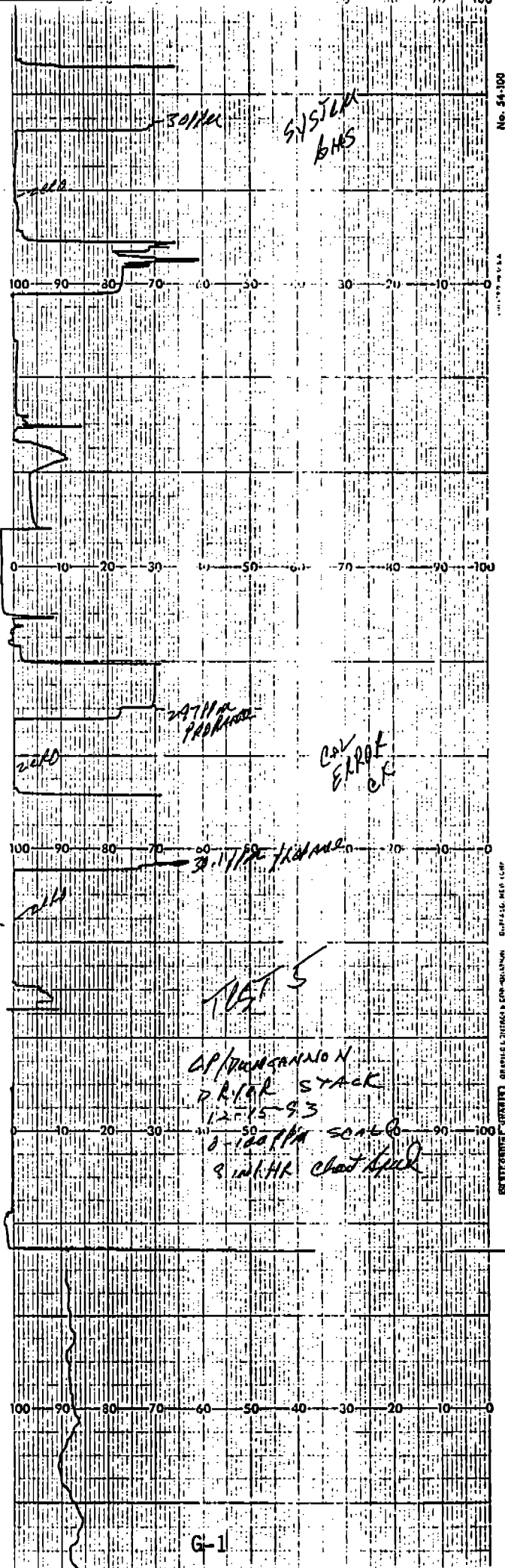
S-278

GASTACKWFORMSS-278.LAS

APPENDIX G

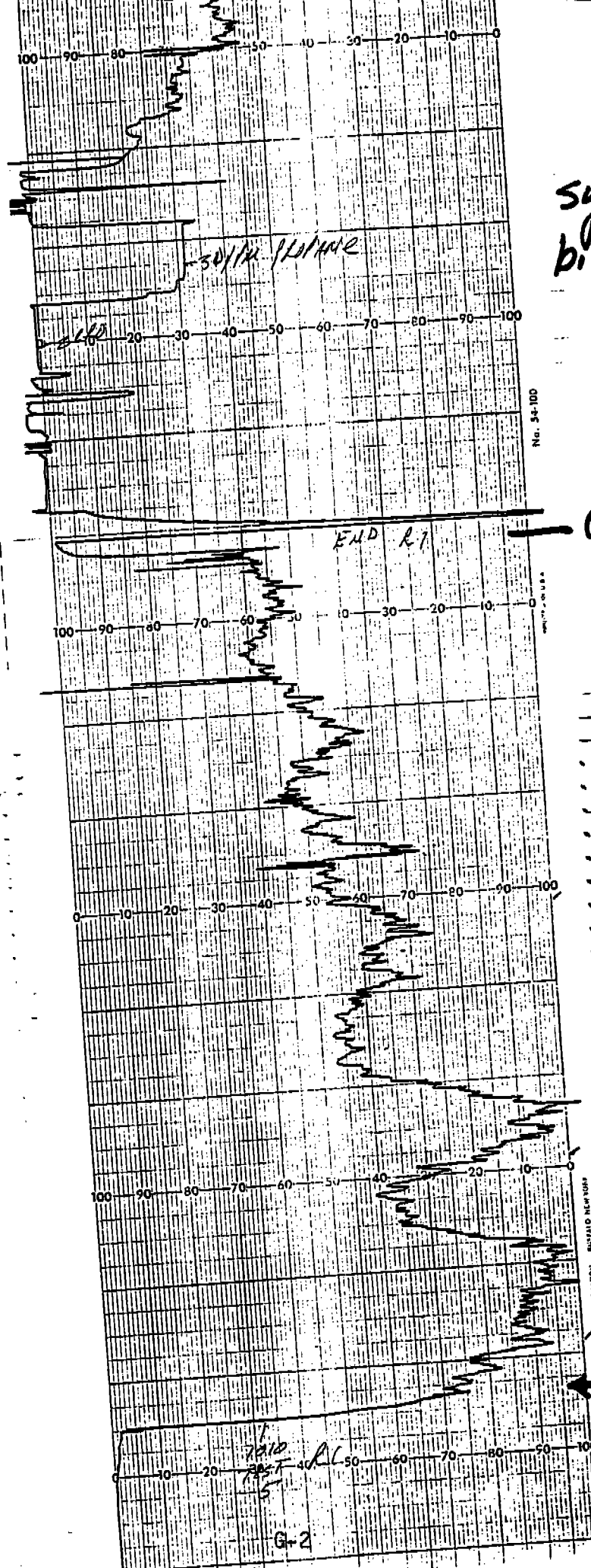
TOTAL HYDROCARBONS STRIPCHART

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



Calibration
DATA

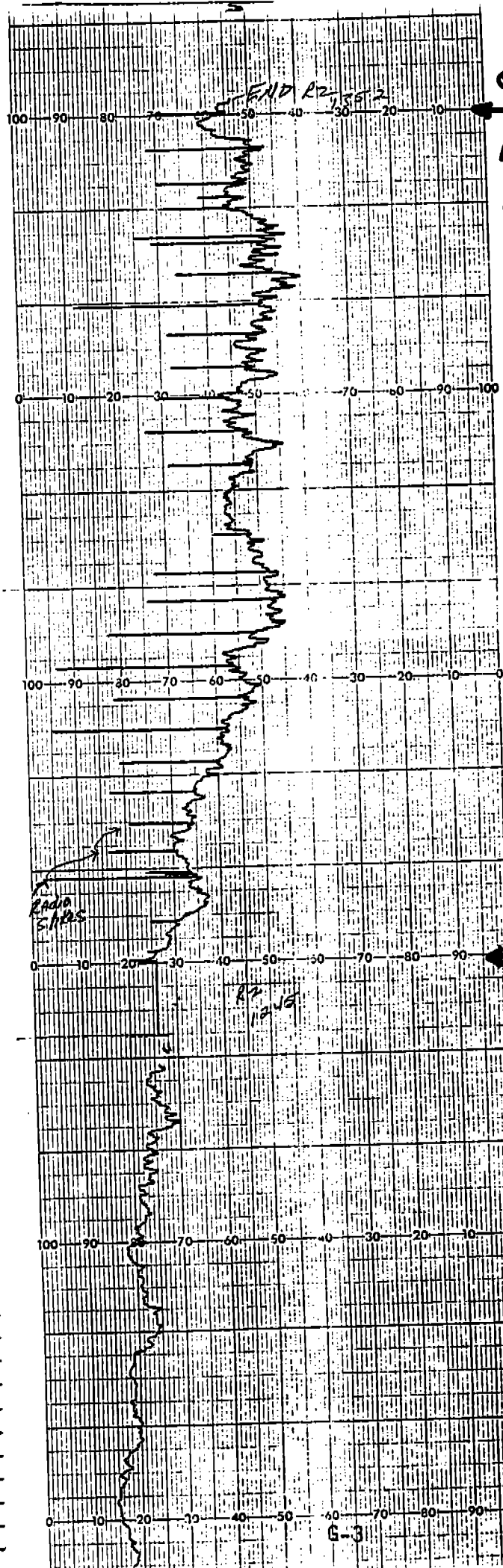
12-15-93
THC - LP
DRYER STACK
0-100 scale
ppm, w as
propane



system
bias check

end Run 1
1120 HRS

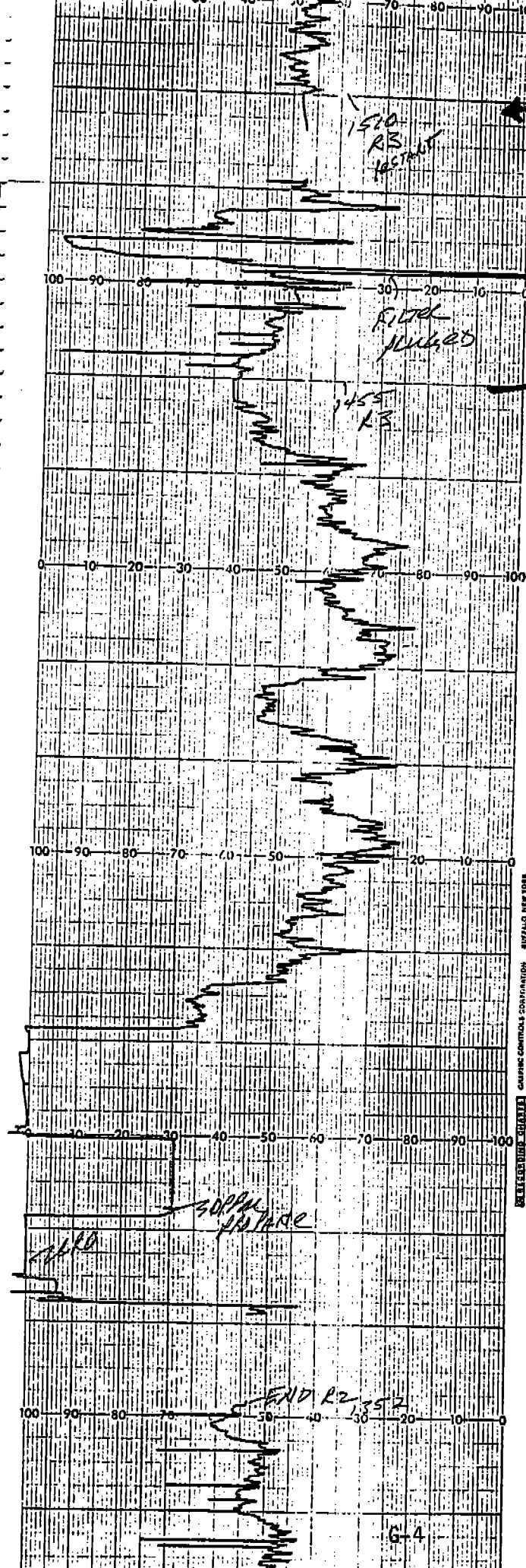
↑ Time
start Run 1
1010 HRS



end
Run 2
1352 HR

1245 HRS
Start
Run 2

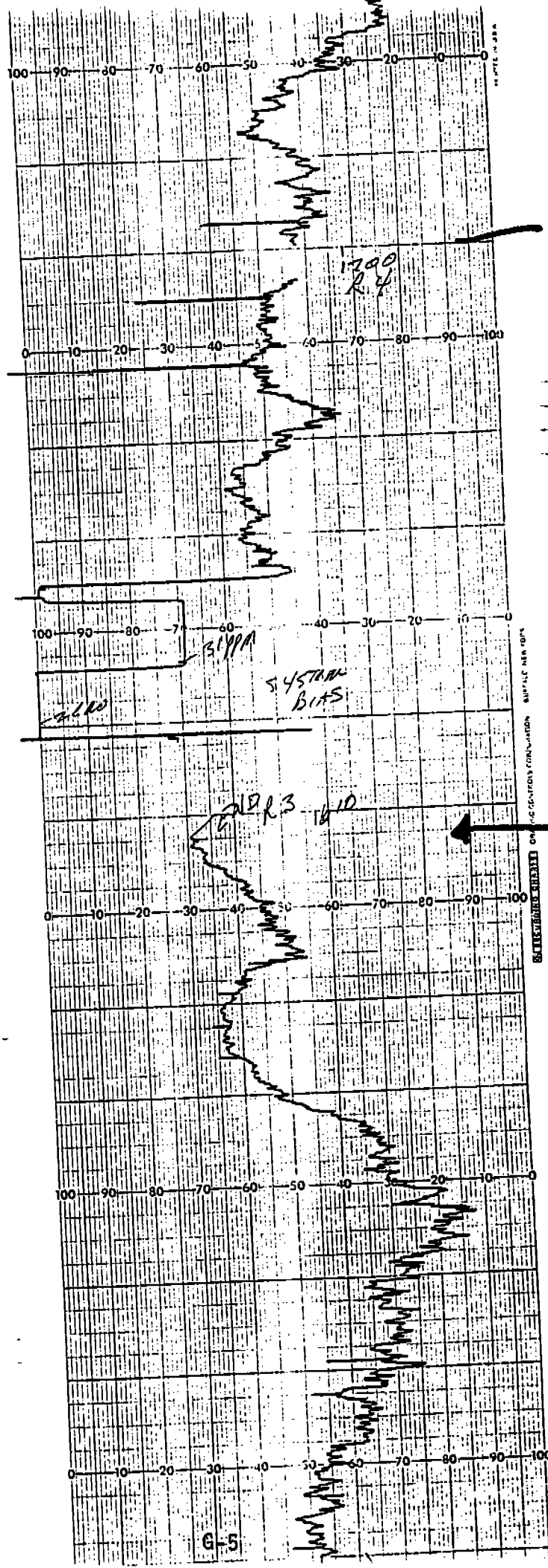
LEGEND: (P) GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK



Restart
Run 3

1455 HRS
start
Run 3

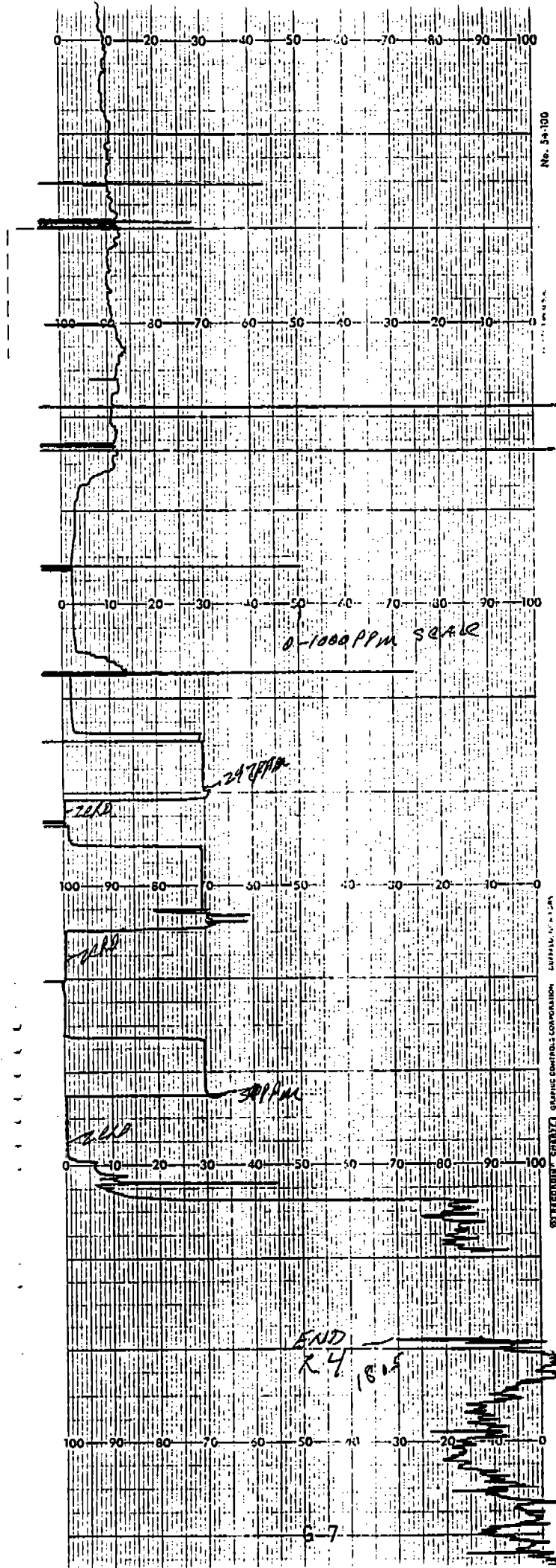
System
Bias



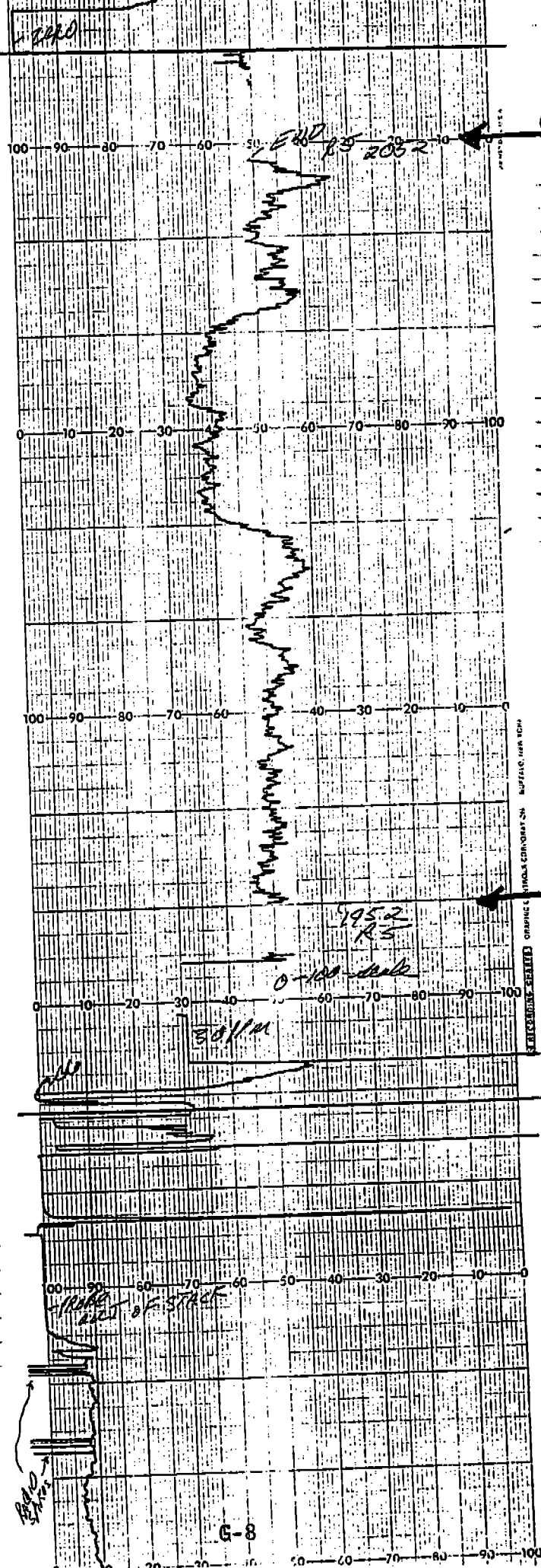
Start Run 4
1700 HRS

System
Bias
Check

END Run 3
1610 HRS



System
Bias
Check



End Run 5
2052 HRS

Start Run 5
1952 HRS

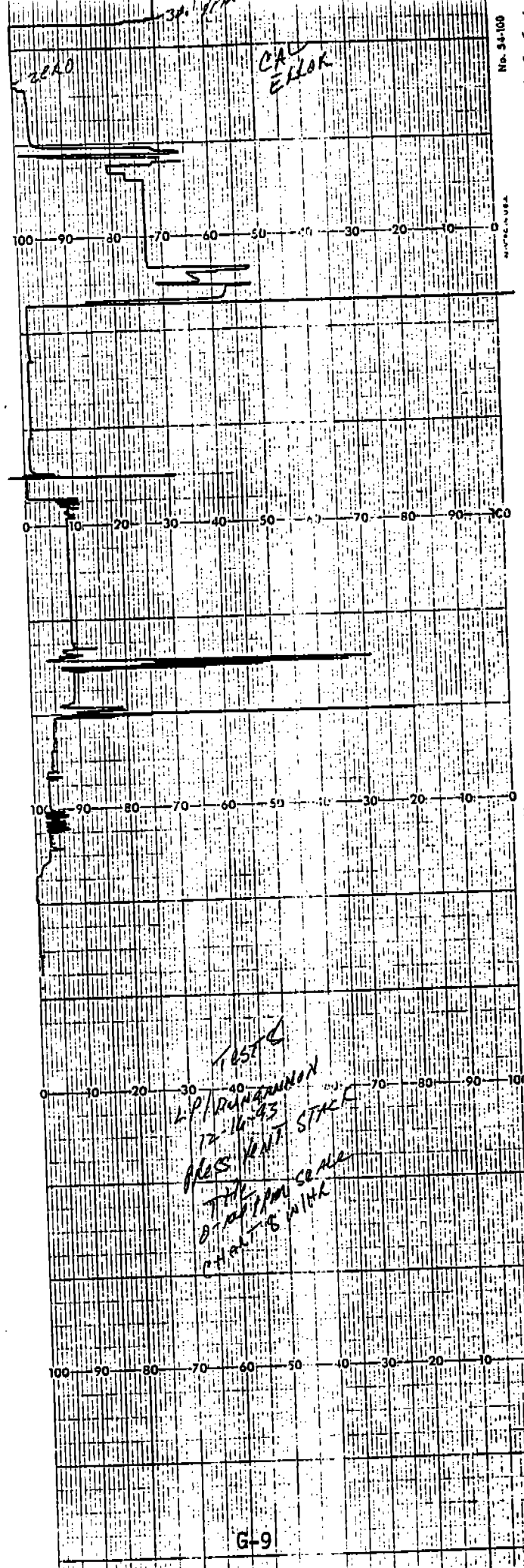
1952
RS

0-100 scale

80/100

1952
RS

End Run 5

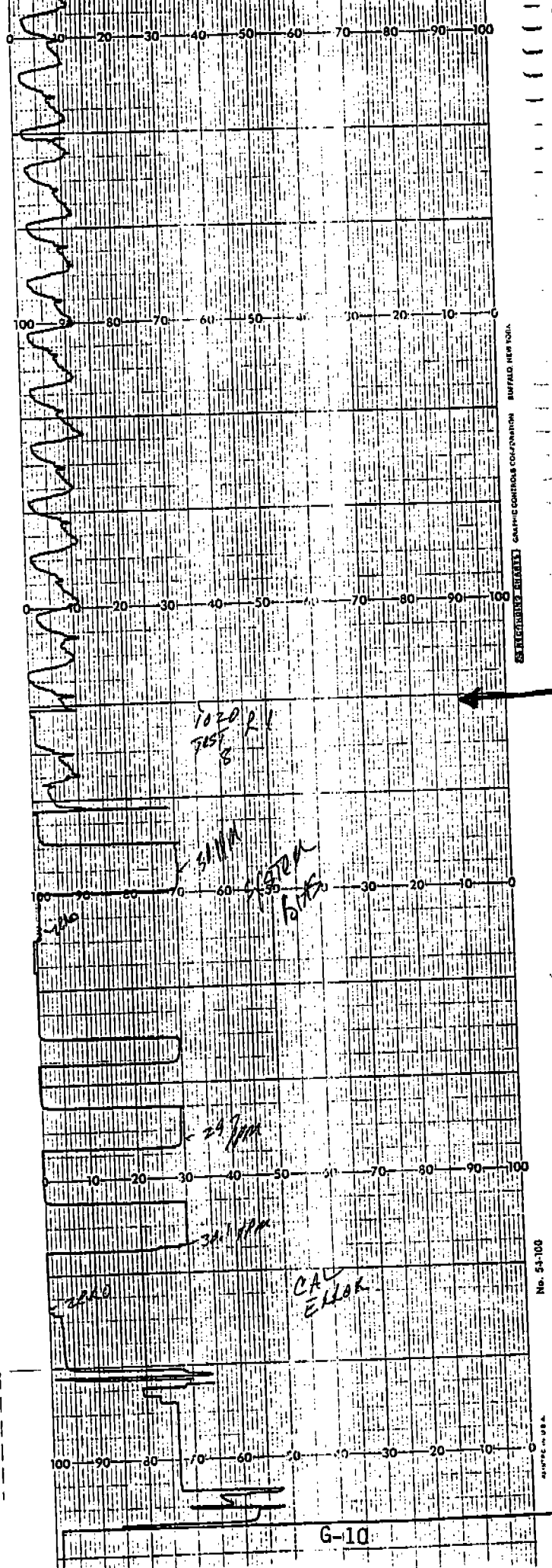


LP-PRESS

THC

12-16-93

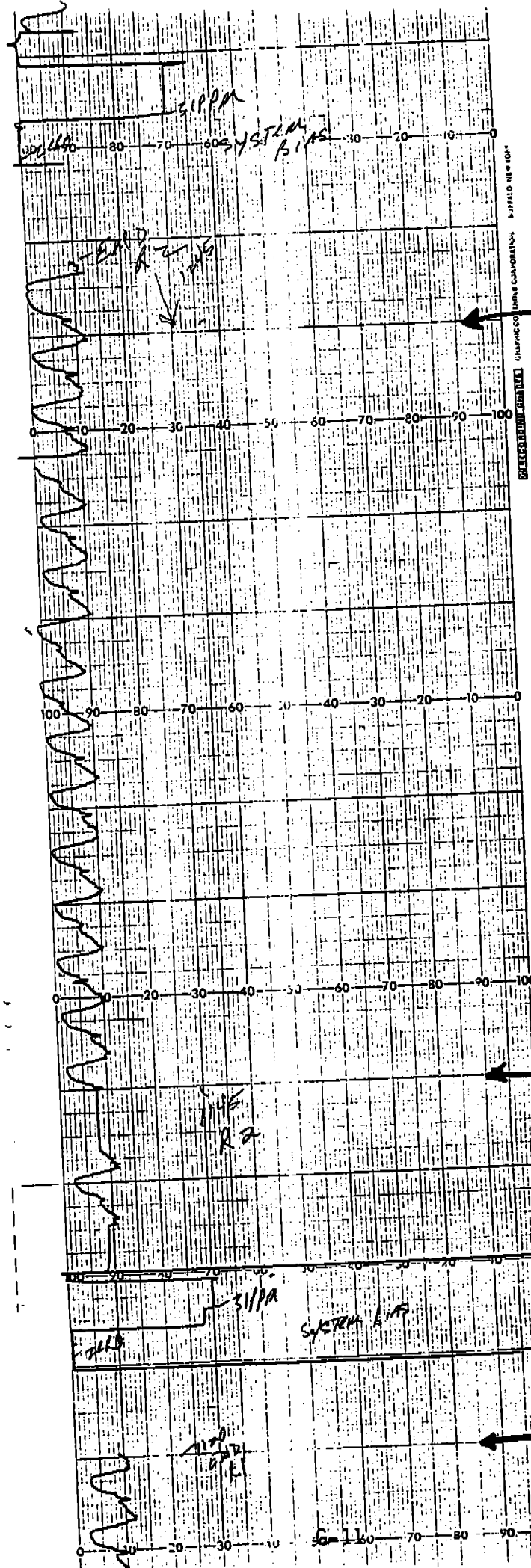
0-100 ppm, w
as propane
scale



Start Run 1
1020 HRS

System
bias
check

system
Bias Check

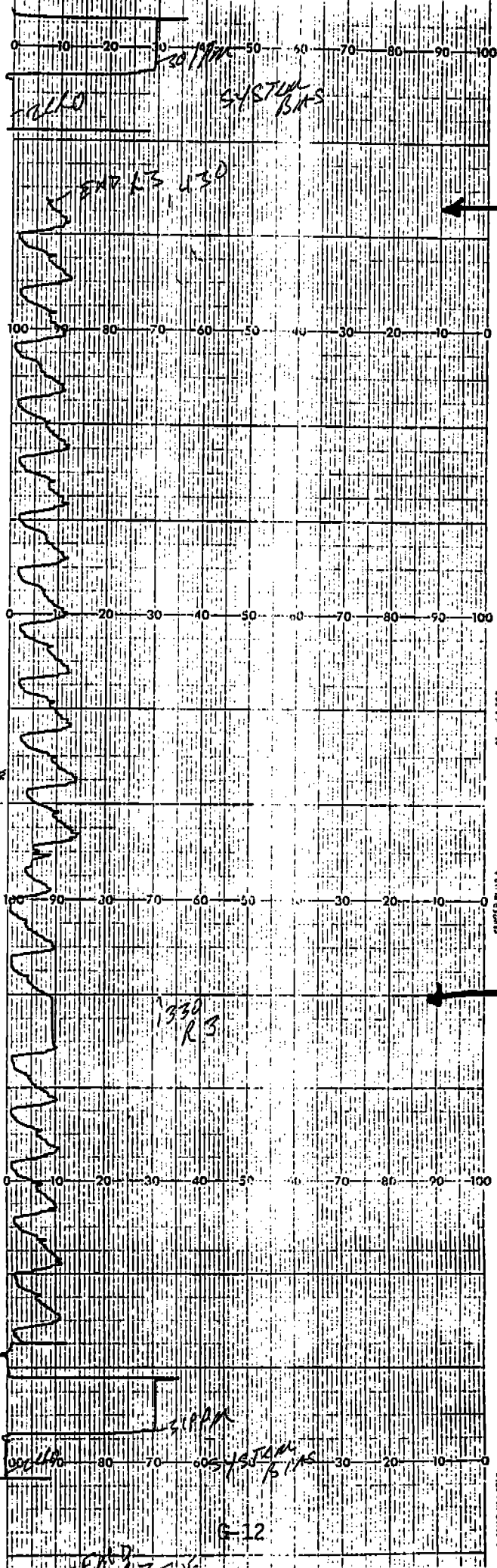


end Run 2
1245 HRS

start Run 2
1145 HRS

system
Bias check

end Run 1
1120 HRS



end Run 3
1430 HRS

start Run 3
1330 HRS

APPENDIX H

THC ANALYZER SPECIFICATIONS

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



TOTAL HYDROCARBON ANALYZER (FLAME IONIZATION)
Model RS 55

TECHNICAL DATA

MAINS : 115V/60H

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

MODEL: X 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...

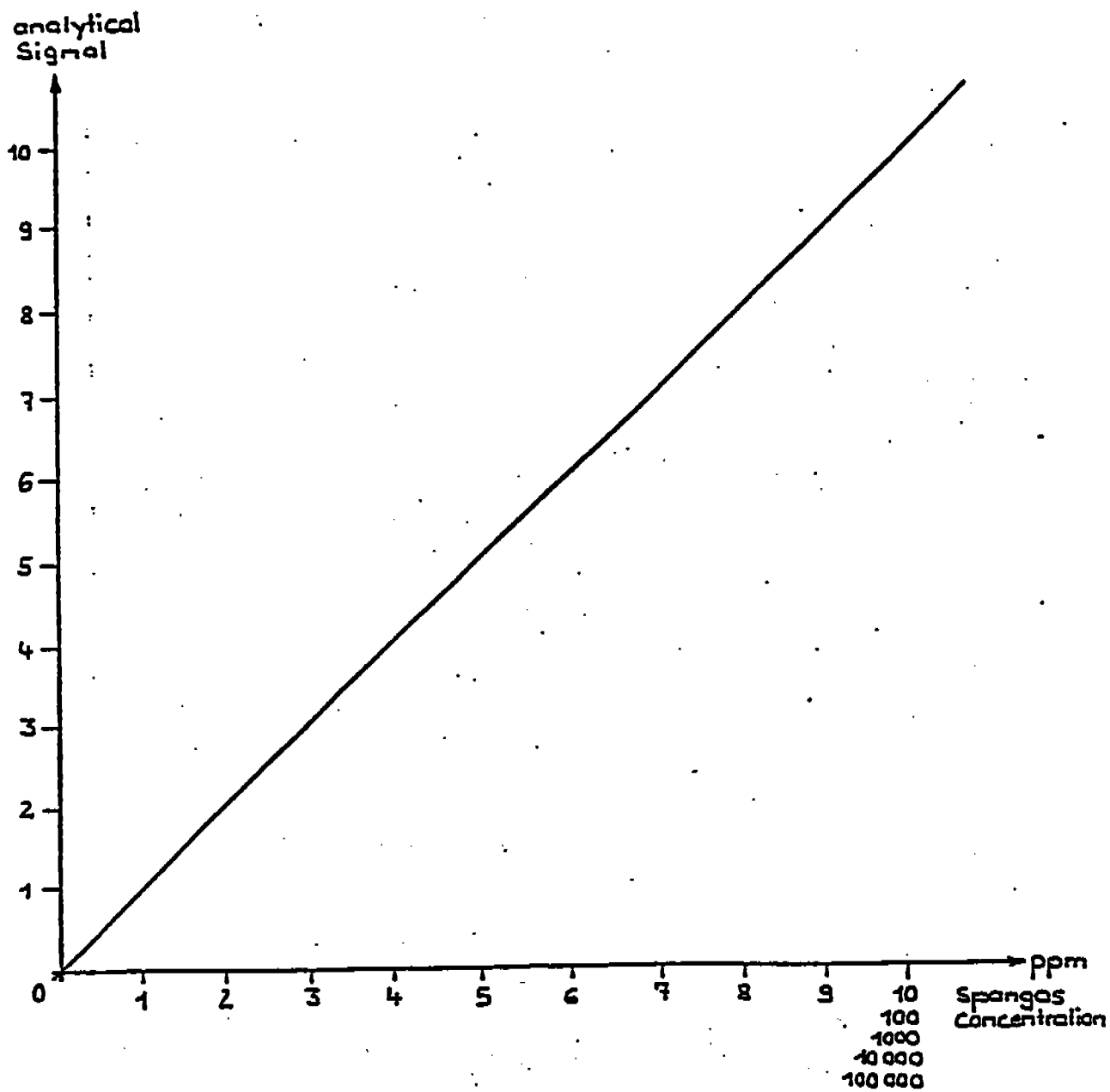
Pressure Setting: Sample/Spangas/Zerogas: 200 mbar

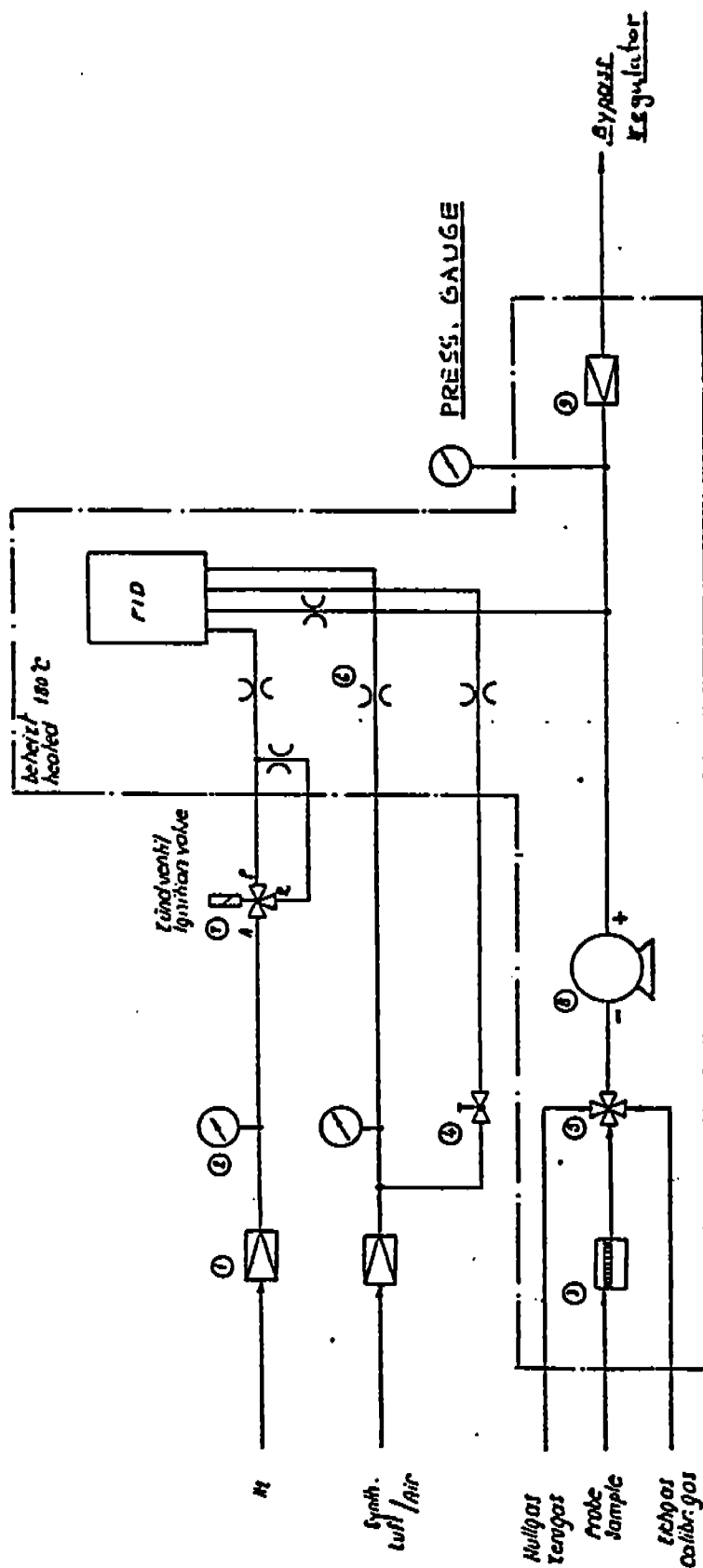
Fuel: Hydrogen : ... 0,35 bar

Combustion Air : ... 0,80 bar

Span Gases : ..300. ppm C₁
24.000. ppm C₁

CALIBRATION DIAGRAMM





zündventil/
ignition valve
P-A angeschlossen
energized
R-A Stromlos
at rest

- 1 Druckregler
pressure regulator
- 2 Manometer
Gauge
- 3 Filter
A filter
- 4 Nadelventil/
Needle valve
- 5 3 Wege Ventil/
3 way valve
- 6 Kapillare
capillary
- 7 Magnetventil/
magnet valve
- 8 Pumpe
pump
- 9 Rückdruckregler
back pressure regulator

Handumkehrung
manual switching

FLAMMEN IONISATIONS DETECTOR
Flame Ionization Detector

RS SS

13.04.88

Rafisch
INSTRUMENTE
Analytische Systeme - Deutschland

APPENDIX I

MEASUREMENT SYSTEMS PERFORMANCE SPECIFICATIONS

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

Job LF/PUNAWAN
Source DRYER STACK
Test 5 Run Date 12-15-93
Stack dimen. 48 IN.
Dry bulb °F Wet bulb °F
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
Barometric pressure in Hg
Static pressure in WC
Operators ET-D/VH
Pitot No. C_p

Cross-section View	Elevation View
Drawing of the structure to be	

[illegible]

INTERPOLL LABORATORIES

Calibration Error Check

Job LP/DUNHAMNONTest 5 Run _____ Date 12-15-93
Operator E. T. WhiteTAL SO₂ Calibration:

Time (HRS) _____

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	0	0	100	0
Mid level	30.1	30.0	0	100	.0
High level	247	300	3	100	.3

NO_x Calibration:

Time (HRS) _____

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

O₂ Calibration:

Time (HRS) _____

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

CO₂ Calibration:

Time (HRS) _____

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

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

S-420-10

INTERPOLL LABORATORIES
(612) 786-6020

THC System Bias Check

Job 10/DUNFANNOX Source DRYER
est 5 Run 1 Date 12-15-93 Site STACK
Operator ETHELBRIDGE

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm)		Diff. CE-SB (ppm)	Span Val (PPM)	% of span
				Cal	Err			
1	0940	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	30	0	100	0
2	1045	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	31	1	100	1
3	1200	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	30	0	100	0
4	1355	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	30	0	100	0
5	1458	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	30	0	100	0
6	1615	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	31	1	100	1
7	1810	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	30	0	100	0
8	1830	Zero gas	0	0	0	0	1000	0
		Upscale	297	300	300	—	1000	0
9	1940	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	30	0	100	0
10	2055	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	30	0	100	0
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

Calibration Error Check & Drift Determination

Job LP/DUNBARTest 5 Run 0 Date 12-15-93Operator E. TROUBLE

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	30.1			100	
Mid level	297			1000	
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					

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

Job LP/DUNBARN
Source PRESS VENT STACK
Test 8 Run Date 12-16-93
Stack dimen. 59.5 IN.
Dry bulb °F Wet bulb °F
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
Barometric pressure in Hg
Static pressure in WC
Operators
Pitot No. C_p

Cross-section View	Elevation View
-------------------------------	---------------------------

Drawing
of Test Site

[illegible]

INTERPOL LABORATORIES
(612) 786-6020

THC System Bias Check

Job LP/DUGANNO Source PROCESS VENT STACK
Test 8 Run 1-3 Date 12-18-83 Site STAFF
Operator ETROWBRIDGE

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm)		Diff. CE-SB (ppm)	Span Val (PPM)	% of span
				Cal Err	Sys Bias			
1	1020	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	30	0	100	0
2	1125	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	30	0	100	0
3	1420	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	31	1	100	1
4	1435	Zero gas	0	0	0	0	100	0
		Upscale	30.1	30	29	1	100	1
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.

S420-11R

INTERPOLL LABORATORIES

EPA Method 25A

Calibration Error Check & Drift Determination

Job LP/DUNHAMMANTest ✓ Run Date 12-15-93Operator E. T. Sandoz

THC Calibration (Low Range):

Time (HRS)

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	0	0	100	
Low level	30.1	30	.1	100	
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					

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

APPENDIX J

CALIBRATION GAS CERTIFICATION SHEETS

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



Scott Specialty Gases

a division of
Scott Environmental Technology, Inc.

Our Project # : 5
Your P.O. # : 40142

1290 COMBERMERE STREET, TROY, MICHIGAN 48064 (313) 589-2950

Expiration Date : 12-11-93

C/O. WEB BARBER POINT COAL
91-086 KAOH LOOP
ENA BEACH HI 96707

1111 CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES 1111
PERFORMED ACCORDING TO SECTION 3.0.4
Procedure # 61

Cylinder Number : ALM018537

Protocol # 1

Cylinder Pressure 1900 psig

File # PO-3533

Certified Accuracy 1 % NBS Traceable

1 of 1 Component(s)

ANALYZED CYLINDER

INSTRUMENTATION

REFERENCE STD

LAST CALIBRATION DATE

ANALYTICAL PRINCIPLE

FLAME IONIZATION DETECTOR

INSTR./MODEL/SERIAL #

BECKMAN 400

COMPONENT

PROPANE

30.17 PPM

CYLINDER NUMBER

CONC.

FF-26980 47.80 PPM

ALM-008846 31.20 PPM

BALANCE GAS : AIR

ANALYSIS

DATE : 6-11-92

ZERO : TEST	REFERENCE	
	GAS	CONC.
GAS (mV)	RESULTS PPM	(mV)
0.00	30.30	47.80 PPM
0.00	30.30	47.80
0.00	30.30	47.80

CALCULATED RESULTS
30.17
30.17
30.17
AVERAGE : 30.17 PPM

CALIBRATION CURVE				3 rd DEGREE
SRM #	CONC. (CRM #)	SPLIT PPM	FWM PT (%)	FITTED VALUE
1667B	47.80	100	47.80	47.80 0.00
8MIS	31.20	65	31.40	31.26 0.20
	22.61	47	22.60	22.53 -0.35
NARM	8.17	17	8.20	8.23 0.70
	0.00	0	0.00	0.00 0.00
		0		0.0000 0.00
		0		0.00 0.00
NARM	8.17	LOW	8.20	8.23 0.70
1664B	47.80	HIGH	47.80	47.80 0.00

ANALYST : Dan Eickler Jr

APPROVED BY : J. Shapiro

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.



Scott Specialty Gases, Inc.

RECEIVED

MAY 28 1991

**GEN EX, LTD.
ROSEVILLE, MN**

1290 COMBERMERE STREET, TROY, MI 48083-0000
PHONE: 313-589-2950 FAX: 313-589-2134

5/13/91

GENEX
2455 CLEVELAND AVENUE N.

PROJECT #: 05-23460
PO #: 4165SA

ROSEVILLE

MN 55113-0000

CYLINDER #: ALM014650

ANALYTICAL ACCURACY: +-1%

COMPONENT

REQUESTED
CONCENTRATION

ANALYSIS 1
(MOLES) U/M

PROPANE
AIR

300.0 PPM
BALANCE

297.6 PPM
N/A

NOTES: ACUBLEND MASTER GAS

ANALYTICAL METHOD: AMG

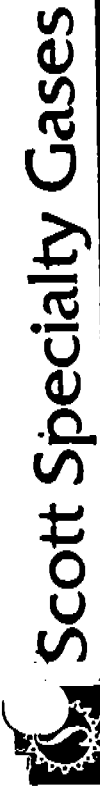
DATE OF ANALYSIS: 5/09/91

ANALYST: A. Behn

ANALYST

APPROVED BY: J. Shapiro

SUPERVISOR



Scott Specialty Gases a division of
Scott Environmental Technology, Inc.

1280 COMBERMERE STREET, TROY, MICHIGAN 48064 (313) 589-2950

Customer:

OXYGEN SERVICE

1111 PIERCE BUTLER ROUTE

ST. PAUL, MN. 55104

Shipped From Scott Michigan

Our Project # 328651

Your P.O. # 4371-BA

Expiration Date: 4-6-93

Cylinder Number ALM-007466

Cylinder Pressure 1900 psig

1111 CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES

PERFORMED ACCORDING TO SECTION 3.0.4

Certified Per Traceability Procedure # 81

Protocol # 1

Certified Accuracy 1% NBS Traceable

REFERENCE STD

COMPONENT	CERTIFIED CONC.
PROPANE	2996 PPM

SRM # (CRM #)	CYLINDER NUMBER	CONC.
2648	FF-26710	4892.00-PPM
2646	AAL-18432	973.20 PPM

GAS ANALYZER

MAKE/MODEL

GAS CHROMATOGRAPHY
VARIAN 3400

LAST CALIBRATION DATE

10-16-91

ANALYTICAL PRINCIPLE

FLAME IONIZATION DETECTOR
GAS CHROMATOGRAPHY

BALANCE GAS: AIR

ANALYSIS

ZERO	TEST	REFERENCE	
		CONC.	BAS
(AREA)	(AREA)	PPM	(AREA)
0.00	642883	0.030	4892.00 PPM 1048770
0.00	643086	0.030	1050710
0.00	643342	0.030	1050004

CALCULATED

RESULTS 2997

AVERAGE: 2996 PPM

DATE: 10-16-91

CALIBRATION CURVE				1 ST	DEGREE
SRM #	CONC.	SPLIT	BC	FITTED	PERCENT
(CRM #)	PPM	PT	(Area)	VALUE	ERROR
2648	4892.00	100	1049828	4892.00	0.00
	973.20	20	210343	977.50	0.44
	0.00	0	0.00	0.00	0.00

2646	973.20	LOW	210343	977.50	0.44
	4892.00	HIGH	1049828	0.03	0.00

1819 - GAS MANUFACTURER'S INTERNAL STANDARD, of this Company Not Used to replace the 1819 standard. This standard is to be replaced by the 1819 standard. This standard is to be replaced by the 1819 standard.

L. P. D.

APPENDIX K

PROCESS RATE INFORMATION

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

DUNGANNON TESTING 12-14-93 THROUGH 12-17-93
PROCESS DATA

<u>CONTENTS</u>	<u>PAGE</u>
<u>TEST SCHEDULE</u>	<u>2</u>
<u>PROCESS DATA SUMMARY</u>	<u>3</u>
<u>DATA SPECIFIED IN TEST PLAN</u>	<u>4-7</u>
THERMAL OIL HEATER TESTING 12-14-93 - TSP and PM-10	
BOARD WEIGHTS / PRODUCTION	8
BTU INPUT	9
PRESS CHARTS	10
PRESS REPORTS	11
THERMAL OIL HEATER LOG	12-13
BARK MOISTURE DATA	14
DUNGANNON DRYER TESTING 12-15-93, TSP, NOx, CO, VOC, formaldehyde	
BOARD WEIGHTS / PRODUCTION	15-16
FUEL BURNING RATE	17-18
DRYER DATA SHEETS	19-20
DRYER CHARTS	21-22
PRESS CHARTS	23-24
PRESS REPORTS	25-26
EFB READINGS	27-28
DUNGANNON PRESS VENT TESTING 12-16-93, phenol, VOC, formaldehyde	
BOARD WEIGHTS / PRODUCTION	29
PRESS CHARTS	30
PRESS REPORTS	31
RESIN AND WAX USAGE	32
RESIN CHARTS	33-51
DUNGANNON PRESS VENT TESTING 12-17-93, MDI	
BOARD WEIGHTS / PRODUCTION	52
RESIN AND WAX USAGE	53
PRESS CHARTS	54-55
PRESS REPORTS	56-57
RESIN CHARTS	58-75
DAILY INVENTORY SHEET (for 12-16 and 12-17)	76

DUNGANNON TESTING 12-14-93 THROUGH 12-17-93
TEST SCHEDULE

THERMAL OIL HEATER TESTING 12-14-93 - TSP and PM-10

<u>DATE</u>	<u>POLLUTANT</u>	<u>RUN #1</u>	<u>RUN #2</u>	<u>RUN #3</u>
12-14	PM-10	0923-1042	1125-1243	1320-1450
12-14	TSP	0924-1028	1127-1239	1320-1446

DUNGANNON DRYER TESTING 12-15-93, TSP, NOx, CO, VOC, formaldehyde

<u>DATE</u>	<u>POLLUTANT</u>	<u>RUN #2</u>	<u>RUN #3</u>	<u>RUN #4</u>
12-15	TSP,CO,NOX	1250-1352	1455-1600	1700-1805
12-15	HCHO	1248-1352	1455-1559	1700-1803
		<u>RUN #2</u>	<u>RUN #3</u>	<u>RUN #5</u>
12-15	VOC	1245-1352	1510-1610	1952-2052

note: runs no 1 for all pollutants was voided due to hydraulic oil leaks on log loader grapple
run no 4 of VOC was voided because readings spiked above chart range

DUNGANNON PRESS VENT TESTING 12-16-93, phenol, VOC, formaldehyde

<u>DATE</u>	<u>POLLUTANT</u>	<u>RUN #1</u>	<u>RUN #2</u>	<u>RUN #3</u>
12-16	PHENOL	0925-1025	1039-1139	1152-1252
12-16	VOC	1020-1120	1145-1245	1330-1430
12-16	HCHO	0958-1058	1143-1243	1329-1429

DUNGANNON PRESS VENT TESTING 12-17-93, MDI

<u>DATE</u>	<u>POLLUTANT</u>	<u>RUN #1</u>	<u>RUN #2</u>	<u>RUN #3</u>
12-17	MDI	1135-1246	1407-1447 1508-1528	1628-1745

DUNGANNON TESTING 12-14-93 THROUGH 12-17-93

PROCESS DATA SUMMARY

THERMAL OIL HEATER TESTING 12-14-93 - TSP

9.57 = PLANT PRODUCTION RATE IN TONS PER HOUR
2.07 = DRY FUEL INPUT IN TONS PER HOUR
22783 = LB PER HOUR OF FURNISH PRODUCED BY DRYER
1076 = AVERAGE DRYER INLET TEMPERATURE IN DEGREES F
43.4% = MOISTURE CONTENT OF INCOMING WOOD
6.1% = MOISTURE CONTENT OF WOOD AFTER DRYING

DUNGANNON DRYER TESTING 12-15-93, TSP, NOX, CO, and formaldehyde

9.47 = PLANT PRODUCTION RATE IN TONS PER HOUR
2.07 = DRY FUEL INPUT IN TONS PER HOUR
22783 = LB PER HOUR OF FURNISH PRODUCED BY DRYER
1076 = AVERAGE DRYER INLET TEMPERATURE IN DEGREES F
43.4% = MOISTURE CONTENT OF INCOMING WOOD
6.1% = MOISTURE CONTENT OF WOOD AFTER DRYING

DUNGANNON DRYER TESTING 12-15-93, VOC testing

9.50 = PLANT PRODUCTION RATE IN TONS PER HOUR
2.04 = DRY FUEL INPUT IN TONS PER HOUR
22853 = LB PER HOUR OF FURNISH PRODUCED BY DRYER
1087 = AVERAGE DRYER INLET TEMPERATURE IN DEGREES F
45.0% = MOISTURE CONTENT OF INCOMING WOOD
6.3% = MOISTURE CONTENT OF WOOD AFTER DRYING

DUNGANNON PRESS VENT TESTING 12-16-93, phenol, VOC, formaldehyde

9.50 = PLANT PRODUCTION RATE IN TONS PER HOUR
200 = MDI RESIN USAGE IN LBS PER HOUR
435 = LIQUID PHENOLIC RESIN USAGE IN LBS PER HOUR (100% SOLIDS)

DUNGANNON PRESS VENT TESTING 12-17-93, MDI

9.62 = PLANT PRODUCTION RATE IN TONS PER HOUR
200 = MDI RESIN USAGE IN LBS PER HOUR
434.5 = LIQUID PHENOLIC RESIN USAGE IN LBS PER HOUR (100% SOLIDS)

Pretest information for Duncannon, Virginia

Description of air pollution control equipment

DESCRIPTION OF THE PROCESS.

THERMAL OIL HEATER

- a). Cyclone and Baghouse
- b). Specific cyclone operating parameters are not recorded. The baghouse operates at a pressure drop of 1 to 7.
- c). Rated capacity 32,600 ACFM for each heater. Cyclone 50% efficient, Baghouse 99.9% efficient.
- d). Collected material is mixed with bark and sold.

DRYERS

- a). Multiclone and EFB.
- b). Specific multiclone operating parameters: are not recorded
EFB operating parameters:
Bed voltage 6KV to 15KV
Bed Amperage 0MA to 1MA
Ionizer Voltage 30KV to 45KV
Ionizer Amperage 1 MA to 5MA
Pressure Drop 0.2"-5"
- c). Rated capacity is 50,000 ACFM. Multiclone 60% efficient, EFB 90% efficient.
- d). Collected material is mixed with bark and sold.

- 1.1 Description and diagrams of sampling trains are enclosed in the attachments.
- 1.2 Descriptions of sampling and analysis procedures are enclosed in the attachments.
- 1.3 Sketches indicating the flow of exhaust gases from the equipment to the stacks are enclosed in the attachments.

each stack are shown in the

DUNGANNON TESTING 12-14-93 THROUGH 12-17-93

PROCESS DATA SUMMARY

THERMAL OIL HEATER TESTING 12-14-93 - TSP and PM-10

9.57 = PLANT PRODUCTION RATE IN TONS PER HOUR
0.62 = ESTIMATED TONS OF DRY FUEL INPUT BASED ON TEMP. DIFFERENTIAL

DUNGANNON DRYER TESTING 12-15-93, TSP, NOx, CO, and formaldehyde

9.47 = PLANT PRODUCTION RATE IN TONS PER HOUR
2.07 = DRY FUEL INPUT IN TONS PER HOUR
22783 = LB PER HOUR OF FURNISH PRODUCED BY DRYER
1076 = AVERAGE DRYER INLET TEMPERATURE IN DEGREES F
43.4% = MOISTURE CONTENT OF INCOMING WOOD
6.1% = MOISTURE CONTENT OF WOOD AFTER DRYING

DUNGANNON DRYER TESTING 12-15-93, VOC testing

9.50 = PLANT PRODUCTION RATE IN TONS PER HOUR
2.04 = DRY FUEL INPUT IN TONS PER HOUR
22853 = LB PER HOUR OF FURNISH PRODUCED BY DRYER
1087 = AVERAGE DRYER INLET TEMPERATURE IN DEGREES F
45.0% = MOISTURE CONTENT OF INCOMING WOOD
6.3% = MOISTURE CONTENT OF WOOD AFTER DRYING

DUNGANNON PRESS VENT TESTING 12-16-93, phenol, VOC, formaldehyde

9.50 = PLANT PRODUCTION RATE IN TONS PER HOUR
200 = MDI RESIN USAGE IN LBS PER HOUR
435 = LIQUID PHENOLIC RESIN USAGE IN LBS PER HOUR (100% SOLIDS)

DUNGANNON PRESS VENT TESTING 12-17-93, MDI

9.62 = PLANT PRODUCTION RATE IN TONS PER HOUR
200 = MDI RESIN USAGE IN LBS PER HOUR
434.5 = LIQUID PHENOLIC RESIN USAGE IN LBS PER HOUR (100% SOLIDS)

Pretest information for Dungannon, Virginia

1. Description of air pollution control equipment associated with the process.

THERMAL OIL HEATER

- a). Cyclone and Baghouse
- b). Specific cyclone operating parameters are not recorded. The baghouse operates at a pressure drop of 1 to 7.
- c). Rated capacity 32,600 ACFM for each heater. Cyclone 50% efficient, Baghouse 99.9% efficient.
- d). Collected material is mixed with bark and sold.

DRYERS

- a). Multiclone and EFB
- b). Specific multiclone operating parameters: are not recorded
EFB operating parameters:
Bed voltage 6KV to 15KV
Bed Amperage 0MA to 1MA
Ionizer Voltage 30KV to 45KV
Ionizer Amperage 1 MA to 5MA
Pressure Drop 0.2"-5"
- c). Rated capacity is 50,000 ACFM. Multiclone 60% efficient, EFB 90% efficient.
- d). Collected material is mixed with bark and sold.

- 1.1 Description and diagrams of sampling trains are enclosed in the attachments.
- 1.2 Descriptions of sampling and analysis procedures are enclosed in the attachments.
- 1.3 Sketches indicating the flow of exhaust gases from the equipment to the stacks are enclosed in the attachments.
- 1.4 Elevation views of each stack are shown in the attachments.
- 1.5 Cross - sectional sketches of the stack are shown in the attachments.
- 1.6 Estimated flue gas conditions are shown in the attachments.
- 1.7 Process and control equipment operating data to be collected during the sampling period:

- 1.8 Copies of field data forms are included in attachment.
- 1.9 The names and titles of personnel are not available at this time. Testing will be performed by Interpoll Laboratories, Inc.
- 1.10 Procedures for maintaining sample integrity and chain of custody are provided in the attachments. Interpoll Laboratories QA-QC manual will be followed. Due to the size of this document, it has not been included here but can be provided on request.

2. THERMAL OIL HEATER OPERATING DATA:

- 2.1 Design heat input is 31mm BTU. Operating heat input to be based on f factor. Heat output to be determined by efficiency calculations.
- 2.2 Type of fuel to be used is 100% green bark and green wood fines.
- 2.3 Tons of dry fuel burned during testing will be determined by bark infeed counts and moisture content and auger calibration.
- 2.4 Plant production rate is tons of finished product per hour.
- 2.5 Thermal Oil Heater operating parameters including:
 - Refractory temperature
 - Incoming oil temperature
 - Outgoing oil temperature
 - Fuel feed setting
 - Building heat setpoint and thermal oil temperature setpoint.
- 2.6 Control equipment parameters to be recorded include:
 - Baghouse pressure drop

3. DRYER OPERATING DATA:

- 3.1 Moisture content of wet wafers.
Moisture content of dry wafers.
- 3.2 Wood to be processed will be $\geq 99\%$ green wood, $\leq 1\%$ dried, dead wood.
- 3.3 Wood to be processed will be $\geq 99\%$ hardwood, $\leq 1\%$ softwood.

- 3.4 Dryer operating temperature to be recorded:
- Inlet temperature
- Outlet temperature
- 3.5 Design airflow rate is 50,000 acfm, actual airflow will be determined during sampling.
- 3.6 Type of fuel to be burned is dry fines.
- 3.7 The heat content of the dry fuel will be determined by analysis.
- 3.8 The dryer is 12' diameter and 60' long.
- 3.9 Dryer production rate in pounds of dry furnish per hour based on press production plus screened fines and board trim using the following formula:
- $$\frac{\text{lb. Dryer Production}}{\text{HR}} = \frac{\text{Tons press prod./hr} / 2000}{1 - (0.07 + 0.08)}$$
- Where: Board Trim = 7% of finished product weight
screened fines = 8% of finished product weight
- Permit rate is 23,280 lb. dry furnish (19.4/hr at 40% M.C.)
Design rate is 29,105 lb. dry furnish/hr.
Test rate is estimated to be equal to permit rate
- 3.10 The level of the dry bins will be recorded before and after testing.
- 3.11 Plant production rate will be at or near 10 tons of finished product per hour based on press production. See 7c10.
- 3.12 Additional dryer operating parameters to be recorded include:
- Wet bin feed rate
- 3.13 EFB operating parameters to be recorded include:
- Bed voltage
- Bed amperage
- Ionizer voltage
- Ionizer amperage
- EFB pressure drop

4. PRESS OPERATING DATA:

- 4.1 Board thickness.
- 4.2 Number of sheets produced per hour to be determined by press chart.
- 4.3 Pounds of resin used per hour to be recorded.
- 4.4 Pounds of wax used per hour to be recorded.
- 4.5 Type of resin used to be recorded.
- 4.6 Press temperature to be recorded.
- 4.7 There are two exhaust fans with a design airflow of 80,000 acfm. Actual acfm will be determined during sampling.
- 4.8 Tons of finished product produced during test will be determined by board weights and press charts.

THERMAL OIL HEATER TESTING 12-14-93 - TSP and PM-10

DATA TIME: START= 09:00 END= 15:00 HOURS= 6.00

BOARD WEIGHTS - LBS

WEIGHTS OF APPROXIMATELY EVERY 25TH
UNTRIMMED BOARD FROM TAPES

194	196
191	190
190	189
191	190
192	189
188	190
188	200
190	187
188	201
197	189
191	196
196	194
184	
195	
198	
196	

192.14 LB = AVERAGE
UNTRIMMED
MAT WEIGHT

175.04 LB = AVERAGE
FINISHED BOARD
WEIGHT
(UNTRIMMED MAT
WEIGHT - TRIM
WEIGHT)

8.9% = TRIM

PLANT PRODUCTION RATE

6 =HOURS DURING TESTING
82 =PRESSLOADS
656 =NO. OF (8' X 16') BOARDS PRODUCED (PRESSLOADS x 8 BOARDS/LOAD)
114826 =LBS FINISHED PRODUCT (BOARDS x WEIGHT OF FINISHED BOARD)
19138 =LBS FINISHED PRODUCT PRODUCED PER HOUR (LBS FINISHED
PROD./TESTING HOURS)
9.57 =TONS FINISHED PRODUCT PRODUCED PER HOUR (LB FINISHED PRODUCT
PER HR / 2000 LB)

THERMAL OIL HEATER TESTING 12-14-93 - TSP and PM-10
DATA TIME: START= 08:55 END= 14:50 HOURS= 5.92

FUEL BURNING RATE ESTIMATED BY BARK INPUT

6.87 =RIGHT SIDE FUEL CALIBRATION IN LB/COUNT
820 =RIGHT SIDE COUNTS DURING TESTING HOURS
5633 =RIGHT SIDE - LB. OF WET FUEL BURNED DURING TESTING

7.07 =LEFT SIDE FUEL CALIBRATION IN LB/COUNT
1083 =LEFT SIDE COUNTS DURING TESTING HOURS
7657 =LEFT SIDE - LB. OF WET FUEL BURNED DURING TESTING

5.92 =HOURS DURING TESTING
13290 =TOTAL LB. OF WET FUEL BURNED DURING TESTING
44.5% =AVERAGE MOISTURE CONTENT OF FUEL
7374 =TOTAL LB. OF DRY FUEL BURNED DURING TESTING (LB WET FUEL X (1- % MOISTURE)
1246 =LB. OF DRY FUEL BURNED PER HOUR (TOTAL LB OF DRY FUEL BURNED /
TESTING HOURS
0.62 =TONS OF DRY FUEL BURNED PER HOUR (TOTAL LB OF DRY FUEL BURNED PER
HOUR / 2000 LB)
9000 = ESTIMATED BTU CONTENT OF DRY FUEL (BTU / LB)
11.21 = ESTIMATED MMBTU INPUT PER HOUR (LB OF FUEL/HR x BTU CONTENT)

FUEL BURNING RATE ESTIMATED TEMPERATURE DIFFERENTIAL

516.7 = AVERAGE INCOMING OIL TEMPERATURE IN DEGREES F
544.8 = AVERAGE INCOMING OIL TEMPERATURE IN DEGREES F
65 = TEMPERATURE DIFFERENTIAL AT 100% CAPACITY IN DEG. F
28.0 = ACTUAL TEMPERATURE DIFFERENTIAL
31 = MAXIMUM BTU INPUT IN MM BTU/HR
13.4 = ESTIMATED MMBTU INPUT PER HOUR (ACTUAL TEMP. DIFF./ MAX. TEMP. DIFF.
x MAX. HEAT INPUT)

9000 = ESTIMATED BTU CONTENT OF DRY FUEL (BTU / LB)
0.74 = ESTIMATED TONS OF DRY FUEL INPUT BASED ON TEMPERATURE DIFFERENTIAL
(BTU INPUT/BTU CONTENT OF DRY FUEL / 2000 lb)

input to be verified by f factor

1300

1400

PRESS CHART

12-14-93

0700-1500

1200

1500
6/0700

1100

0800

1000

0900

PRESSLOADS
0900 - 1500 = 82
7/16"

LOUISIANA-PACIFIC CORPORATION
DUNGANNON, VIRGINIA

PRESS REPORT

OPERATOR Rich V SHIFT 7-3 CREW 0 DATE 12-14-93
SICKNESS: 7/16 PRESS LOADS 110-131,417 BLENDER SHUTDOWNS
CORE 3
OVERALL TIMER: _____ DECOMPRESSION TIME _____ SURFACE 13
PRESS TEMP: 400°

LINE SPEED	FROM	TO
30	7:00	7:40
31	7:40	3:00

BEGIN CORE RESIN 884860 SURFACE RESIN 3518023
END 886281 3524028

Cleaned Blender Shrouds & Tracks

Formed hydraulic and radiator
blown out

FCOS hydraulic unit and radiator
blown out

Blender outfeed conv. tail pulleys
cleaned

DOWNTIME (Mins.)
FROM TO M E O

KEY

REASONS FOR DOWNTIME

NMDT

DOWNTIME CODE: M-MECHANICAL E-ELECTRICAL O-OPERATOR

**** MAINTENANCE/LOCK-OUT LOG ****

MOTOR # LOCKED OUT	FROM	TO	BRIEF DESCRIPTION OF WORK BEING DONE	INITIALS OF PERSON LOCKING OUT

KONUS DATA

PLANT: DUNGANNON
 OIL SETPOINT 540 4:30 550
 BUILDING HEAT SETPOINT

DATE 12-14-93
 BY _____

EVERY 10 MINUTES

(NOTE ANY CHANGES IN SETPOINTS)

TIME	PRIMARY AIR LEFT	MO I.D. FAN	PRIMARY AIR RIGHT	OIL IN deg. C	OIL OUT deg. F	REFRACTORY TEMP deg c		FUEL COUNT		FEED RATE SETTING		EVERY HOUR	
						LT	RT	LT	RT	LT	RT	BAG H. PRESS.	BARK MOISTURE
0730	2200	-12	2300	488	515	605	≈600	169	120	699	599	21	
0740	2300	-10	2300	488	515	620	600	215	163	699	599		
0750	2300	-02	2300	480	502	620	600	254	193	699	599		
0800	2200	-02	2300	473	506	620	600	299	227	699	599		
0810	2200	-02	2300	481	510	630	≈600	338	262	699	599		
0820	2300	-02	2300	480	510	625	≈600	379	294	699	599		
0830	2200	-02	2300	488	520	630	≈600	425	333	699	599	2	
0840	2200	-02	2300	502	537	645	≈600	470	367	699	599		
0855	2200	-02	2200	519	554	700	≈600	531	417	699	599		
9:05	2200	-02	2300	523	549	720	≈600	573	449	699	599		
9:20	2200	-02	2300	512	531	700	≈600	604	467	699	599		
0930	2250	-01	2300	499	521	680	≈600	633	492	364	299		Full A.
0940	2200	-02	2300	492	521	680	≈600	668	521	364	300	2	
0950	2200	-02	2200	492	521	685	≈600	702	550	364	300		
1000	2200	-02	2300	499	534	700	≈600	737	576	364	301		
1010	2200	-02	2200	509	539	720	≈600	775	605	364	299		
1020	2200	-02	2300	512	543	720	≈600	801	625	364	299		
1030	2100	-02	2300	516	547	725	≈600	833	655	364	299		
1045	2200	-02	2300	519	544	725	≈600	886	696	365	299	2	
1050	2360	-02	2200	515	541	720	≈600	915	719	364	299		
1100	2200	-02	2300	520	551	720	≈600	935	740	364	296		
1110	2200	-02	2300	520	548	720	≈600	966	768	365	299		
1120	2200	-02	2300	524	552	720	≈600	997	795	353	285		
1130	2100	-02	2200	517	544	720	≈600	1035	824	365	299		
1140	2200	-02	2300	513	538	720	≈600	1070	851	364	299	2.5	
1150	2200	-02	2200	513	541	720	≈600	1101	878	364	298		
1200	2200	-02	2300	525	555	720	≈600	1134	900	331	257		
1210	2200	-02	2200	519	544	720	≈600	1162	920	364	298		
1222	2200	-02	2200	522	557	720	≈600	1196	948	008	002		
1230	2200	-02	2200	525	553	720	≈600	1229	970	326	249		

PLANT: Dingsman
OIL SETPOINT 550
BIUILDING HEAT SETPOINT

BY

(NOTE ANY CHANGES IN SETPOINTS)

K-13

MOISTURE CONTENT

14
K-14

DUNGANNON DRYER TESTING 12-15-93, TSP, NOx, CO, and formaldehyde

DATA TIME: START= 12:40 END= 18:10 HOURS= 5.50

BOARD WEIGHTS - LBS

WEIGHTS OF APPROXIMATELY EVERY 25TH
UNTRIMMED BOARD FROM TAPES

185	195
190	186
187	180
190	191
194	198
190	195
196	181
184	197
192	
194	
188	
191	
187	
197	
189	
195	

190.5 LB = AVERAGE
UNTRIMMED
MAT WEIGHT

173.55 LB = AVERAGE
FINISHED BOARD
WEIGHT
(UNTRIMMED MAT
WEIGHT - TRIM
WEIGHT)

8.9% = TRIM

PLANT PRODUCTION RATE

5.5 = HOURS DURING TESTING
75 = PRESSLOADS
600 = NO. OF (8' X 16') BOARDS PRODUCED (PRESSLOADS x 8 BOARDS/LOAD)
104130 = LBS FINISHED PRODUCT (BOARDS x WEIGHT OF FINISHED BOARD)
18933 = LBS FINISHED PRODUCT PRODUCED PER HOUR (LBS FINISHED
PROD./TESTING HOURS)
9.47 = TONS FINISHED PRODUCT PRODUCED PER HOUR (LB FINISHED PRODUCT
PER HR / 2000 LB)

DRYER PRODUCTION RATE:

22783 = LB OF DRYER PRODUCTION / HR (LB OF FINISHED PROD./
(1-(% TRIM + % FINES))

8.0% = %FINES

8.9% = %TRIM

43.4% = MOISTURE CONTENT OF INCOMING WOOD

6.1% = MOISTURE CONTENT OF WOOD AFTER DRYING

DUNGANNON DRYER TESTING 12-15-93, VOC testing

DATA TIME: START= 12:40 END= 16:10 HOURS= 3.50

DATA TIME: START= 19:50 END= 12:40 HOURS= 1.17

BOARD WEIGHTS - LBS

WEIGHTS OF APPROXIMATELY EVERY 25TH
UNTRIMMED BOARD FROM TAPES

185	183
190	183
187	192
190	189
194	197
190	
196	
184	
192	
194	
188	
191	
187	
197	
189	
195	

190.14 LB = AVERAGE
UNTRIMMED
MAT WEIGHT

173.22 LB = AVERAGE
FINISHED BOARD
WEIGHT
(UNTRIMMED MAT
WEIGHT - TRIM
WEIGHT)

8.9% = TRIM

PLANT PRODUCTION RATE

4.67 =HOURS DURING TESTING

64 =PRESSLOADS

512 =NO. OF (8' X 16') BOARDS PRODUCED (PRESSLOADS x 8 BOARDS/LOAD)

88689 =LBS FINISHED PRODUCT (BOARDS x WEIGHT OF FINISHED BOARD)

18991 =LBS FINISHED PRODUCT PRODUCED PER HOUR (LBS FINISHED
PROD./TESTING HOURS)

9.50 =TONS FINISHED PRODUCT PRODUCED PER HOUR (LB FINISHED PRODUCT
PER HR / 2000 LB)

DRYER PRODUCTION RATE:

22853 =LB OF DRYER PRODUCTION / HR (LB OF FINISHED PROD./
(1-(% TRIM + % FINES)

8.0% =%FINES

8.9% =%TRIM

45.0% = MOISTURE CONTENT OF INCOMING WOOD

6.3% = MOISTURE CONTENT OF WOOD AFTER DRYING

DUNGANNON DRYER TESTING 12-15-93. TSP, NOx, CO, and formaldehyde

DATA TIME: START= 12:40 END= 18:10 HOURS= 5.50
DRYER FUEL BURNING RATE

7.44 =FUEL CALIBRATION IN LB/COUNT

3062 = TOTAL COUNTS DURING TESTING HOURS

5.5 =HOURS DURING TESTING

22781 =TOTAL LB. OF FUEL BURNED DURING TESTING (TOTAL COUNTS x CALIBRATION)

4142 =LB. OF FUEL BURNED PER HOUR (TOTAL LB OF FUEL BURNED /
TESTING HOURS

2.07 =TONS OF FUEL BURNED PER HOUR (TOTAL LB OF FUEL BURNED PER
HOUR / 2000 LB)

8600 = ESTIMATED BTU CONTENT OF DRY FUEL (BTU / LB)

35.6 = ESTIMATED MMBTU INPUT PER HOUR (LB OF FUEL/HR x BTU CONTENT)

DUNGANNON DRYER TESTING 12-15-93, VOC testing

DATA TIME:	START=	12:40	END=	16:10	HOURS=	3.50
DATA TIME:	START=	19:50	END=	21:00	HOURS=	1.17

DRYER FUEL BURNING RATE

7.44 =FUEL CALIBRATION IN LB/COUNT

2559 = TOTAL COUNTS DURING TESTING HOURS

4.67 =HOURS DURING TESTING

19039 =TOTAL LB. OF FUEL BURNED DURING TESTING (TOTAL COUNTS x CALIBRATION)

4077 =LB. OF FUEL BURNED PER HOUR (TOTAL LB OF FUEL BURNED /
TESTING HOURS

2.04 =TONS OF FUEL BURNED PER HOUR (TOTAL LB OF FUEL BURNED PER
HOUR / 2000 LB)

8600 = ESTIMATED BTU CONTENT OF DRY FUEL (BTU / LB)

35.1 = ESTIMATED MMBTU INPUT PER HOUR (LB OF FUEL/HR x BTU CONTENT)

DRYER DATA SHEET

DATE 12-15-93

BY Sandy W. H. S.

PLANT: Dungannon, VA

REVOLUTIONS per MINUTE: _____

FUEL CALIBRATION: _____

(NOTE ANY CHANGES IN SETPOINTS)

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
1230	202	640	971	202	3824	.50	.50	.50	42.1	8.0
1240	202	650	1020	202	2910	.50	.50	.50		
1250	202	650	1081	201	3005	.50	.50	.50		
1300	202	650	1090	201	3091	.50	.50	.50		7.0
1310	202	650	1123	201	3185	.50	.50	.50		
1320	202	650	1095	197	3277	.50	.50	.50		
1330	202	650	1090	202	3381	.50	.50	.50	43.8	7.0
1340	202	650	1095	203	3464	.50	.50	.50		
1350	203	650	1043	203	3564	.50	.50	.50		6.0
1400	203	650	1063	202	3680	.50	.50	.50		6.0
1410	203	650	1024	206	3716	.50	.50	.50		
1420	204	650	1121	203	3806	.50	.50	.50		
1430	204	650	1113	206	3914	.50	.50	.50	45.9	6.0
1440	204	650	1140	204	4013	.50	.50	.50		
1450	204	650	1133	204	4099	.50	.50	.50		
1500	204	650	1114	203	4185	.50	.50	.50		
1510	204	650	1063	204	104	.25	.50	.50		6.0
1520	204	650	1098	202	214	.25	.50	.50		
1530	204	650	1112	204	291	.25	.50	.50	46.5	6.0
1540	204	650	1105	203	384	.25	.25	.50		
1550	204	660	1023	206	459	.25	.25	.25		
1600	205	660	928	205	528	.25	.50	.25		7.0
1610	204	660	1014	205	639	.50	.25	.25		
1620	204	660	1107	203	742	.50	.25	.25		
1630	204	680	1117	204	841	.50	.25	.25	37.4	5.0
1640	204	680	1143	205	928	.85	.25	.25		
1650	204	680	1165	205	1034	.85	.25	.25		
1700	204	680	1166	203	1131	.85	.25	.25		6.0
1710	204	680	1118	206	1218	.50	.25	.25		
1720	204	680	1192	203	1289	.50	.25	.25	43.4	

chg. Fuel

DRYER DATA SHEET

DATE 12-15-93

BY Sandy Willis

PLANT: Dungenov

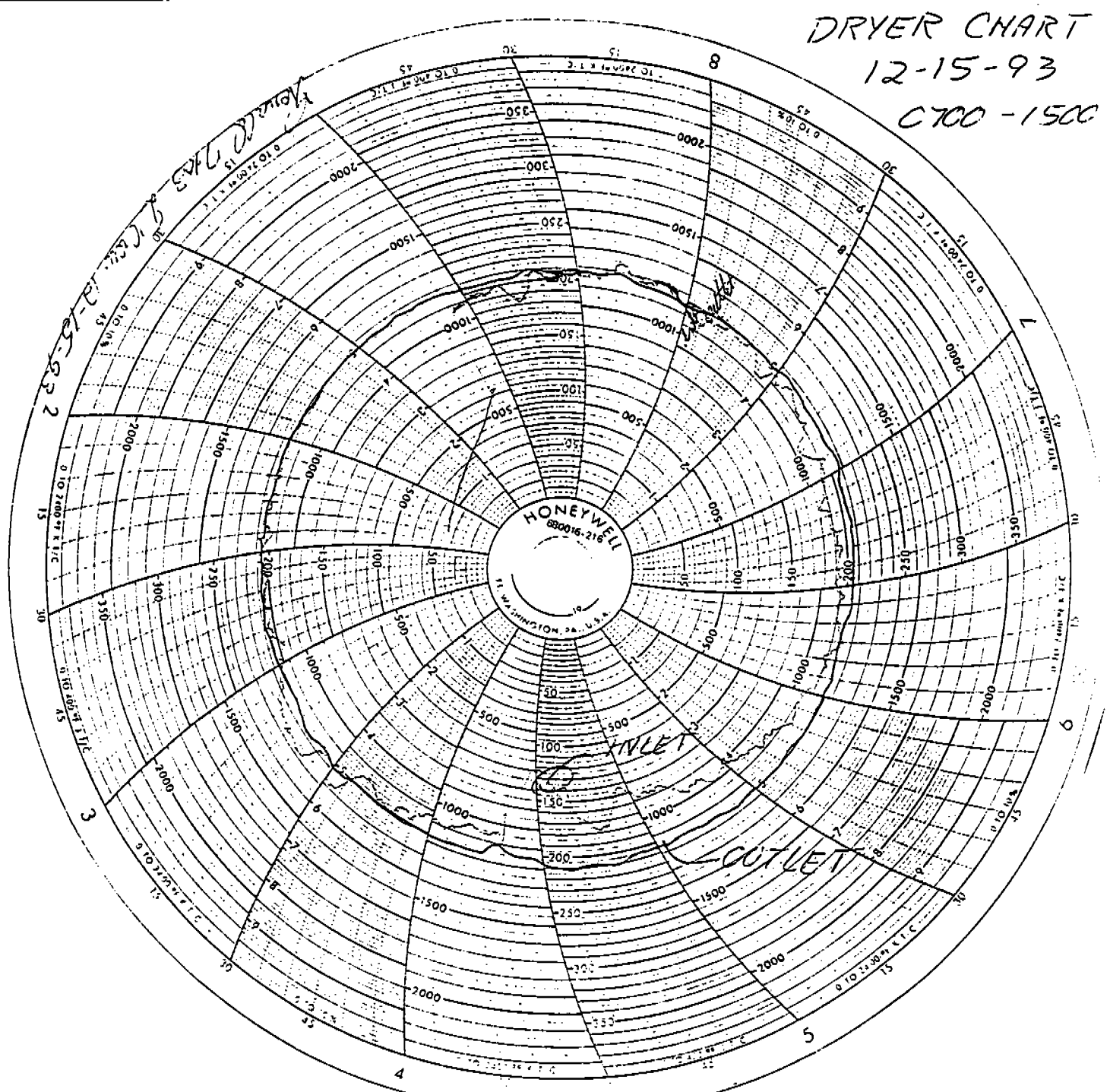
REVOLUTIONS per MINUTE:

FUEL CALIBRATION:

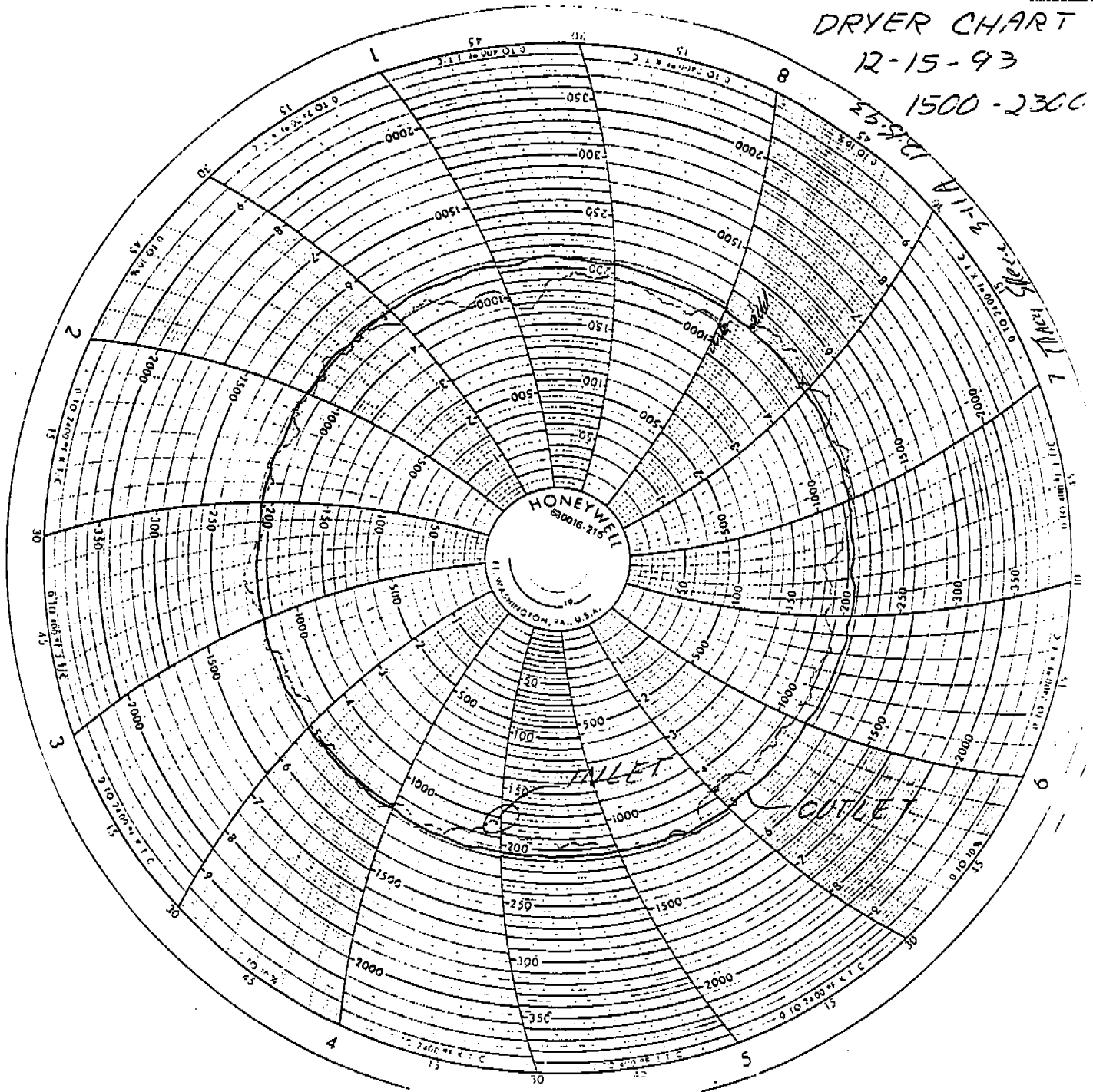
(NOTE ANY CHANGES IN SETPOINTS)

[illegible]

DRYER CHART
 12-15-93
 0700-1500



DRYER CHART
 12-15-93
 1500-2300

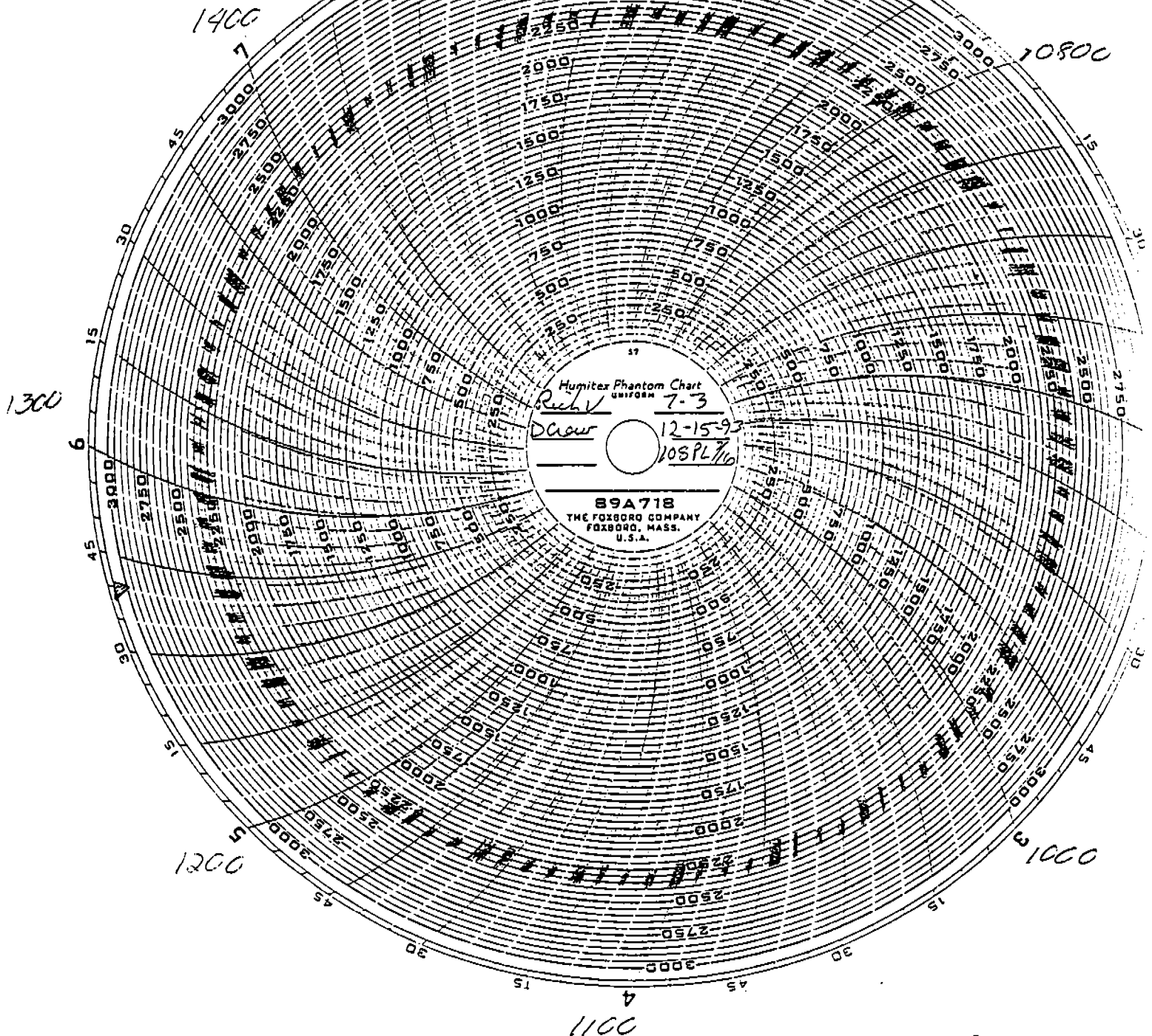


PRESS CHART

12-15-93

0700-1500

1500 8/0700



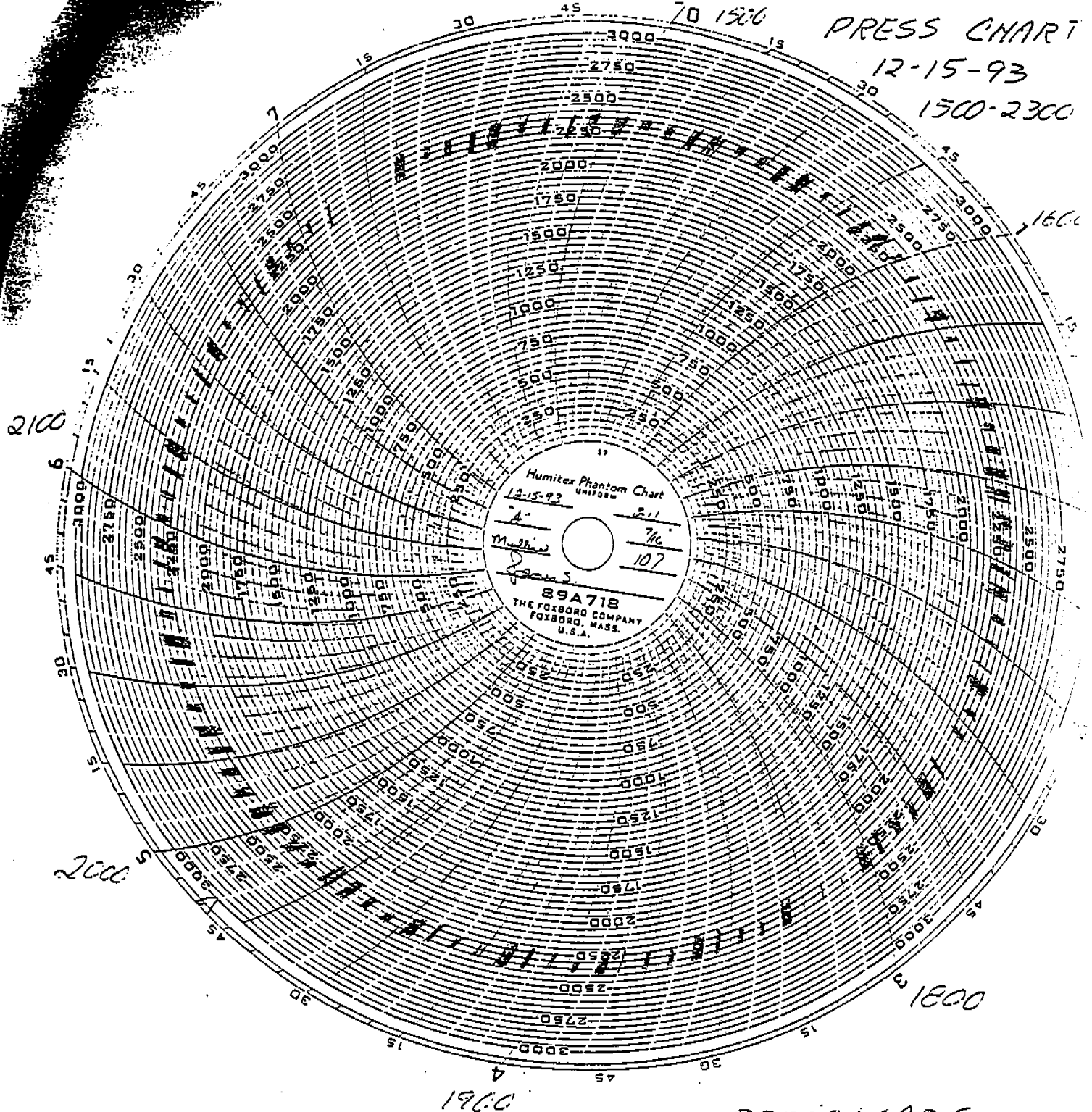
PRESS LOADS

1240 - 1500 = 32

PRESS CHART

12-15-93

1500-2300



PRESSLOADS

1500-1610 = 16
1500-1810 = 43
1950-2100 = 16

PRESS REPORT

LINE	SPEED	FROM	TO
	30	7:00	3:00

	CORE RESIN	SURFACE RESIN
BEGIN	888809	3534750
END	890230	3540709

Cleaned Blender Shrouds & Tracks

Former hydraulic and radiator
blown out

FCOS hydraulic unit and radiator
blown out

Blender outfeed conv. tail pulleys
cleaned

[illegible]

DOWNTIME CODE: M-MECHANICAL E-ELECTRICAL O-OPERATOR

**** MAINTENANCE/LOCK-OUT LOG ****

[illegible]

AFRIC CORPORATION
VIRGINIA

PRESS REPORT

OR James S SHIFT 3-11 CREW "A" DATE 12-15-93

THICKNESS: 7/16"

PRESS LOADS 107-127,833

BLENDER SHUTDOWNS
CORE 29

OVERALL TIMER: _____

DECOMPRESSION TIME _____ SURFACE 58

PRESS TEMP: 400°

LINE SPEED	FROM	TO
<u>31</u>	<u>3:00</u>	<u>7:40</u>
<u>30</u>	<u>9:40</u>	<u>11:00</u>

	CORE	SURFACE
	RESIN	RESIN
BEGIN	<u>890230</u>	<u>3540709</u>
END	<u>891672</u>	<u>3546283</u>

Cleaned Blender Shrouds & Tracks

Formed hydraulic and radiator
blown out

FCOS hydraulic unit and radiator
blown out

Blender outfeed conv. tail pulleys
cleaned

DOWNTIME		DOWNTIME (Mins.)			KEY	REASONS FOR DOWNTIME
FROM	TO	M	E	O		
<u>5:36</u>	<u>5:38</u>				<u>2</u>	<u>Unloader beam dropped #7 H.B.</u>
<u>9:27</u>	<u>9:28</u>				<u>1</u>	<u>Loading #6, line kicked out.</u>
<u>10:06</u>	<u>10:07</u>				<u>1</u>	<u>Loading #6, line kicked out.</u>
<u>10:12</u>	<u>10:21</u>				<u>9</u>	<u>Loader bag down + pilot stopped them #1,3,5,7</u>
						<u>tried to pull out of pass.</u>

DOWNTIME CODE: M-MECHANICAL E-ELECTRICAL O-OPERATOR

**** MAINTENANCE/LOCK-OUT LOG ****

MOTOR # LOCKED OUT	FROM	TO	BRIEF DESCRIPTION OF WORK BEING DONE	INITIALS OF PERSON LOCKING OUT

(OVER)

EFB READINGS

EVERY 10 MINUTES

DATE 12-15-93

PLANT: Dungannon, VA

BY Sandy Willis

TIME	"A" SIDE				"B" SIDE					
	BED VOLT	BED CURR.	ION VOLT	ION CURR.	BED VOLT	BED CURR.	ION VOLT	ION CURR.	EFB PRESS.	BAG H. PRESS.
1230	15+	.02	33	2.0	15+	.02	31	2.1	.02	3.0
1240	15+	.02	34	2.0	15+	.02	31	2.0	.02	3.0
1250	15+	.02	34	2.0	15+	.02	31	2.0	.02	3.0
1300	15+	.02	36	2.1	15+	.02	34	2.0	.02	3.2
1310	15+	.02	36	2.1	15+	.02	35	2.0	.02	3.2
1320	15+	.02	37	2.1	15+	.02	34	2.1	.02	3.1
1330	15+	.02	36	2.1	15+	.02	35	2.0	.02	3.1
1340	15+	.02	36	2.0	15+	.02	35	2.0	.02	3.0
1350	15+	.02	37	2.0	15+	.02	35	2.0	.02	3.0
1400	15+	.02	37	2.2	15+	.02	35	2.0	.02	3.2
1410	15+	.02	37	2.2	15+	.02	35	2.0	.02	3.4
1420	15+	.02	37	2.0	15+	.02	35	2.0	.02	3.2
1430	15+	.02	37	2.0	15+	.02	36	2.0	.02	3.2
1440	15+	.02	37	2.0	15+	.02	35	2.0	.02	3.3
1450	15+	.02	40	2.0	15+	.02	38	2.1	.02	3.4
1500	15+	.02	40	2.0	15+	.02	38	2.1	.02	3.0
1510	15+	.02	40	2.0	15+	.02	38	2.1	.02	3.1
1520	15+	.02	40	2.0	15+	.02	38	2.1	.02	3.1
1530	15+	.02	42	2.0	15+	.02	40	2.0	.02	3.4
1540	15+	.02	41	2.0	15+	.02	39	2.0	.02	2.9
1550	15+	.02	42	2.0	15+	.03	39	2.1	.02	3.0
1600	15+	.02	41	2.0	15+	.03	39	2.0	.02	2.9
1610	15+	.02	41	2.0	15+	.03	39	2.1	.02	3.0
1620	15+	.02	41	2.0	15+	.02	39	2.2	.02	2.7
1630	14	.02	41	2.1	15+	.02	38	2.2	.02	3.5
1640	14	.02	40	2.0	15+	.02	38	2.0	.02	3.3
1650	15+	.02	41	2.0	15+	.02	39	2.0	.02	3.0
1700	15+	.02	41	2.0	15+	.02	39	2.0	.02	3.3
1710	15+	.02	42	2.0	15+	.02	39	2.0	.02	3.1
1720	15+	.02	41	2.0	15+	.02	39	1.8	.02	3.8

EVERY 10 MINUTES

DATE 12-15-93

PLANT: Duncannon

BY Sandy Willis

[illegible]

DUNGANNON PRESS VENT TESTING 12-16-93, phenol, VOC, formaldehyde
 DATA TIME: START= 09:00 END= 15:00 HOURS= 6.00

BOARD WEIGHTS - LBS

WEIGHTS OF APPROXIMATELY EVERY 25TH
 UNTRIMMED BOARD FROM TAPES

185	192
189	188
192	188
202	187
189	191
194	192
197	193
193	193
191	186
190	188
192	187
190	193
187	
190	
188	
197	

190.86 LB = AVERAGE
 UNTRIMMED
 MAT WEIGHT

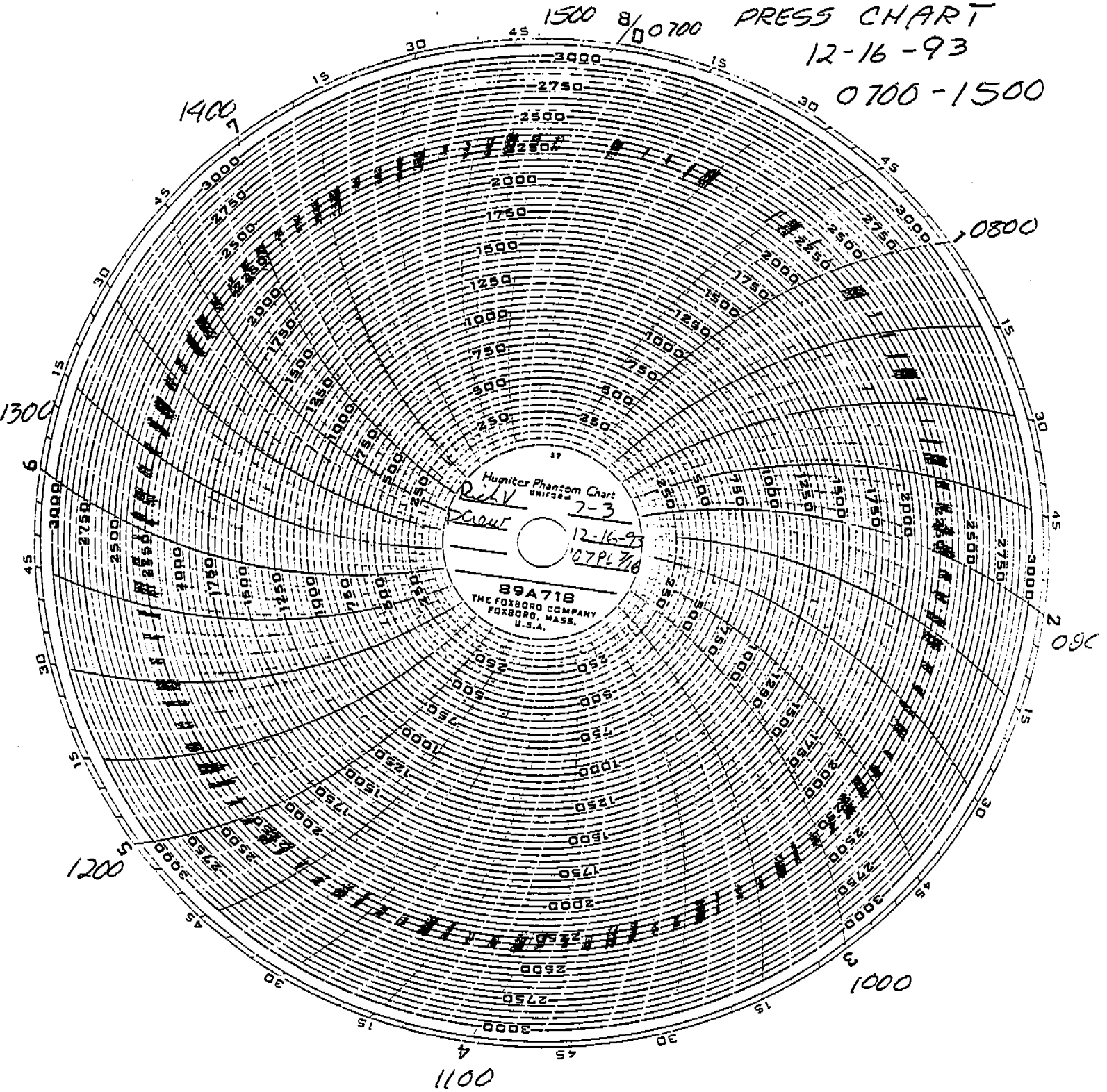
173.87 LB = AVERAGE
 FINISHED BOARD
 WEIGHT
 (UNTRIMMED MAT
 WEIGHT - TRIM
 WEIGHT)

8.9% = TRIM

PLANT PRODUCTION RATE

6 =HOURS DURING TESTING
 82 =PRESSLOADS
 656 =NO. OF (8' X 16") BOARDS PRODUCED (PRESSLOADS x 8 BOARDS/LOAD)
 114059 =LBS FINISHED PRODUCT (BOARDS x WEIGHT OF FINISHED BOARD)
 19010 =LBS FINISHED PRODUCT PRODUCED PER HOUR (LBS FINISHED
 PROD./TESTING HOURS)
 9.50 =TONS FINISHED PRODUCT PRODUCED PER HOUR (LB FINISHED PRODUCT
 PER HR / 2000 LB)

1500 8/0700 PRESS CHART
 12-16-93
 0700-1500



PRESSLOADS
 0900 - 1500 = 82
 7/16"

LOUISIANA-PACIFIC CORPORATION

PRESS REPORT

DUNGANNON, VIRGINIA

OPERATOR Rich V SHIFT 7-3 CREW D DATE 12-16-93THICKNESS: 7/16 PRESS LOADS 107 = 127,833 BLENDER SHUTDOWNS
CORE 9OVERALL TIMER: _____ DECOMPRESSION TIME _____ SURFACE 14PRESS TEMP: 400

LINE SPEED	FROM	TO
<u>30</u>	<u>7:00</u>	<u>8:20</u>
<u>31</u>	<u>8:20</u>	<u>3:00</u>

	CORE	SURFACE
	RESIN	RESIN
BEGIN	<u>892928</u>	<u>3551968</u>
END	<u>894434</u>	<u>3557985</u>

Cleaned Blender Shrouds & Tracks

Forme hydraulic and radiator
blown outFCOS hydraulic unit and radiator
blown outBlender outfeed conv. tail pulleys
cleaned

DOWNTIME (Mins.)					KEY	REASONS FOR DOWNTIME
FROM	TO	M	E	O		
<u>7:00</u>	<u>7:09</u>				<u>9</u>	<u>building dry bins</u>
<u>2:46</u>	<u>12:17</u>				<u>1</u>	<u>did not get close press</u>

DOWNTIME CODE: M-MECHANICAL E-ELECTRICAL O-OPERATOR

**** MAINTENANCE/LOCK-OUT LOG ****

MOTOR # LOCKED OUT	FROM	TO	BRIEF DESCRIPTION OF WORK BEING DONE	INITIALS OF PERSON LOCKING OUT

DUNGANNON PRESS VENT TESTING 12-16-93, phenol, VOC, formaldehyde
DATA TIME: START= 09:00 END= 15:00 HOURS= 6.00

RESIN USAGE FROM FLOW CHARTS

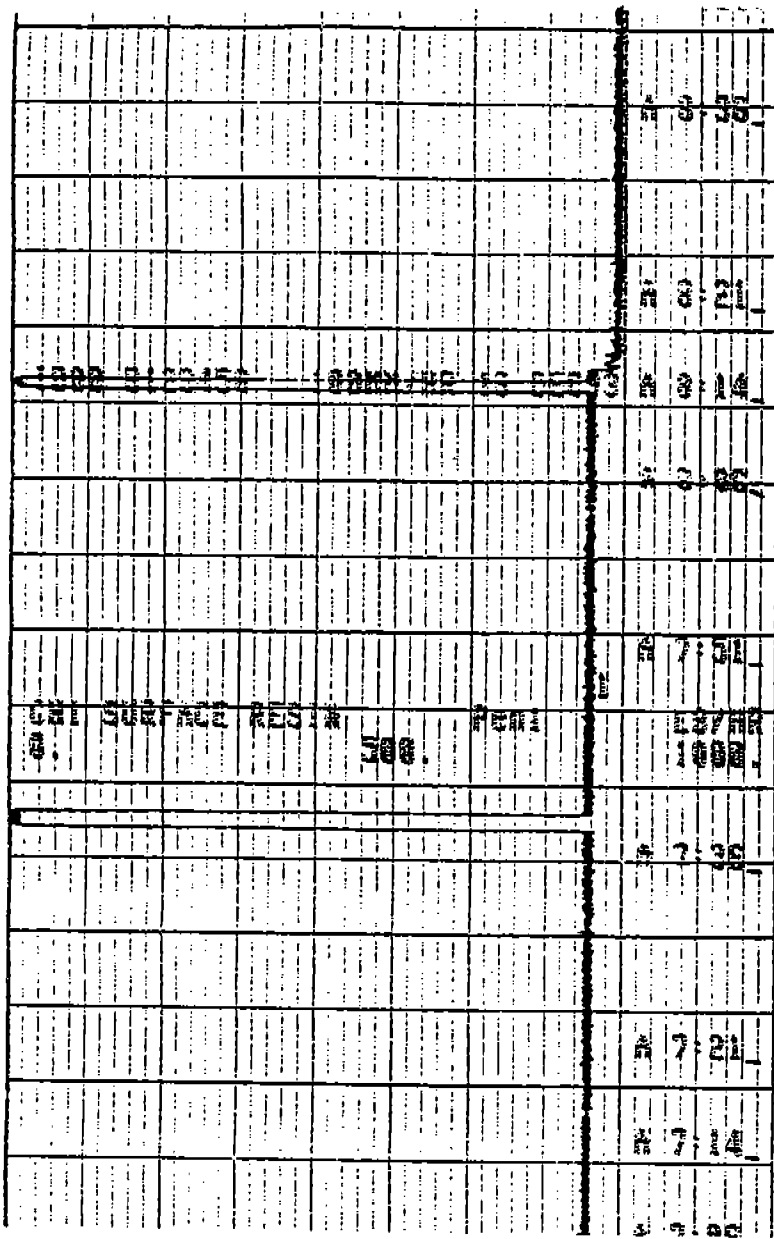
200 = LBS OF MDI RESIN PER HOUR
19010 = LBS FINISHED PRODUCT PRODUCED PER HOUR
1.05% = MDI RESIN USED AS % OF FINAL PRODUCT

790 = LBS OF LIQUID PHENOLIC RESIN PER HOUR ON A 55% SOLIDS BASIS
435 = LBS OF LIQUID PHENOLIC RESIN PER HOUR ON A 100% SOLIDS BASIS
2.29% = LIQUID PHENOLIC RESIN USED AS % OF FINAL PRODUCT

WAX USAGE FROM DAILY INVENTORY SHEET

8088 = LBS OF WAX USED FOR THE DAY @ 48% SOLIDS
4206 = LBS OF WAX USED FOR THE DAY @ 100% SOLIDS
359605 = PRODUCTION FOOTAGE FOR THE DAY - 3/8" BASIS
308232.9 = PRODUCTION FOOTAGE FOR THE DAY - 7/16" BASIS
 ((3/8" FOOTAGE) / (7/16" / 3/8"))
2408 = NO OF 8'x16' BOARDS PRODUCED (7/16" FOOTAGE / (8'x16"))
173.87 = WEIGHT OF FINISHED 8'x16' 7/16" BOARD
418679 = TOTAL LBS OF BOARD PRODUCED (NO. OF BOARDS x BOARD WEIGHT)
1.00% = WAX AS % OF FINAL PRODUCT

19010 = LBS FINISHED PRODUCT PRODUCED PER HOUR
191 = LBS OF WAX USED PER HOUR DURING TESTING (% WAX x LBS
 FINISHED PRODUCT PER HOUR)



MADE IN ENGLAND

CHART No. GD201125

Dungannon 12-93

36

K-36

3

CH3 SURFACE RESIN

580.

CH3 SURFACE RESIN
580.

010893

MADE IN ENGLAND

CHART No. GD201125

010893

CH2 SURFACE RES

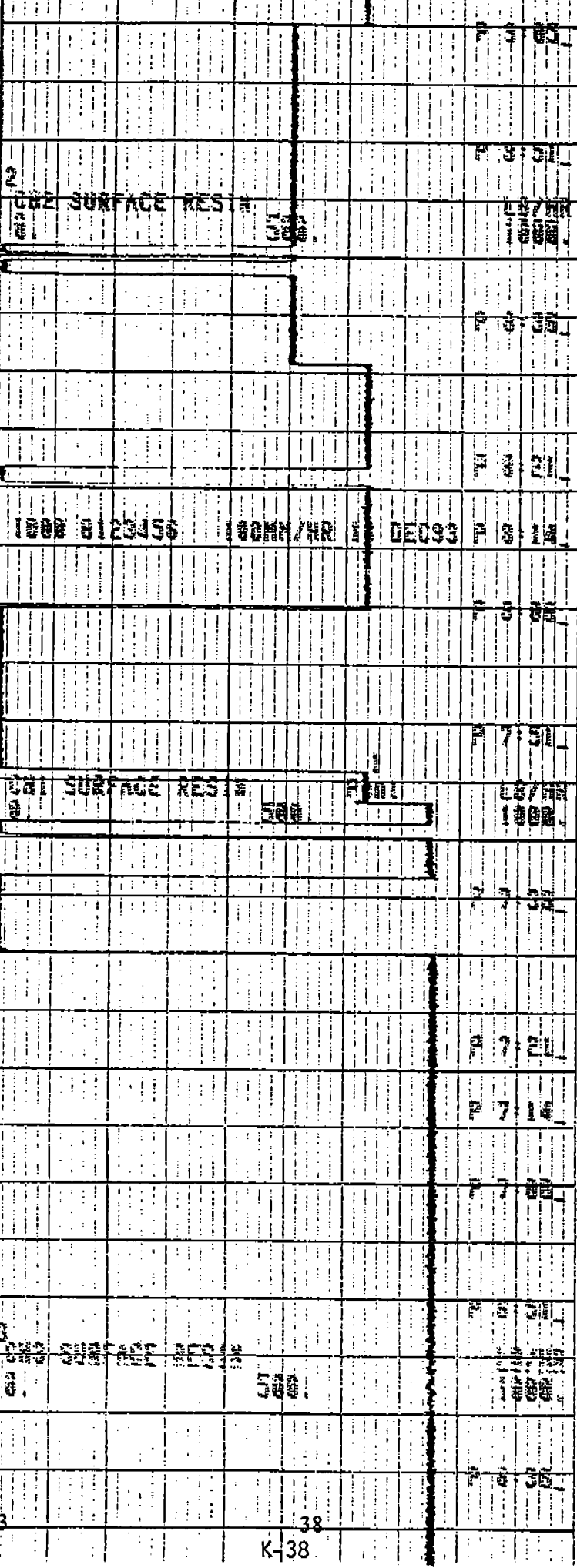
1088 0123456 1088 0123456

CH2 SURFACE RES

MADE IN ENGLAND

CHART No. GD201125

010893



MADE IN ENGLAND CHART NO. G0201125

Dungannon 12-93

41
K-41

0108 93

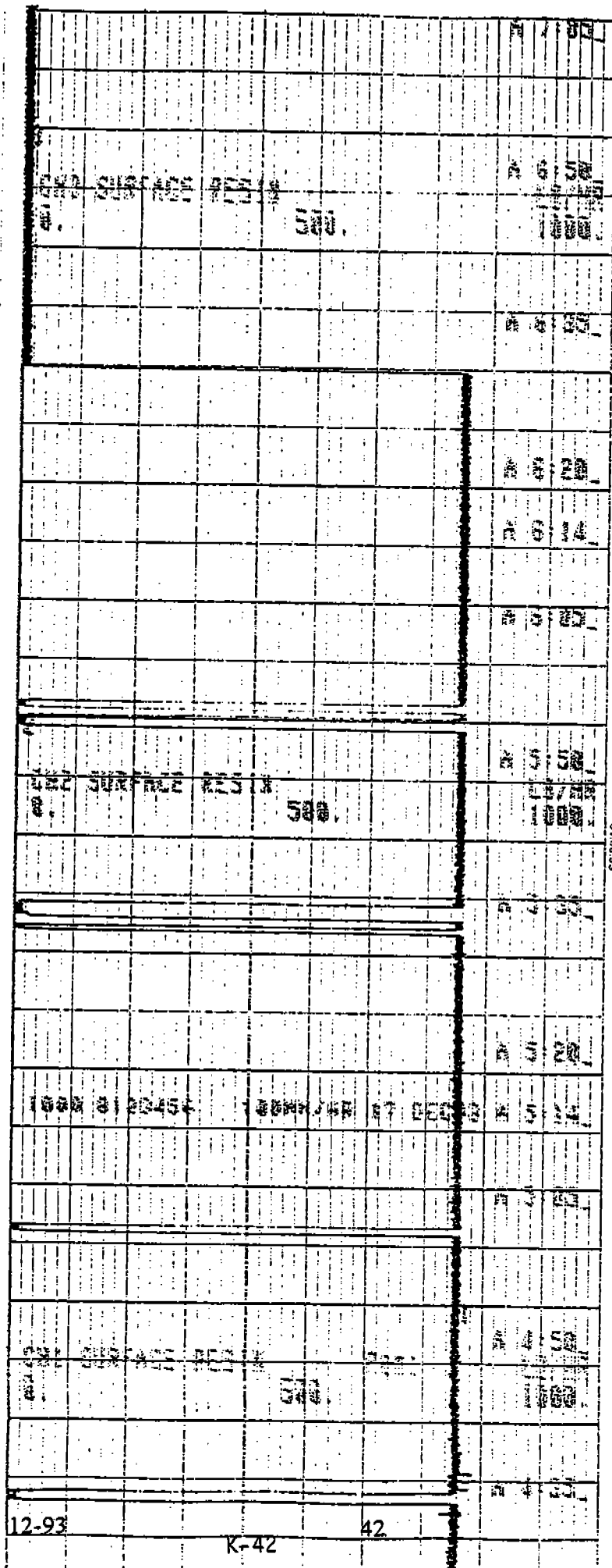
MADE IN ENGLAND

CHART No. GD201125

Dungannon 12-93

K-42

42



01.08.93

MADE IN ENGLAND

CHART No. 60201125

1000	B	23456	100MM/HR	16 DEC93	A 8:25
CHI	CORE	RESIN	500.	Pen1	LB/HR
					1000.
1000	B	23456	100MM/HR	16 DEC93	A 7:25
TT1	TOTALIZER			1057264	LB/HR
CHI	CORE	RESIN			1. LB/HR
1000	B	23456	100MM/HR	16 DEC93	A 7:00
					A 7:00

010093

Core Resin
12/16/93

[illegible]

MADE IN ENGLAND

CHART No. GD201125

01.08.93

K-45

1000 B 23456 100MM/HR 18 DEC93 P 7 25

CHI CORE RESIN Pen1 LB/HR
500 1000

1000 B 23456 100MM/HR 18 DEC93 P 8 25

CHI CORE RESIN Pen1 LB/HR
500 1000

1000 B 23456 100MM/HR 18 DEC93 P 9 25

CHI CORE RESIN Pen1 LB/HR
500 1000

MADE IN ENGLAND

CHART No. GD201125

Dungannon 12-93

47

1000 B 23456 100MM/HR 18 DEC93 P 4 25

K-47

1000 B 23456 100MM/HR 17 DEC93 A 4 25

CHI CORE RESIN Peni LB/HR
500 1000

1000 B 23456 100MM/HR 17 DEC93 A 3 25

CHI CORE RESIN Peni LB/HR
500 1000

1000 B 23456 100MM/HR 17 DEC93 A 2 25

CHI CORE RESIN Peni LB/HR
500 1000

MADE IN ENGLAND

CHART No. GD201125

Dungannon 12.93 50

1000 B 23456 100MM/HR 17 DEC93 A 1 25

K-50

[illegible]

CH	COM	REGIM	500	P001	LB/HR
					1000

[illegible]

CH	COM	REG	IN	PEN	LD/HR
00	00	00	00	00	0000

05555 02-93450 100MM/HR 17 05550 A 4 25

MADE IN ENGLAND

CHART No. GD201125

01.04.20

~~Dungannon PZ-93-000 00000/HK 17 DE93 N 4-25~~

DUNGANNON PRESS VENT TESTING 12-17-93, MDI

DATA TIME: START= 11:30 END= 17:45 HOURS= 6.25

BOARD WEIGHTS - LBS

WEIGHTS OF APPROXIMATELY EVERY 25TH
UNTRIMMED BOARD FROM TAPES

184	193
194	190
194	194
188	191
192	189
187	190
195	189
189	189
192	
212	
187	
187	
194	
198	
186	
199	

191.79 LB = AVERAGE
UNTRIMMED
MAT WEIGHT

174.72 LB = AVERAGE
FINISHED BOARD
WEIGHT
(UNTRIMMED MAT
WEIGHT - TRIM
WEIGHT)

8.9% = TRIM

PLANT PRODUCTION RATE

6.25 =HOURS DURING TESTING

86 =PRESSLOADS

688 =NO. OF (8' X 16") BOARDS PRODUCED (PRESSLOADS x 8 BOARDS/LOAD)

120207 =LBS FINISHED PRODUCT (BOARDS x WEIGHT OF FINISHED BOARD)

19233 =LBS FINISHED PRODUCT PRODUCED PER HOUR (LBS FINISHED
PROD./TESTING HOURS)

9.62 =TONS FINISHED PRODUCT PRODUCED PER HOUR (LB FINISHED PRODUCT
PER HR / 2000 LB)

DUNGANNON PRESS VENT TESTING 12-17-93, MDI

DATA TIME: START= 11:30 END= 17:45 HOURS= 6.25

RESIN USAGE FROM FLOW CHARTS

200 = LBS OF MDI RESIN PER HOUR
19233 = LBS FINISHED PRODUCT PRODUCED PER HOUR
1.04% = MDI RESIN USED AS % OF FINAL PRODUCT

790 = LBS OF LIQUID PHENOLIC RESIN PER HOUR ON A 55% SOLIDS BASIS
435 = LBS OF LIQUID PHENOLIC RESIN PER HOUR ON A 100% SOLIDS BASIS
2.26% = LIQUID PHENOLIC RESIN USED AS % OF FINAL PRODUCT

WAX USAGE FROM DAILY INVENTORY SHEET

6128 = LBS OF WAX USED FOR THE DAY @ 48% SOLIDS
3187 = LBS OF WAX USED FOR THE DAY @ 100% SOLIDS
289118 = PRODUCTION FOOTAGE FOR THE DAY - 3/8" BASIS
247815.4 = PRODUCTION FOOTAGE FOR THE DAY - 7/16" BASIS
((3/8" FOOTAGE) / (7/16" / 3/8"))
1936 = NO OF 8'x16' BOARDS PRODUCED (7/16" FOOTAGE / (8'x16"))
174.72 = WEIGHT OF FINISHED 8'x16'7/16" BOARD
338257.9 = TOTAL LBS OF BOARD PRODUCED (NO. OF BOARDS x BOARD WEIGHT)
0.94% = WAX AS % OF FINAL PRODUCT

19233 = LBS FINISHED PRODUCT PRODUCED PER HOUR
181 = LBS OF WAX USED PER HOUR DURING TESTING (% WAX x LBS
FINISHED PRODUCT PER HOUR)

DRESS CHART

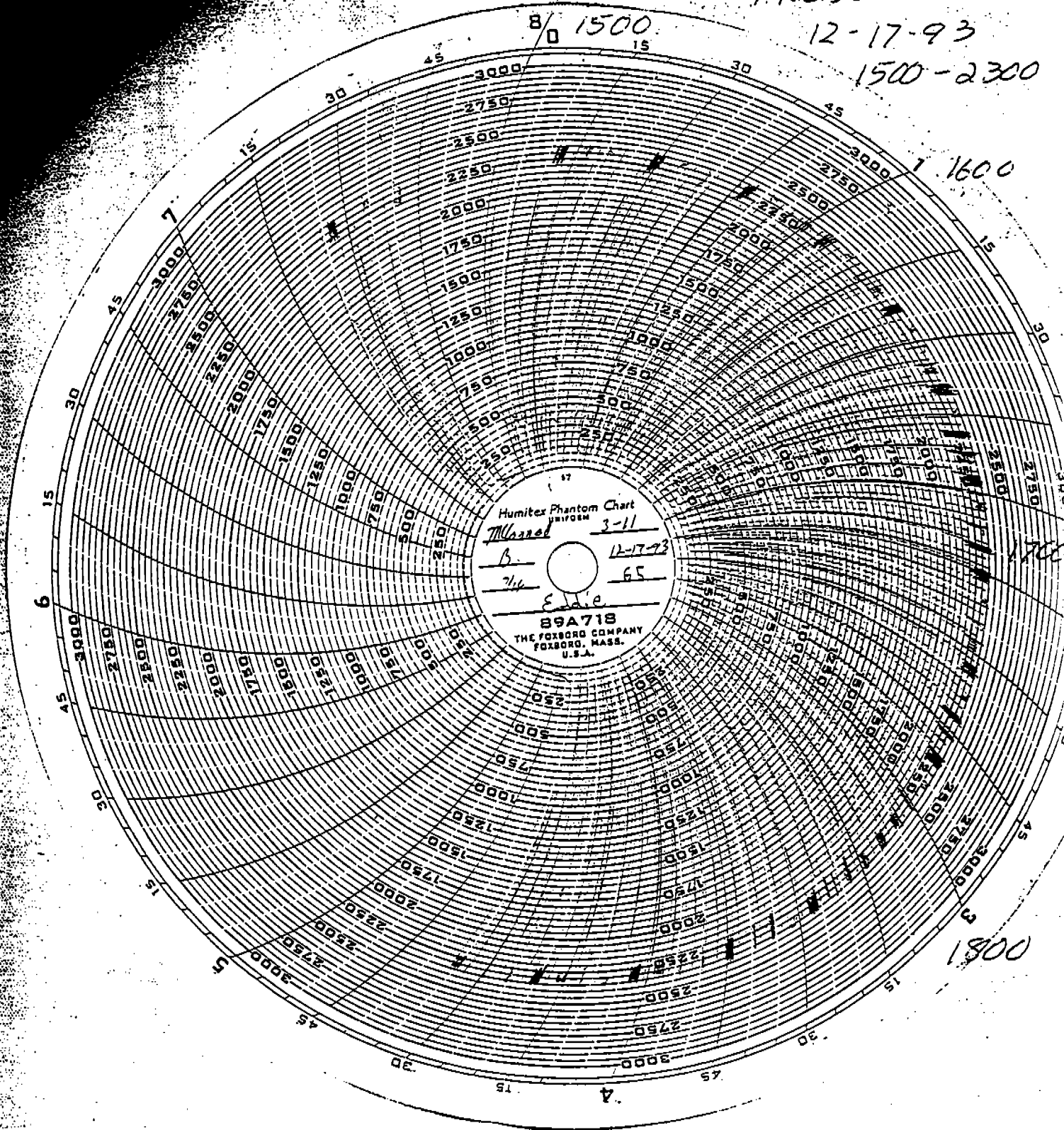
12-17-93

1500-2300

1600

1700

1800



DRESSLOADS

$$1500 - 1745 = 38$$

LOUISIANA-PACIFIC CORPORATION
DUNGANNON, VIRGINIA

PRESS REPORT

OPERATOR James S. SHIFT 7-3 CREW "A" DATE 12-17-93
THICKNESS: 3/16" PRESS LOADS 72-87, 213 BLENDER SHUTDOWNS
OVERALL TIMER: _____ DECOMPRESSION TIME _____ SURFACE 17
PRESS TEMP: 400

LINE SPEED	FROM	TO
<u>30</u>	<u>7:00</u>	<u>10:00</u>
<u>31</u>	<u>10:02</u>	<u>3:00</u>

BEGIN CORE RESIN SURFACE RESIN
896992 3568768
END 898006 3572818
Cleaned Blender Shrouds & Tracks
Formed hydraulic and radiator
blown out
FCOS hydraulic unit and radiator
blown out
Blender outfeed conv. tail pulleys
cleaned

DOWNTIME		DOWNTIME (Mins.)				KEY	REASONS FOR DOWNTIME
FROM	TO	M	E	O			
<u>7:00</u>	<u>9:33</u>				<u>153</u>		<u>Working on press, (see - fil)</u>
<u>10:28</u>	<u>10:29</u>				<u>1</u>		<u>#3 stuck to press.</u>
<u>3:28</u>	<u>2:31</u>				<u>3</u>		<u>Unloader beam dropped #7 H.B.</u>

DOWNTIME CODE: M-MECHANICAL E-ELECTRICAL O-OPERATOR

**** MAINTENANCE/LOCK-OUT LOG ****

MOTOR #	LOCKED OUT	FROM	TO	BRIEF DESCRIPTION OF WORK BEING DONE	INITIALS OF PERSON LOCKING OUT

PRESS REPORT

LINE	SPEED	FROM	TO
31		3:00	5:52
30		5:52	7:31
20		7:31	11:00

DOWNTIME		DOWNTIME (Mins.)			KEY	REASONS FOR DOWNTIME
FROM	TO	M	E	O		
7:42	10:26				164	Low Dry Bins because of Stipped insert at flaker
10:46	11:00				14	Low Dry Bins because of above problem
						178m total Down time

**** MAINTENANCE/LOCK-OUT LOG ****

[illegible]

MADE IN ENGLAND

CHART No. GD201125

010893

MADE IN ENGLAND

CHART NO. G0201125

Dungannon 12-93

K-62

62

010893

MADE IN ENGLAND

CHART No. GD201125

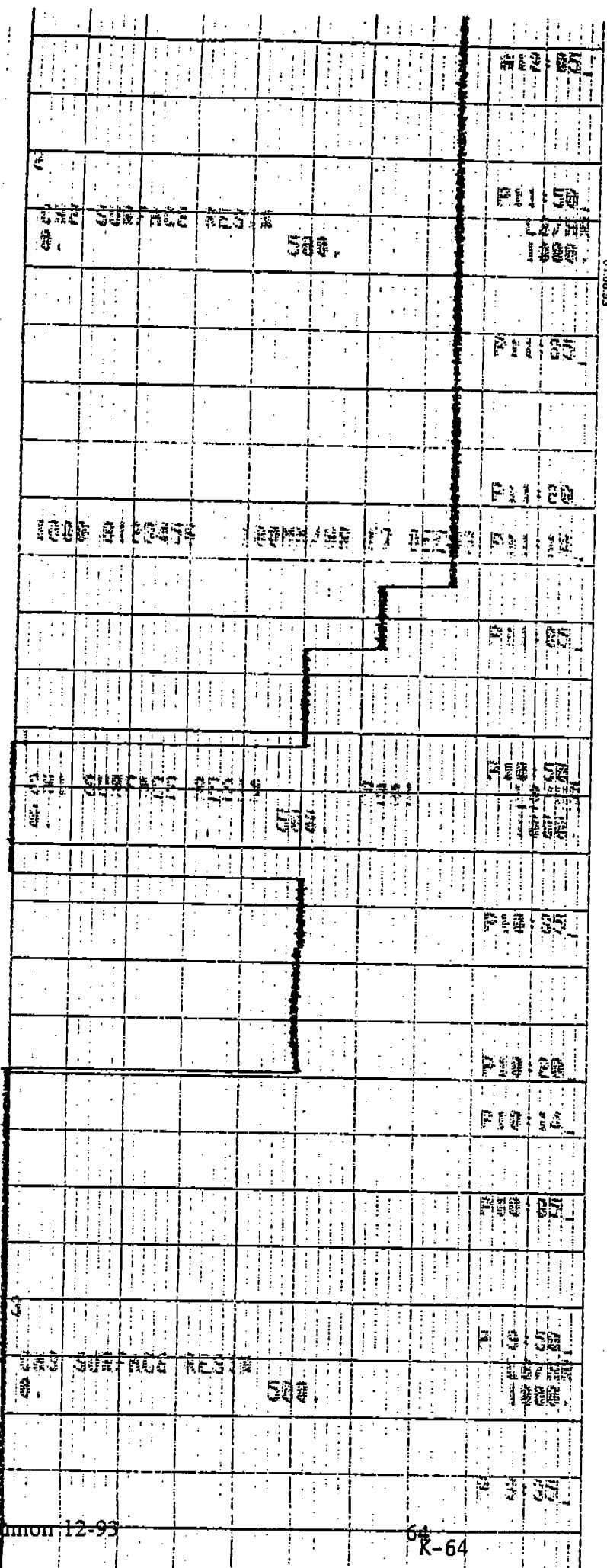
Dunganon 12-93

K-68

63

MADE IN ENGLAND

CHART No. GD201125



010893

1000	B123456	100MM/HR	17 DEC93	A 9 25L
CHI	CORE RESIN	500	Pen1	LB/HR
0				1000
1000	B123456	100MM/HR	17 DEC93	A 8 25
CHI	CORE RESIN	500	Pen1	LB/HR
9				1000
1000	B123456	100MM/HR	17 DEC93	A 7 25
TTI	TOTALIZER		1061324	LB
CHI	CORE RESIN			LB/HR
1000	B123456	100MM/HR	17 DEC93	A 7 00

MADE IN ENGLAND CHART No. GD201125

010003

Core Resin
12-17-93
~~XXXXXXXXXX~~
~~XXXXXXXXXX~~

CHART No. GD201125

1000 BT23456	100MM/HR	17 DEC93	PT2 23
CHI CORE RESIN	500	Pen1	LB/HR 1000
0.			
1000 BT23456	100MM/HR	17 DEC93	PT1 25
CHI CORE RESIN	500	Pen1	LB/HR 1000
0.			
1000 BT23456	100MM/HR	17 DEC93	PT0 23
CHI CORE RESIN	500	Pen1	LB/HR 1000
0.			
1000 BT23456	100MM/HR	17 DEC93	PT0 23
CHI CORE RESIN	500	Pen1	LB/HR 1000
0.			
non 12-93	100MM/HR	17 DEC93	PT0 25

CHI CORE RESIN	Pen	LB/HR
3.	380	1000

Dungannon 207

CHART No. GD201125

1000 8123456	100MM/HR	17 DEC93	P 9 25
CHI CORE RESIN	500	Pen1	LG/HR
8.			1000
1000 8123456	100MM/HR	17 DEC93	P 8 25
CHI CORE RESIN	500	Pen1	LG/HR
8.			1000
1000 8123456	100MM/HR	17 DEC93	P 7 25
CHI CORE RESIN	500	Pen1	LG/HR
8.			1000
1000 8123456	100MM/HR	17 DEC93	P 6 25
CHI CORE RESIN	500	Pen1	LG/HR
8.			1000
1000 8123456	100MM/HR	17 DEC93	P 5 25
CHI CORE RESIN	500	Pen1	LG/HR
8.			1000
1000 8123456	100MM/HR	17 DEC93	P 4 25
CHI CORE RESIN	500	Pen1	LG/HR
8.			1000
1000 8123456	100MM/HR	17 DEC93	P 3 25
CHI CORE RESIN	500	Pen1	LG/HR
8.			1000
1000 8123456	100MM/HR	17 DEC93	P 2 25
CHI CORE RESIN	500	Pen1	LG/HR
8.			1000
1000 8123456	100MM/HR	17 DEC93	P 1 25
CHI CORE RESIN	500	Pen1	LG/HR
8.			1000

[illegible]

MADE IN ENGLAND CHART No. GD201125

01.08.93

K-73

1000	B	23435	100MM/HK	18 DEC 93	A 5 25
CHI	CODE	RESIN	500	Pen1	LB/HR 1000
1000	B	23435	100MM/HK	18 DEC 93	A 3 25
CHI	CODE	RESIN	500	Pen1	LB/HR 1000
1000	B	23435	100MM/HK	18 DEC 93	A 4 25
CHI	CODE	RESIN	500	Pen1	LB/HR 1000
1000	B	23435	100MM/HK	18 DEC 93	A 5 25
CHI	CODE	RESIN	500	Pen1	LB/HR 1000

MADE IN ENGLAND

CHART No. GD201125

600 92

TOTALS:

DAY	DATE	DAILY MSF	WAX USE DAILY
1	11-28-93	322.569	6854
2	11-29-93	178.010	3532
3	11-30-93	219.825	5483
4	12-1-93	330.932	5806
5	12-2-93	326.153	7096
6	12-3-93	272.392	5483
7	12-4-93	284.339	5483
8	12-5-93	371.552	7741
9	12-6-93	243.895	4516
10	12-7-93	336.564	6451
11	12-8-93	296.286	7342
12	12-9-93	102.744	1290
13	12-10-93	310.797	5806
14	12-11-93	226.993	5806
15	12-12-93	291.507	5483
16	12-13-93	258.055	5161
17	12-14-93	364.384	7418
18	12-15-93	377.525	7741
19	12-16-93	359.605	8088
20	12-17-93	289.118	6128
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			

APPENDIX L

PROCEDURES

Particulate Loadings and Emission Rates

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

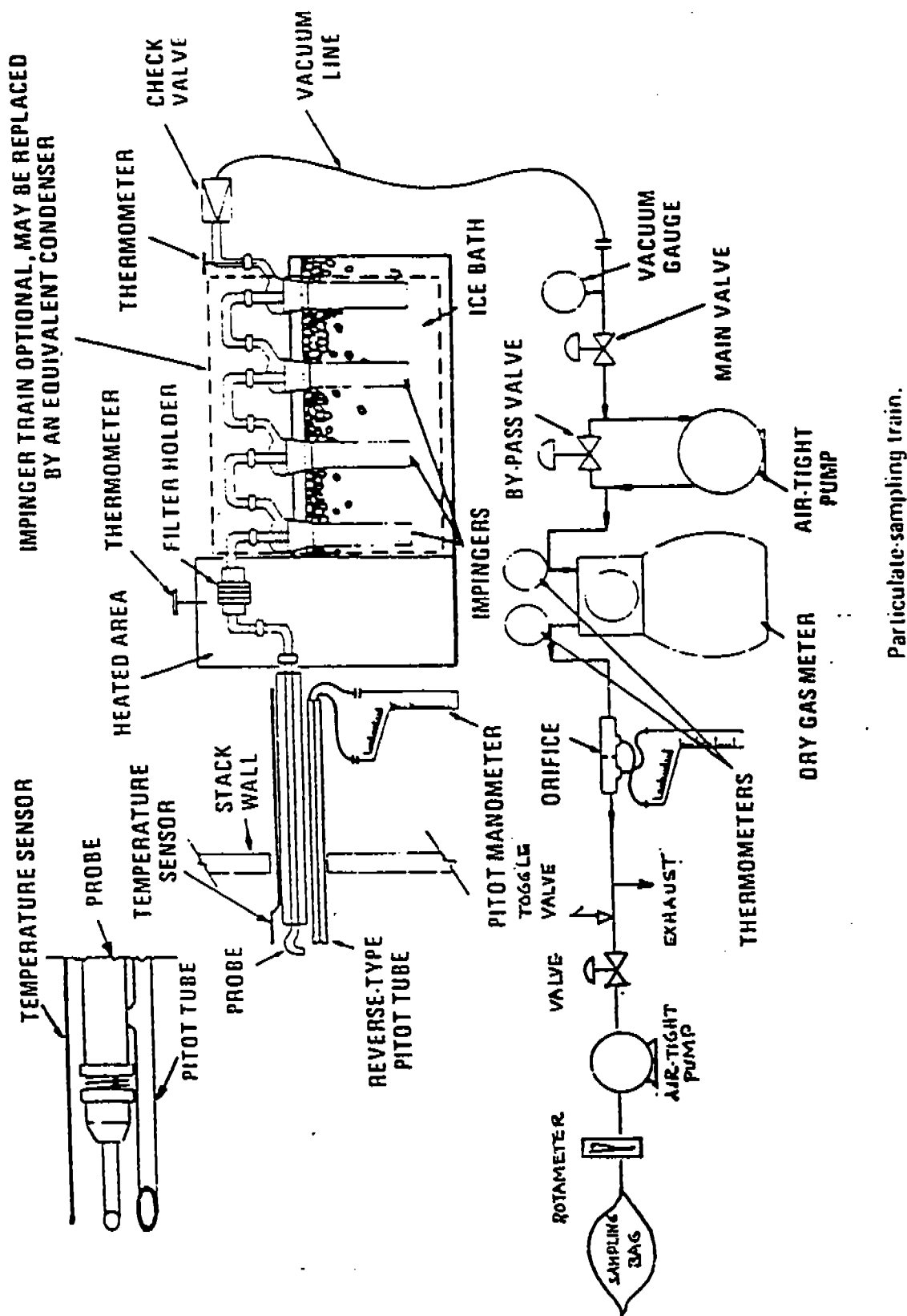
The sampling train consists of a heated glass-lined sampling probe equipped with a Type S pitot and a thermocouple. The probe is attached to a sampling module which houses the all-glass in line filter holder in a temperature controlled oven. In addition, the sampling module also houses the impinger case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

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

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

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

Integrated flue gas samples for Orsat analysis were collected simultaneously from the stack and from the breeching at the inlet to the wet scrubber. The samples were collected in 15-liter gas sampling bags 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).



**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 Sortell 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-90-03, 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 Sortell 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 (SO₂) as condensible.

The dissolution of SO₂ in water does not lead immediately to the formation of sulfuric acid (H₂SO₄), but tends to lower the solution pH, which further inhibits sulfate or H₂SO₄ formation. The method includes a purging procedure which effectively removes SO₂ 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 PM₁₀ 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 (N₂) purge is too long. He believes the majority of the SO₂ 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 SO₂ from the impinger solution.

Another commenter suggests that the method should be revised to give credit for ammonium sulfate ((NH₄)₂SO₄) dihydrate and other condensible particulate matter formed in the gas stream due to ammonia (NH₃) 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 NH₃ 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 MeCl₂ 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 MeCl₂ 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 6, 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 28 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 Pipes. 5-ml.

3.3.5 Ion Chromatograph. Same as in Method 5F, Section 2.1.6.

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 gas stream, i.e., when the pH of 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 60). 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_{sam} = Concentration of the CPM in the stack gas, dry basis, corrected to standard conditions, g/dscm (g/dscf).

C_{SO_4} = Concentration of SO_4^{2-} in the sample, mg/ml.

m_6 = Sum of the mass of the water and MeCl_2 blanks, mg.

m_7 = Mass of the NH_4^+ added to sample to form ammonium sulfate, mg.

m_8 = Mass of inorganic CPM matter, mg.

m_9 = Mass of organic CPM, mg.

m_{10} = Mass of dried sample from inorganic fraction, mg.

V_0 = Volume of aliquot taken for IC analysis, ml.

V_{ic} = 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^{2-} and if desired, add the combined water removed by the acid-base reaction.

$$m_7 = K C_{\text{SO}_4} V_{\text{ic}} \quad \text{Eq. 202-1}$$

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.

$$m_8 = m_{10} \frac{V_{\text{ic}}}{V_{\text{ic}} - V_0} - m_7 \quad \text{Eq. 202-2}$$

7.4

Concentration of CPM.

$$C_{\text{sam}} = \frac{m_8 + m_9 - m_{10}}{V m_{\text{std}}} \quad \text{Eq. 202-3}$$

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^{2-} in the sample using the following equation.

$$C_{\text{SO}_4} = \frac{48.03 V_1 N}{100} \quad \text{Eq. 202-4}$$

where

N = Normality of the NH_4OH , mg/ml.

V_1 = 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_2 from Impinger Contents. As an alternative to the post-test N_2 purge described in section 5.3.1, 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 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.

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-stack 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:

$$C_{\text{sam}} = \frac{m_6 + m_7 + m_8 - m_9}{V m_{\text{std}}} \quad \text{Eq. 202-5}$$

where:

m_7 = amount of CPM collected on out-of-stack filter, mg.

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

9. Bibliography

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

SELLING CODE 6580-55-M

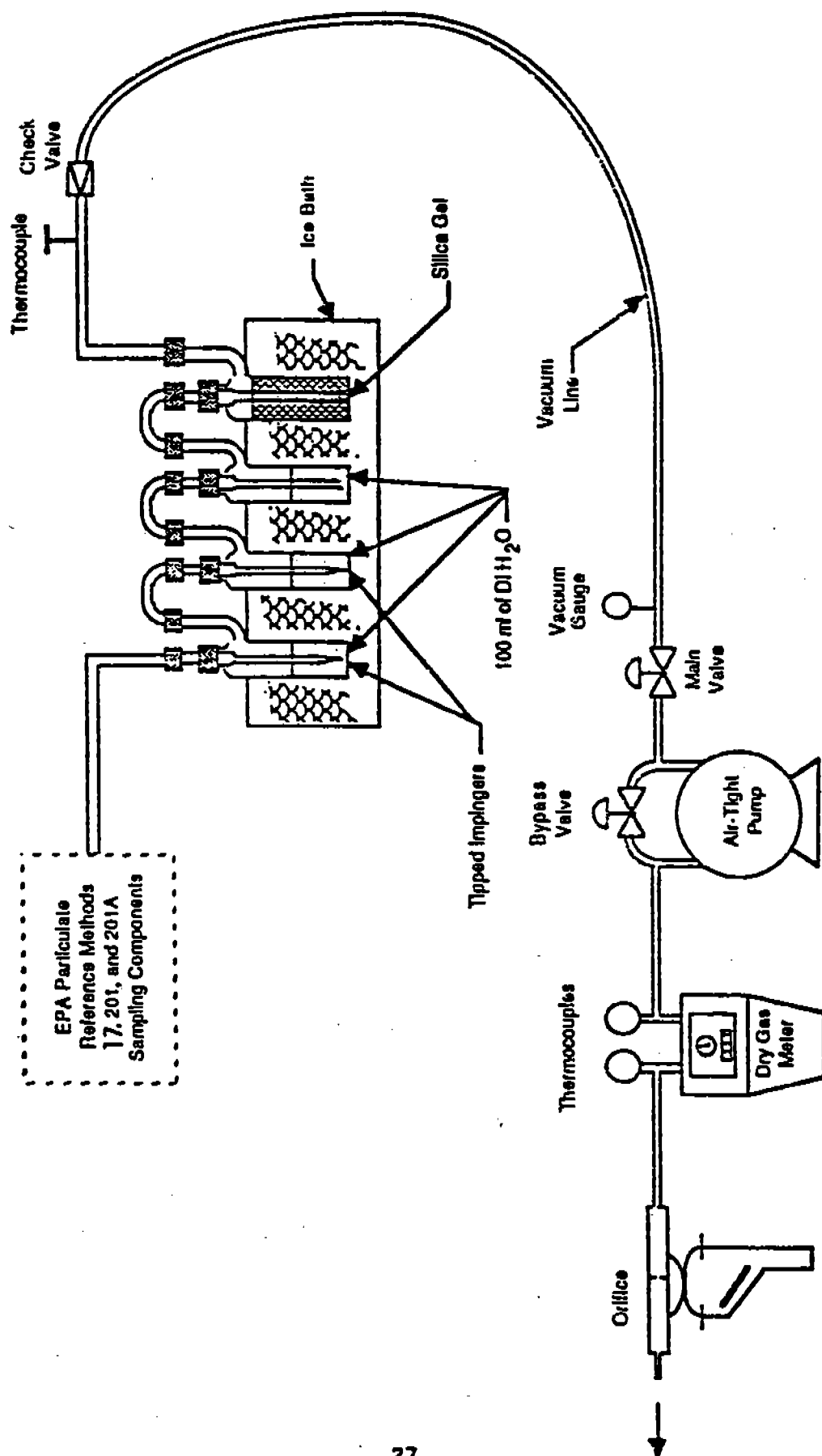


Figure 202-1. Schematic of condensable particulate sampling train.

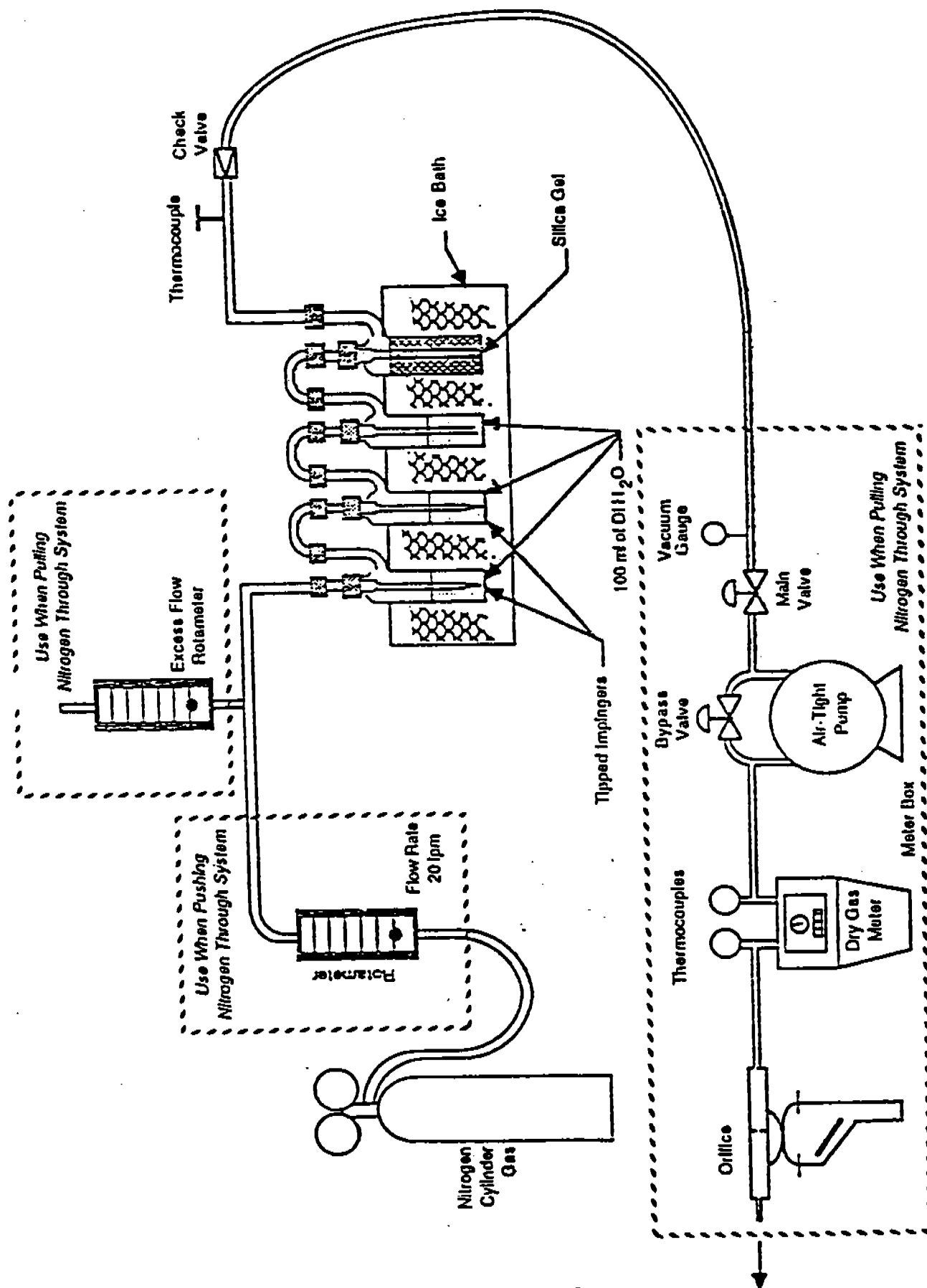


Figure 202-2. Schematic of post-test nitrogen purge system.

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 NH_4OH 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 condensable 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. 91-39957 Filed 12-16-91; 8:45 am]

BILLING CODE 6540-60-M

METHOD 201A - DETERMINATION OF PM_{10} EMISSIONS
(Constant Sampling Rate Procedure)

(55 FR 14246)

1. Applicability and Principle

1.1 Applicability. This method applies to the in-stack measurement of particulate matter (PM) emissions equal to or less than an aerodynamic diameter of nominally 10 μm (PM_{10}) from stationary sources. The EPA recognizes that condensible emissions not collected by an in-stack method are also PM_{10} , and that emissions that contribute to ambient PM_{10} levels are the sum of condensible emissions and emissions measured by an in-stack PM_{10} method, such as this method or Method 201. Therefore, for establishing source contributions to ambient levels of PM_{10} , such as for emission inventory purposes, EPA suggests that source PM_{10} measurement include both in-stack PM_{10} and condensible emissions. Condensible emissions may be measured by an impinger analysis in combination with this method.

1.2 Principle. A gas sample is extracted at a constant flow rate through an in-stack sizing device, which separates PM greater than PM_{10} . Variations from isokinetic sampling conditions are maintained within well-defined limits. The particulate mass is determined gravimetrically after removal of uncombined water.

2. Apparatus

NOTE: Methods cited in this method are part of 40 CFR Part 60, Appendix A.

2.1 Sampling Train. A schematic of the Method 201A sampling train is shown in Figure 1. With the exception of the PM_{10} sizing device and in-stack filter, this train is the same as an EPA Method 17 train.

2.1.1 Nozzle. Stainless steel (316 or equivalent) with a sharp tapered leading edge. Eleven nozzles that meet the design specifications in Figure 2

This version is a corrected version of (55 FR 14246)
Apr 17 1990

are recommended. A large number of nozzles with small nozzle increments increase the likelihood that a single nozzle can be used for the entire traverse. If the nozzles do not meet the design specifications in Figure 2, then the nozzles must meet the criteria in Section 5.2.

2.1.2 PM_{10} Sizer. Stainless steel (316 or equivalent), capable of determining the PM_{10} fraction. The sizing device shall be either a cyclone that meets the specifications in Section 5.2 or a cascade impactor that has been calibrated using the procedure in Section 5.4.

2.1.3 Filter Holder. 63-mm, stainless steel. An Andersen filter, part number SE274, has been found to be acceptable for the in-stack filter.

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

2.1.4 Pitot Tube. Same as in Method 5, Section 2.1.3. The pitot lines shall be made of heat resistant tubing and attached to the probe with stainless steel fittings.

2.1.5 Probe Liner. Optional, same as in Method 5, Section 2.1.2.

2.1.6 Differential Pressure Gauge, Condenser, Metering System, Barometer, and Gas Density Determination Equipment. Same as in Method 5, Sections 2.1.4, and 2.1.7 through 2.1.10, respectively.

2.2 Sample Recovery.

2.2.1 Nozzle, Sizing Device, Probe, and Filter Holder Brushes. Nylon bristle brushes with stainless steel wire shafts and handles, properly sized and shaped for cleaning the nozzle, sizing device, probe or probe liner, and filter holders.

2.2.2 Wash Bottles, Glass Sample Storage Containers, Petri Dishes, Graduated Cylinder and Balance, Plastic Storage Containers, Funnel and Rubber

Policeman, and Funnel. Same as in Method 5, Sections 2.2.2 through 2.2.8, respectively.

2.3 Analysis. Same as in Method 5, Section 2.3.

3. Reagents

The reagents for sampling, sample recovery, and analysis are the same as that specified in Method 5, Sections 3.1, 3.2, and 3.3, respectively.

4. Procedure

4.1 Sampling. The complexity of this method is such that, in order to obtain reliable results, testers should be trained and experienced with the test procedures.

4.1.1 Pretest Preparation. Same as in Method 5, Section 4.1.1.

4.1.2 Preliminary Determinations. Same as in Method 5, Section 4.1.2, except use the directions on nozzle size selection and sampling time in this method. Use of any nozzle ^{less than} greater than 0.16 in. in diameter require a sampling port diameter of 6 inches. Also, the required maximum number of traverse points at any location shall be 12.

? See pg. 22

4.1.2.1 The sizing device must be in-stack or maintained at stack temperature during sampling. The blockage effect of the CSR sampling assembly will be minimal if the cross-sectional area of the sampling assembly is 3 percent or less of the cross-sectional area of the duct. ^{ie $D_s \geq 17.5$ inches} If the cross-sectional area of the assembly is greater than 3 percent of the cross-sectional area of the duct, then either determine the pitot coefficient at sampling conditions or use a standard pitot with a known coefficient in a configuration with the CSR sampling assembly such that flow disturbances are minimized.

* When $D_s \leq 17.5$ inches, blockage exceeds 3%

4.1.2.2 The setup calculations can be performed by using the following procedures.

4.1.2.2.1 In order to maintain a cut size of $10\ \mu\text{m}$ in the sizing device, the flow rate through the sizing device must be maintained at a constant, discrete value during the run. If the sizing device is a cyclone that meets the design specifications in Figure 3, use the equations in Figure 4 to calculate three orifice ^{pressure drops} heads (ΔH): one at the average stack temperature, and the other two at temperatures $\pm 28^\circ\text{C}$ ($\pm 50^\circ\text{F}$) of the average stack temperature. Use the ΔH calculated at the average stack temperature as the ^{orifice} pressure head for the sample flow rate as long as the stack temperature during the run is within 28°C (50°F) of the average stack temperature. If the stack temperature varies by more than 28°C (50°F), then use the appropriate ΔH .

4.1.2.2.3 To select a nozzle, use the equations in Figure 5 to calculate $\Delta p_{\min}$ and $\Delta p_{\max}$ for each nozzle at all three temperatures. If the sizing device is a cyclone that does not meet the design specifications in Figure 3, the example worksheets can be used.

4.1.2.2.4 Correct the Method 2 pitot readings to Method 201A pitot readings by multiplying the Method 2 pitot readings by the square of a ratio of the Method 201A pitot coefficient to the Method 2 pitot coefficient.

Select the nozzle for which $\Delta p_{\min}$ and $\Delta p_{\max}$ bracket all of the corrected Method 2 pitot readings. If more than one nozzle meets this requirement,

select the nozzle giving the greatest symmetry. Note that if the expected pitot reading for one or more points is near a limit for a chosen nozzle, it may be outside the limits at the time of the run.

4.1.2.2.5 Vary the dwell time, or sampling time, at each traverse point proportionately with the point velocity. Use the equations in Figure 6 to calculate the dwell time at the first point and at each subsequent point. It is recommended that the number of minutes sampled at each point be rounded to the nearest 15 seconds.

4.1.3 Preparation of Collection Train. Same as in Method 5, Section 4.1.3, except omit directions about a glass cyclone.

4.1.4 Leak-Check Procedure. The sizing device is removed before the post-test leak-check to prevent any disturbance of the collected sample prior to analysis.

4.1.4.1 Pretest Leak-Check. A pretest leak-check of the entire sampling train, including the sizing device, is required. Use the leak-check procedure in Method 5, Section 4.1.4.1 to conduct a pretest leak-check.

4.1.4.2 Leak-Checks During Sample Run. Same as in Method 5, Section 4.1.4.1.

4.1.4.3 Post-Test Leak-Check. A leak-check is required at the conclusion of each sampling run. Remove the cyclone before the leak-check to prevent the vacuum created by the cooling of the probe from disturbing the collected sample and use the procedure in Method 5, Section 4.1.4.3 to conduct a post-test leak-check.

4.1.5 Method 201A Train Operation. Same as in Method 5, Section 4.1.5, except use the procedures in this section for isokinetic sampling and flow rate adjustment. Maintain the flow rate calculated in Section 4.1.2.2.1

throughout the run provided the stack temperature is within 28°C (50°F) of the temperature used to calculate ΔH . If stack temperatures vary by more than 28°C (50°F), use the appropriate ΔH value calculated in Section 4.1.2.2.1. Calculate the dwell time at each traverse point as in Figure 6.

4.2 Sample Recovery. If a cascade impactor is used, use the manufacturer's recommended procedures for sample recovery. If a cyclone is used, use the same sample recovery as that in Method 5, Section 4.2, except an increased number of sample recovery containers is required.

4.2.1 Container Number 1 (In-Stack Filter). The recovery shall be the same as that for Container Number 1 in Method 5, Section 4.2.

4.2.3 Container Number 2 (Cyclone or Large PM Catch). This step is optional. The anisokinetic error for the cyclone PM is theoretically larger than the error for the PM_{10} catch. Therefore, adding all the fractions to get a total PM catch is not as accurate as Method 5 or Method 201. Disassemble the cyclone and remove the nozzle to recover the large PM catch. Quantitatively recover the PM from the interior surfaces of the nozzle and cyclone, excluding the "turn around" cup and the interior surfaces of the exit tube. The recovery shall be the same as that for Container Number 2 in Method 5, Section 4.2.

4.2.4 Container Number 3 (PM_{10}). Quantitatively recover the PM from all of the surfaces from the cyclone exit to the front half of the in-stack filter holder, including the "turn around" cup inside the cyclone and the interior surfaces of the exit tube. The recovery shall be the same as that for Container Number 2 in Method 5, Section 4.2.

4.2.6 Container Number 4 (Silica Gel). The recovery shall be the same as that for Container Number 3 in Method 5, Section 4.2.

4.2.7 Impinger Water. Same as in Method 5, Section 4.2, under "Impinger Water."

4.3 Analysis. Same as in Method 5, Section 4.3, except handle Method 201A Container Number 1 like Container Number 1, Method 201A Container Numbers 2 and 3 like Container Number 2, and Method 201A Container Number 4 like Container Number 3. Use Figure 7 to record the weights of PM collected. Use Figure 5-3 in Method 5, Section 4.3, to record the volume of water collected.

4.4 Quality Control Procedures. Same as in Method 5, Section 4.4.

4.5 PM_{10} Emission Calculation and Acceptability of Results. Use the procedures in Section 6 to calculate PM_{10} emissions and the criteria in Section 6.3.5 to determine the acceptability of the results.

5. Calibration

Maintain an accurate laboratory log of all calibrations.

5.1 Probe Nozzle, Pitot Tube, Metering System, Probe Heater Calibration, Temperature Gauges, Leak-check of Metering System, and Barometer. Same as in Method 5, Section 5.1 through 5.7, respectively.

6. Calculations

Calculations are as specified in Method 5, Sections 6.3 through 6.7, and 6.9 through 6.11, with the addition of the following:

6.1 Nomenclature.

B_{ws} = Moisture fraction of stack, by volume, dimensionless.

C_1 = Viscosity constant, 51.12 micropoise for $^{\circ}\text{K}$ (51.05 micropoise for $^{\circ}\text{R}$).

C_2 = Viscosity constant, 0.372 micropoise/ $^{\circ}\text{K}$ (0.207 micropoise/ $^{\circ}\text{R}$).

C_3 = Viscosity constant, 1.05×10^{-4} micropoise/ $^{\circ}\text{K}^2$
(3.24×10^{-5} micropoise/ $^{\circ}\text{R}^2$).

C_4 = Viscosity constant, 53.147 micropoise/fraction O_2 .

C_5 = Viscosity constant, 74.143 micropoise/fraction H_2O .

D_{50} = Diameter of particles having a 50 percent probability of penetration, μm .

f_o = Stack gas fraction O_2 , by volume, dry basis.

K_1 = 0.3858 $^{\circ}\text{K}/\text{mm Hg}$ (17.64 $^{\circ}\text{R}/\text{in. Hg}$).

M_w = Wet molecular weight of the stack gas, g/g-mole (lb/lb-mole).

M_d = Dry molecular weight of stack gas, g/g-mole (lb/lb-mole).

P_{bar} = Barometric pressure at sampling site, mm Hg (in. Hg).

P_s = Absolute stack pressure, mm Hg (in. Hg).

Q_s = Total cyclone flow rate at wet cyclone conditions, m^3/min (ft³/min).

YES!

$Q_{s(\text{std})}$ = Total cyclone flow rate at ^{dry} standard conditions, dscm/min (dscf/min). DSCFM

YES!

T_m = Average absolute temperature of dry meter, $^{\circ}\text{K}$ ($^{\circ}\text{R}$).

T_s = Average absolute stack gas temperature, $^{\circ}\text{K}$ ($^{\circ}\text{R}$).

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

$V_{w(std)}$ = Volume of water vapor in gas sample (standard conditions), scm (scf).

θ = Total sampling time, min.

μ_s = Viscosity of stack gas, micropoise.

6.2 Analysis of Cascade Impactor Data. Use the manufacturer's recommended procedures to analyze data from cascade impactors.

6.3 Analysis of Cyclone Data. Use the following procedures to analyze data from a single stage cyclone.

6.3.1 PM_{10} Weight. Determine the PM catch in the PM_{10} range from the sum of the weights obtained from Container Numbers 1 and 3 less the acetone blank.

6.3.2 Total PM Weight (optional). Determine the PM catch for greater than PM_{10} from the weight obtained from Container Number 2 less the acetone blank, and add it to the PM_{10} weight.

6.3.3 PM_{10} Fraction. Determine the PM_{10} fraction of the total particulate weight by dividing the PM_{10} particulate weight by the total particulate weight.

6.3.4 Aerodynamic Cut Size. Calculate the stack gas viscosity as follows:

$$\mu_s = C_1 + C_2 T_s + C_3 T_s^2 + C_4 f_{O_2} - C_5 B_{ws}$$

No! Use equation on page 24

6.3.4.1 The PM_{10} flow rate, at actual cyclone conditions, is calculated as follows:

$$Q_s = \frac{T_s}{K_1 P_s} \left[Q_{s(std)} + \frac{V_{u(std)}}{\theta} \right]$$

$$\begin{aligned} V_{u(std)} &= .04707 (V_f - V_i) \\ T_s &= \bar{T}_s + 466 \\ \text{but } Q_{s(std)} &= \frac{V_{m(std)}}{\theta} \\ K_1 &= 17.64 \\ \text{Substituting gives:} \\ Q_s &= \frac{5.669 \times 10^{-2} (\bar{T}_s + 466)}{\theta P_s} [V_{u(std)} + .04707(V_f - V_i)] \end{aligned}$$

6.3.4.2 Calculate the molecular weight on a wet basis of the stack gas as follows:

$$M_w = M_d (1 - B_{ws}) + 18.0 (B_{ws})$$

6.3.4.3 Calculate the actual D_{50} of the cyclone for the given conditions as follows:

$$D_{50} = \beta_1 \left(\frac{T_s}{M_w P_s} \right)^{0.2091} \left(\frac{\mu_s}{Q_s} \right)^{0.7091}$$

actual cutpoint
achieved during
run

where $\beta_1 = 0.027754$ for metric units (0.15625 for English units).

6.3.5 Acceptable Results. The results are acceptable if two conditions are met. The first is that $9.0 \mu m \leq D_{50} \leq 11.0 \mu m$. The second is that no sampling points are outside Δp_{min} and Δp_{max} , or that $80 \text{ percent} \leq I \leq 120 \text{ percent}$ and no more than one sampling point is outside Δp_{min} and Δp_{max} . If D_{50} is less than $9.0 \mu m$, reject the results and repeat the test.

7. Bibliography

1. Same as Bibliography in Method 5.
2. McCain, J.D., J.W. Ragland, and A.D. Williamson. Recommended Methodology for the Determination of Particle Size Distributions in Ducted Sources, Final Report. Prepared for the California Air Resources Board by Southern Research Institute. May 1986.
3. Farthing, W.E., S.S. Dawes, A.D. Williamson, J.D. McCain, R.S. Martin, and J.W. Ragland. Development of Sampling Methods for Source PM₁₀ Emissions. Southern Research Institute for the Environmental Protection Agency. April 1989. NTIS PB 89 190375, EPA/600/3-88-056.
4. Application Guide for Source PM₁₀ Measurement with Constant Sampling Rate, EPA/600/3-88-057.

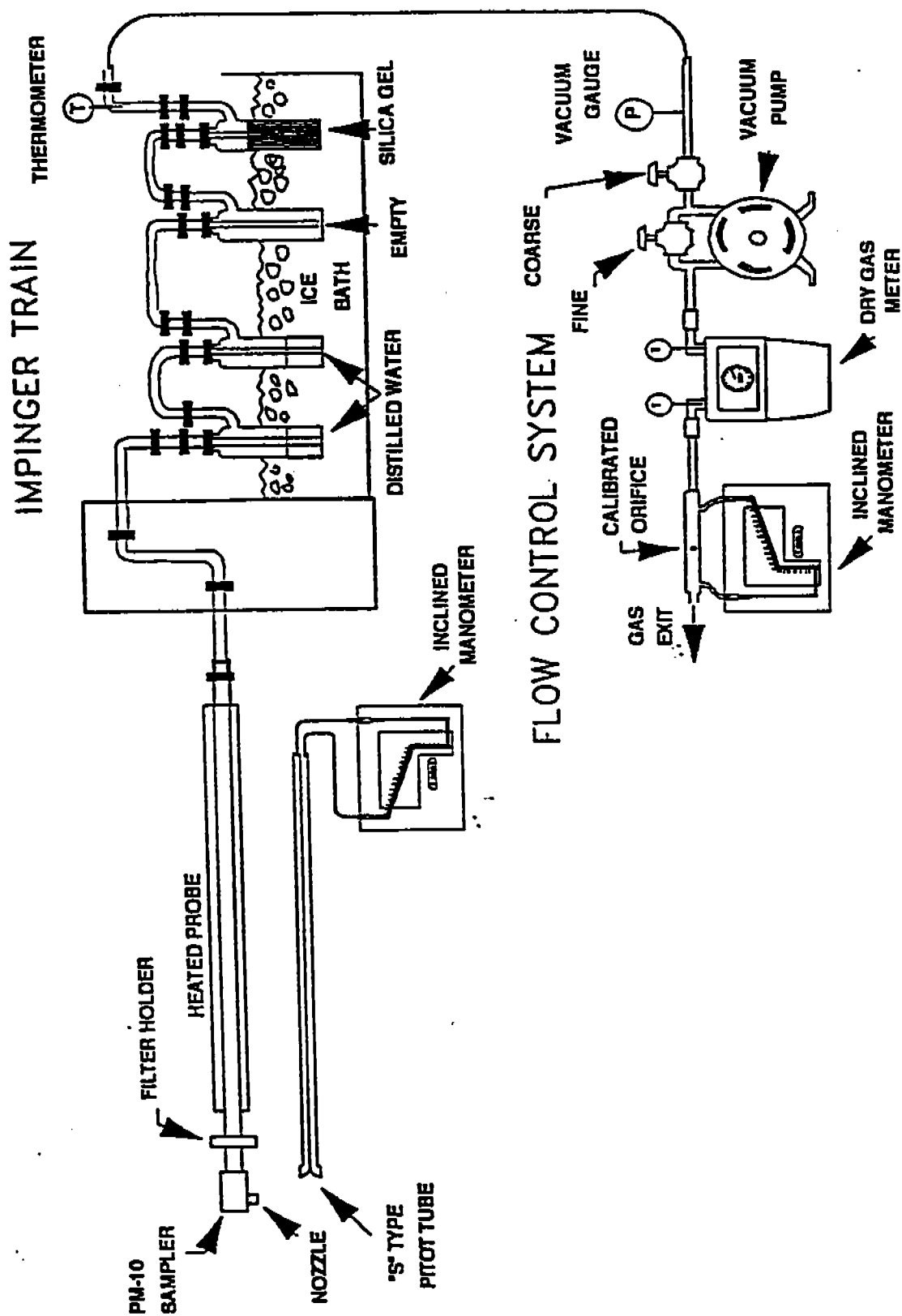
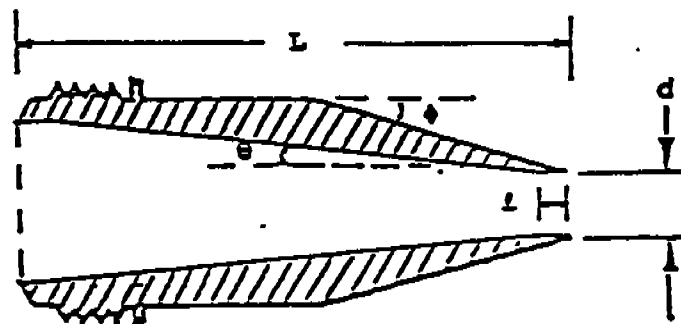


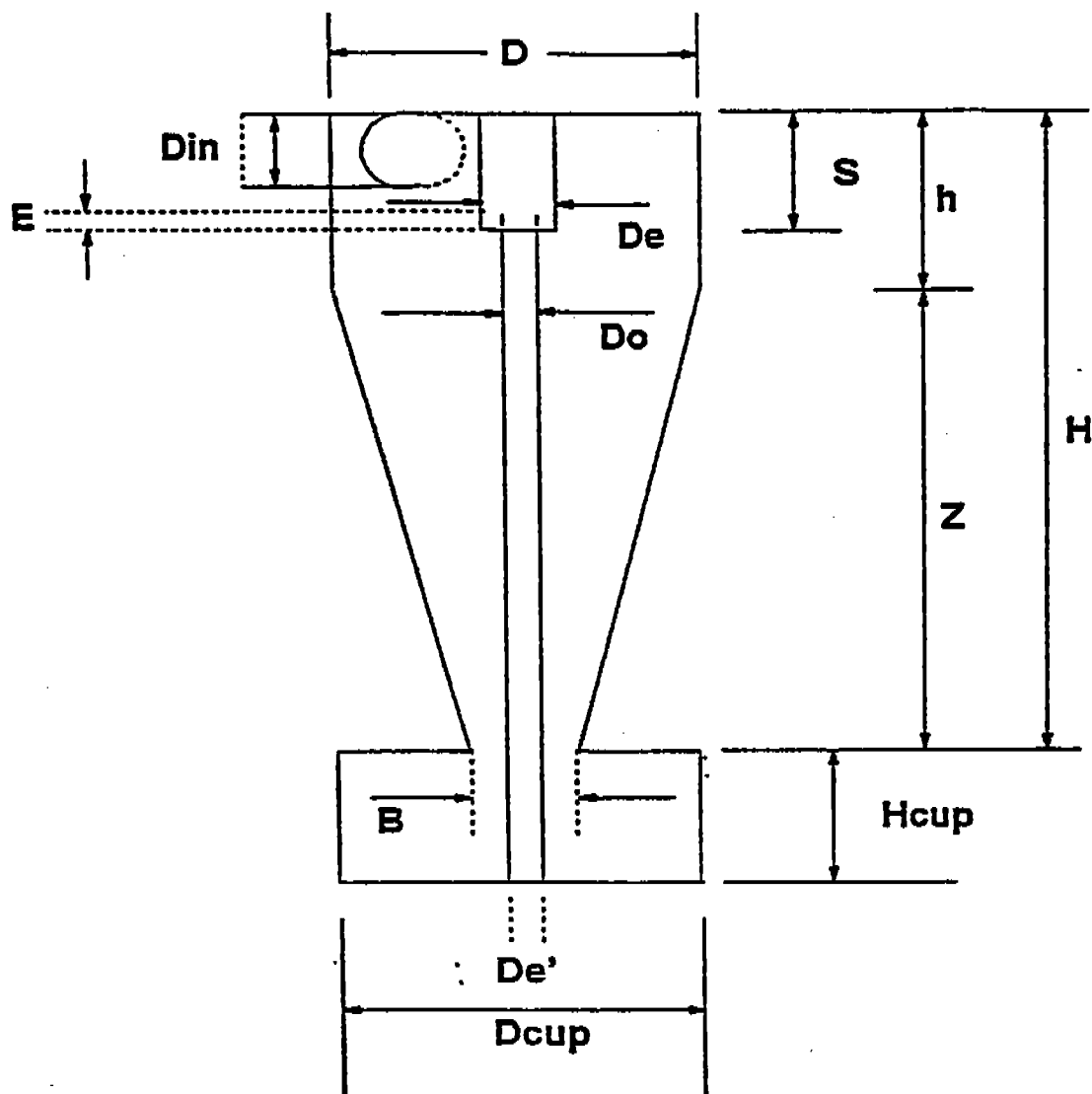
Figure 1. CSR Sampling Train



Nozzle Diameter (inches)	Cone Angle, θ (degrees)	Outside taper, ϕ (degrees)	Straight inlet length, l (inches)	Total Length L (inches)
0.136	4	15	<0.05	2.653 ± 0.05
0.150	4	15	<0.05	2.553 ± 0.05
0.164	5	15	<0.05	1.970 ± 0.05
0.180	6	15	<0.05	1.572 ± 0.05
0.197	6	15	<0.05	1.491 ± 0.05
0.215	6	15	<0.05	1.45 ± 0.05
0.233	6	15	<0.05	1.45 ± 0.05
0.264	5	15	<0.05	1.45 ± 0.05
0.300	4	15	<0.05	1.48 ± 0.05
0.342	4	15	<0.05	1.45 ± 0.05
0.390	3	15	<0.05	1.45 ± 0.05

Figure 2. Nozzle design specifications.

Cyclone Interior Dimensions



	Dimensions (+0.02 cm, +0.01 in.)												
	Din	D	De	B	H	h	Z	S	Hcup	Dcup	De'	Do	E
cm	1.27	4.47	1.50	1.88	6.95	2.24	4.71	1.57	2.25	4.45	1.02	1.24	0.25
in.	0.50	1.76	0.59	0.74	2.74	0.88	1.85	0.62	0.89	1.75	0.40	0.49	0.10

Figure 3. Cyclone design specifications.

Barometric pressure, P_{bar} , in. Hg = _____
 Stack static pressure, P_s , in. H₂O = _____
 Average stack temperature, t_s , °F = _____
 Meter temperature, t_m , °F = _____
 Orifice ΔH_o , in. H₂O = _____

Gas analysis:

$\%CO_2$ = _____
 $\%O_2$ = _____
 $\%N_2 + \%CO$ = _____
 Fraction moisture content, B_{ws} = _____

Molecular weight of stack gas, dry basis:

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO) = \text{_____ lb/lb mole}$$

Molecular weight of stack gas, wet basis:

$$M_w = M_d(1 - B_{ws}) + 18(B_{ws}) = \text{_____ lb/lb mole}$$

Absolute stack pressure:

$$P_s = P_{bar} + \frac{P_g}{13.6} = \text{_____ in. Hg}$$

Viscosity of stack gas:

$$\mu_s = 152.418 + 0.2552 t_s + 3.2355 \times 10^{-5} t_s^2 + 0.53147 (\%O_2) - 74.143 B_{ws} = \text{_____ micropoise}$$

Cyclone flow rate:

$$Q_s = 0.002837 \mu_s \left(\frac{t_s + 460}{M_w P_s} \right)^{0.2949} = \text{_____ ft}^3/\text{min}$$

Figure 4. Example worksheet 1 (Page 1 of 2), cyclone flow rate and ΔH .

Orifice pressure head (ΔH) needed for cyclone flow rate:

$$\Delta H = \left[\frac{Q_s(1-B_{ws})P_s}{t_s + 460} \right]^2 \frac{(t_m + 460) M_d (1.083) \Delta H_s}{P_{bar}} = \text{_____ in. H}_2\text{O}$$

Calculate ΔH for three temperatures:

$t_s, ^\circ\text{F}$			
$\Delta H, \text{ in. H}_2\text{O}$			

Figure 4. Example worksheet 1 (Page 2 of 2), cyclone flow rate and ΔH .

Stack viscosity, μ_s , micropoise = _____
 Absolute stack pressure, P_s , in. Hg = _____
 Average stack temperature, t_s , °F = _____
 Meter temperature, t_m , °F = _____
 Method 201A pitot coefficient, C_p = _____
 Cyclone flow rate, ft^3/min , Q_s = _____
 Method 2 pitot coefficient, C_p = _____
 Molecular weight of stack gas, wet basis, M_w = _____
 Nozzle diameter, D_n , in. = _____

Nozzle velocity

$$v_n = \frac{3.056 Q_s}{D_n^2} = \text{_____ ft/sec}$$

Maximum and minimum velocities:

Calculate R_{min} .

$$R_{min} = 0.2457 + \sqrt{0.3072 - \frac{0.2603 (\sqrt{Q_s}) \mu_s}{v_n^{1.5}}} = \text{_____}$$

If R_{min} is less than 0.5, or if an imaginary number occurs when calculating R_{min} , use Equation 1 to calculate v_{min} . Otherwise, use Equation 2.

Eq. 1 $v_{min} = v_n (0.5) = \text{_____ ft/sec}$

Eq. 2 $v_{min} = v_n R_{min} = \text{_____ ft/sec}$

Calculate R_{max} .

$$R_{max} = 0.4457 + \sqrt{0.5690 + \frac{0.2603 (\sqrt{Q_s}) \mu_s}{v_n^{1.5}}} = \text{_____}$$

Figure 5. Example worksheet 2 (page 1 of 2), nozzle selection.

If $R_{\max}$ is greater than 1.5, use Equation 3 to calculate $v_{\max}$. Otherwise, use Equation 4.

Eq. 3 $v_{\max} = v_n (1.5) = \underline{\hspace{2cm}} \text{ ft/sec}$

Eq. 4 $v_{\max} = v_n R_{\max} = \underline{\hspace{2cm}} \text{ ft/sec}$

Maximum and minimum velocity head values:

$$\Delta p_{\min} = 1.3686 \times 10^{-4} \frac{P_s M_w (v_{\min})^2}{(t_s + 460) C_p^2} = \underline{\hspace{2cm}} \text{ in. H}_2\text{O}$$

$$\Delta p_{\max} = 1.3686 \times 10^{-4} \frac{P_s M_w (v_{\max})^2}{(t_s + 460) C_p^2} = \underline{\hspace{2cm}} \text{ in. H}_2\text{O}$$

Nozzle Number				
D_n , in.				
v_n , ft/sec				
$v_{\min}$, ft/sec				
$v_{\max}$, ft/sec				
$\Delta p_{\min}$, in. H ₂ O				
$\Delta p_{\max}$, in. H ₂ O				

Velocity traverse data:

incorrect

$$\Delta p(\text{Method 201A}) = \Delta p(\text{Method 2}) \left(\frac{C_p}{C_p'} \right)^2 = \Delta p^{H2} \left(\frac{C_p^{H2}}{C_p^{201A}} \right)^2$$

Figure 5. Example worksheet 2 (page 2 of 2), nozzle selection.

4-11-91 PL

Total run time, minutes = _____

Number of traverse points = _____

$$t_1 = \left[\frac{\Delta p'_1}{\Delta p'_{avg}} \left(\frac{\text{Total run time}}{\text{Number of points}} \right) \right]$$

where:

t_1 = dwell time at first traverse point, minutes.

$\Delta p'_1$ = the velocity head at the first traverse point (from a previous traverse), in. H_2O .

$\Delta p'_{avg}$ = the square of the average square root of the Δp 's (from a previous velocity traverse), in. H_2O .

At subsequent traverse points, measure the velocity Δp and calculate the dwell time by using the following equation:

$$t_n = \frac{t_1}{\sqrt{\Delta p_1}} \sqrt{\Delta p_n}, \text{ where } n = 2, 3, \dots \text{total number of sampling points}$$

where:

t_n = dwell time at traverse point n , minutes.

Δp_n = measured velocity head at point n , in. H_2O .

Δp_1 = measured velocity head at point 1, in. H_2O .

Figure 6. Example worksheet 3 (page 1 of 2), dwell time.

Port No _____ Port No _____ Port No _____ Port No _____

Point Number	Δp	t	Δp	t	Δp	t	Δp	t
1								
2								
3								
4								
5								
6								

Figure 6. Example worksheet 3 (page 2 of 2), dwell time.

Plant _____
 Date _____
 Run no. _____
 Filter no. _____
 Amount of liquid lost during transport _____
 Acetone blank volume, ml _____
 Acetone wash volume, ml (4) _____ (5) _____
 Acetone blank conc., mg/mg (Equation 5-4, Method 5) _____
 Acetone wash blank, mg (Equation 5-5, Method 5) _____

Container number	Weight of PM ₁₀ (mg)		
	Final weight	Tare weight	Weight gain
1			
3			
Total.....			
Less acetone blank....			
Weight of PM ₁₀			

Figure 7. Method 201A analysis sheet.

TABLE 1. PERFORMANCE SPECIFICATIONS FOR SOURCE PM₁₀ CYCLONES
AND NOZZLE COMBINATIONS

Parameter	Units	Specification
1. Collection efficiency	Percent	Such that collection efficiency falls within envelope specified by Section 5.2.6 and Figure 8.
2. Cyclone cut size (D ₅₀)	μm	10 ± 1 μm aerodynamic diameter

TABLE 2. PARTICLE SIZES AND NOMINAL GAS VELOCITIES FOR EFFICIENCY

Particle size (μm) ^a	Target gas velocities (m/sec)		
	7 ± 1.0	15 ± 1.5	25 ± 2.5
5 ± 0.5			
7 ± 0.5			
10 ± 0.5			
14 ± 1.0			
20 ± 1.0			

(a) Mass median aerodynamic diameter.

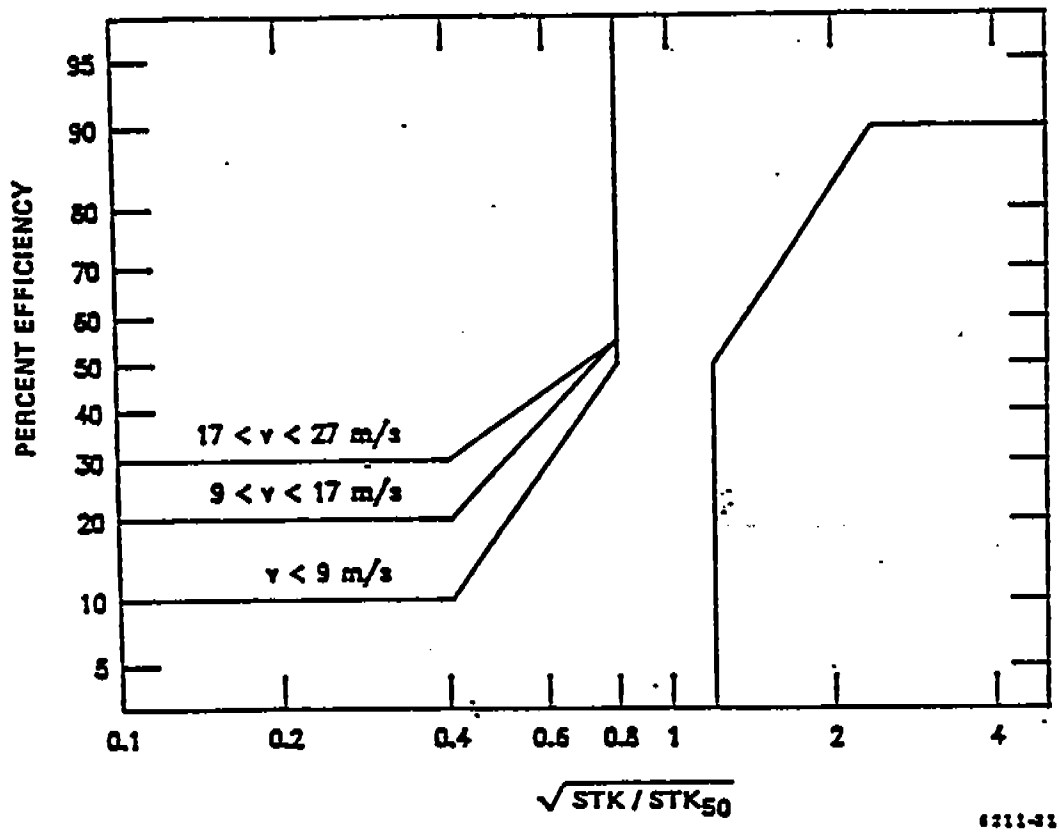


Figure 9. Efficiency envelope for first calibration stage.

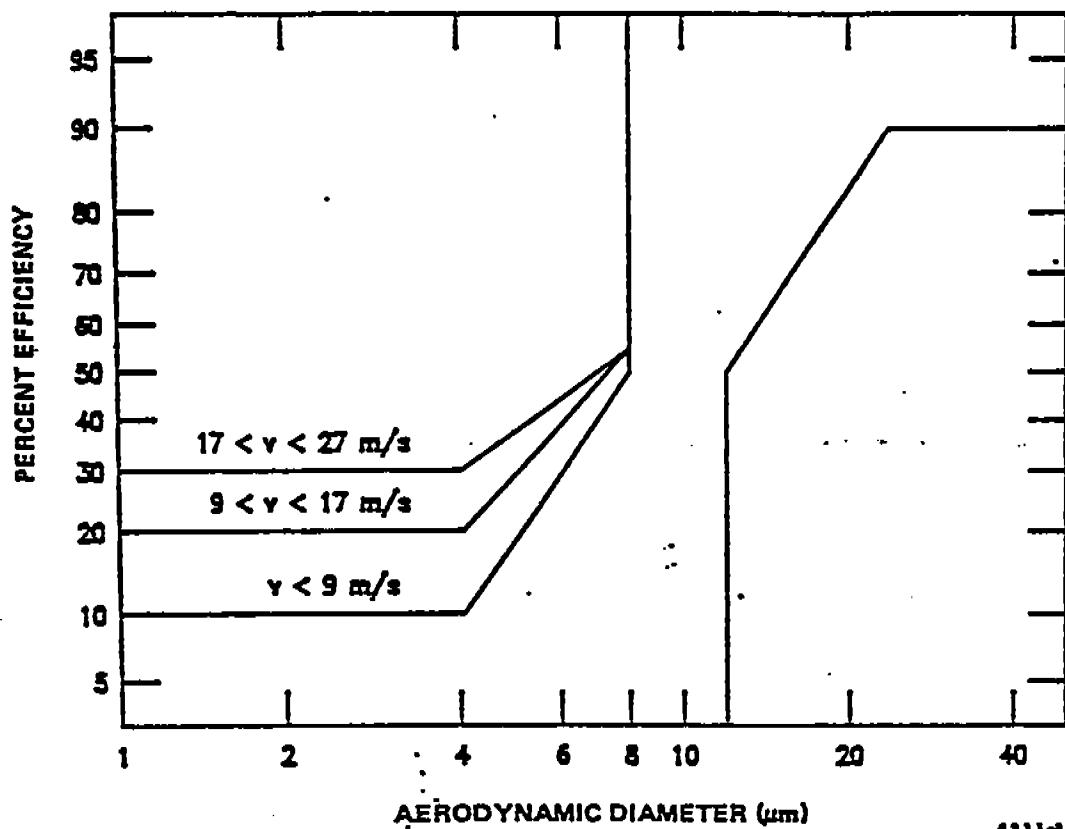


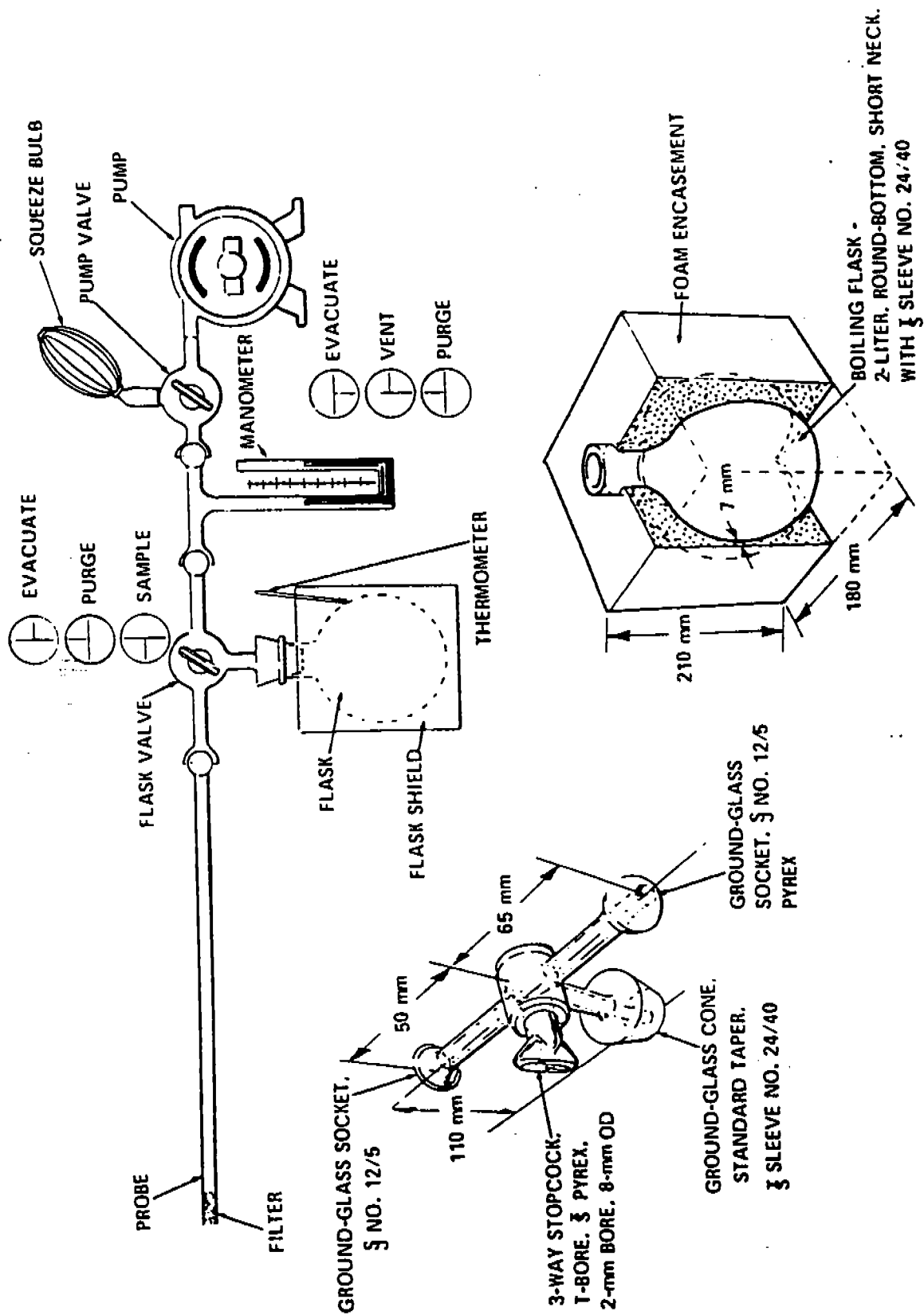
Figure 8. Efficiency envelope for the PM₁₀ cyclone.

Oxides of Nitrogen

Oxides of nitrogen concentrations were collected in accordance with EPA Method 7 (see above-cited reference) with a specially designed all glass manifold and valving assembly and a heated stainless steel-lined probe. Samples were collected in two-liter evacuated insulated flasks which contained 25 cc of acidified peroxide solution (Method 7 reagent). Nine sets or more of three samples each were collected over a period of 4.5 to 5 hours.

The sampling train was leak checked through the probe at the beginning and end of the test and, in addition, the system leak checked at the time of evacuation of each flask. Before the samples were collected, the probe was purged to eliminate dead volume effects and to raise the temperature of the probe outlet and manifold assembly to minimize condensation of moisture. A plug of microfiber glass wool inserted in the probe inlet was used to prevent particulate material from entering into the flask. The temperature of the flask, vacuum in the flask and barometric pressure at the time of sampling was recorded for each flask. After sampling was complete, as evidenced by the in-line vacuum gauge, the flask valve was closed, the flask assembly disconnected from the manifold/valve assembly and the flask shook for several minutes to promote oxidation and absorption. The recovered oxides of nitrogen samples were returned to the laboratory and analyzed immediately by ion chromatography as per EPA 7A.

The internal volume of each numbered flask assembly has been measured prior to initial use by filling with water, weighing before and after and then converting the weight of water to volume by means of the density of water at room temperature. Flask volumes are stored in the computer and recalled automatically in the computer calculation.



Sampling train, flask valve, and flask.

DETERMINATION OF CARBON MONOXIDE EMISSIONS
FROM STATIONARY SOURCES

Carbon monoxide concentrations were determined in accordance with CFR Title 40, Part 60, Appendix A (revised July 1, 1990), EPA Method 10 using the integrated sampling technique. An integrated gas sample is extracted from a three-point sampling traverse and analyzed for carbon monoxide content using a ACS Model 3300 nondispersive infrared analyzer (NDIR). This analyzer has a measuring range of 0-500 and 0-1000 ppm. The measuring method is single beam. Linearity is better than $\pm 2\%$ full scale and the noise is less than 0.5 fs. The minimum detectable concentration is 5 ppm. Zero drift is rated at $\pm 1\%$ fs per 24 hours and the span drift is less than 1% in a 24-hour period. Response time is less than 15 seconds to 90% of final reading. Precision is rated at better than $\pm 0.5\%$ fs on low range and $\pm 1\%$ fs on high range. The flow rate through the analyzer is 1.0 ± 0.5 LPM..

Integrated flue gas samples are collected over a 21-minute period using a three or more point traverse. The flue gas samples are collected at a flow rate of 400-1000 cc per minute. The flue gas is dried using a desiccant column filled with silica gel or Drierite. Integrated gas samples are collected in 44-liter Tedlar bags. The bags are leak-checked immediately before initiation of sampling. The integrated bags are housed in aluminum housings to eliminate any contact with sharp objects which might cause puncture and leakage.

After sampling is complete, the bags are transported to the laboratory for analysis. The bags are analyzed using a flow system whereby any residual moisture and carbon dioxide are quantitatively removed prior to introduction into the NDIR. This is accomplished using two cartridges in series immersed in an ice bath. The first cartridge contains silica gel or Drierite and the second cartridge Ascarite as prescribed in EPA Method 10. The analyzer is then zeroed and calibrated

using NBS traceable standard gases (Scott Specialty Gases). These gases are introduced directly into the system and passed through the two adsorbent cartridges. A high purity nitrogen zero gas is used to zero the analyzer. Several concentrations of carbon monoxide in air standards are used to calibrate the analyzer and to quality assure intermittently the analysis of the individual flue gas samples.

The integrated bag samples are also analyzed for carbon dioxide and oxygen by means of a standard Orsat analyzer equipped with a 100 cc buret using standard commercially available absorption reagents in accordance with EPA Method 3. The moisture content of the flue gas is determined independently in accordance with EPA Method 4 (large impinger version) to allow mathematical conversion of the dry, CO₂-free concentrations to actual flue gas conditions.

The reported carbon monoxide concentrations, unless otherwise noted, have been mathematically corrected for both carbon dioxide and moisture content in accordance with the equations given in EPA Method 10.

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 (FIA). 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:

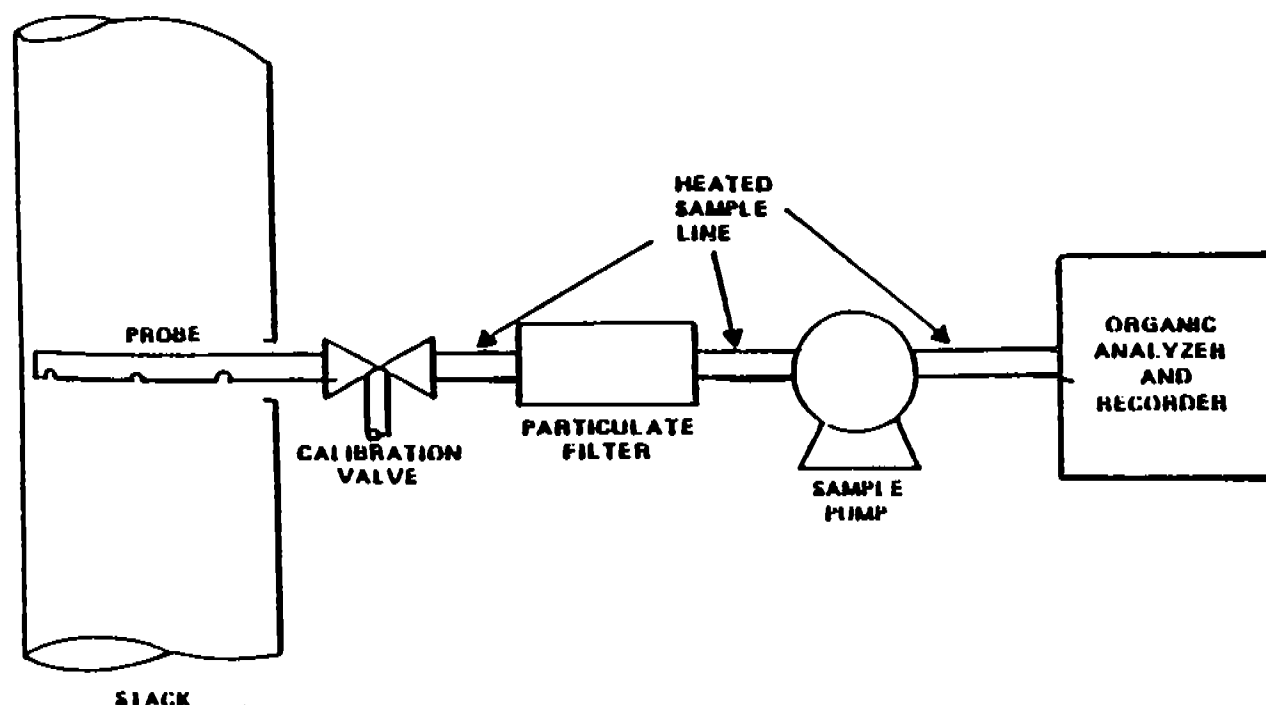


Figure 25A 1. Organic Concentration Measurement System.

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.

$$C_c = K C_{\text{meas}}$$

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

1.0 SCOPE AND APPLICATION

INTERPOL LABORATORIES

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

INTERPOL LABORATORIES
4500 BALL ROAD N.E.
CIRCLE PINES, MN 55014-1819
(612) 786-8020

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 $>0.00057 \text{ m}^3/\text{min}$ (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:

Total mg formaldehyde = $C_d \times V \times DF \times$

$$([g/mole \text{ aldehyde}] / [g/mole \text{ DNPH derivative}]) \times 10^{-3} \text{ mg}/\mu\text{g}$$

where:

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

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 ft^3/m^3 if $V_{m(\text{std})}$ is expressed in English units

= 1.00 m^3/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 =

$$[(WF) (FORM_1 \text{ conc}) (100 - \%DRE)] / 100$$

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 µL of the Field Spike Standard into an impinger containing 200 mL of DNPH solution. Standard impinger recovery procedures are followed and the field spike sample is returned to the laboratory for analysis. The field spike is used as a check on field handling and recovery procedures. An aliquot of the field spike standard is retained in the laboratory for derivatization and comparative analysis.

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.

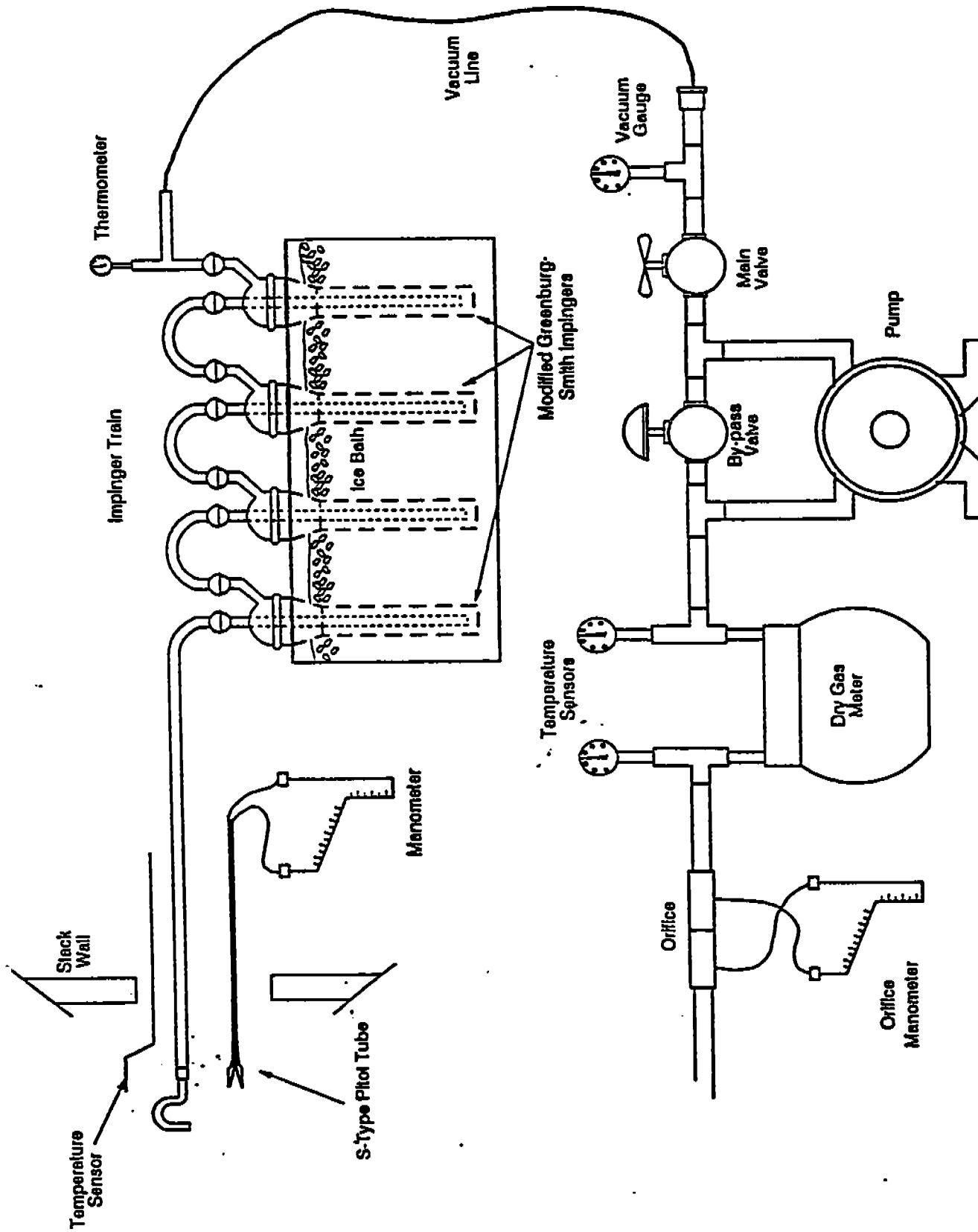
Table 3. Expected Method Performance for Formaldehyde

Parameter	Precision	¹ Accuracy ²	Detection Limit ³
Matrix: Dual trains	±15% RPD	±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

3402457

The diagram shows a square grid of sites. A central site is labeled 'i'. To its right is site 'j', and to its left is site 'i-1'. Above site 'i' is site 'i+', and below it is site 'i-'. The diagram illustrates the spatial arrangement of sites in a 2D lattice.

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 Healing Setting _____
 Leak Rate, m³/min. (cfm) _____
 Probe Liner Material _____
 Static Pressure, mm Hg (in. Hg) _____
 Filter No. _____

[illegible]

Figure 2. Field Data Sheet

PHENOL

Phenol samples were collected using a Method 5 sampling train at 0.75 CFM using neutral-buffered absorbing reagent. The first impinger in each sampling was spiked with isotopically-labeled phenol (phenol- d_5) and 2-fluorophenol for sampling and recovery efficiency surrogates. The recovered samples were extracted and the extracts analyzed by GC/MS for phenol, phenol- d_5 and 2-fluorophenol as per EPA Method 8270. The recoveries of phenol- d_5 and 2-fluorophenol were used to adjust the measured phenol concentrations.

**Polyurethanes**

ICI Polyurethanes Group

New MDI Method

INTERNAL MEMORANDUM

DATE: MARCH 22, 1993

FROM: MARK D. BAKER *Mark D. Baker*

TO: METHOD FILE

ORIGINAL
Do Not Remove

RECEIVED

MAR 26 1993

INTERPOLL LABORATORIES

SUBJ: IH SAMPLING METHOD I1024-G, 1993 REVISION

The IH sampling Method I1024-G, Method for the Collection and Determination of Airborne MDI, PI, Vapor and Particulates, has been reviewed and modified for 1993. The major 1993 revisions are listed below:

- A. The Electrochemical Detector has been removed and replaced with a Fluorescence Detector.
- B. The Fluorescence detector is now the primary detector and the UV detector is the secondary.
- C. Phenylisocyanate standard has been removed as a required component and replaced with a Triisocyanate oligomer standard.
- D. The concentration of dilute 12MP was increased from 0.4 mM to 1 mM.
- E. A more detailed section on impinger work was added.
- F. A note on the USDOT requirements for shipping toluene was added.
- G. The requirement for Bulk sample analysis was modified as a result of the triiso standard.
- H. The framework for statistical studies to determine Limits of Detection and Quantification is incorporated into this revision.

Post-It™ brand fax transmittal memo 7671

of pages >

To <i>Perry-Lonnes</i>	From <i>Mark Baker</i>
Co.	Co.
Dept.	Phone #
Fax # <i>612-786-7854</i>	Fax #

ICI Polyurethanes Group
West Deptford, NJ 08066 USATelephone (609) 423-8300
Fax (609) 423-8503 (floor 1)
423-8502 (floor 2)CC: W. W. BRAND
W. J. KAROLY
J. FLATLEYR. D. STEVENSON, III
J. D. BOWERS
P. F. O'BRIEN

The following individuals have read the revised Method I1024G:

W. J. Karoly

Date

John Flatley

Date

R. D. Stevenson, III

Date

Beth Melles

Date

IH93001
DOCUMENT NUMBER:

**METHOD I1024G
REVISION 1.6**

**Method for the Collection, Storage,
and Determination of
Airborne 4,4'-Methylenediphenylisocyanate (MDI),
Phenylisocyanate (PI) Vapor,
and OLIGOMERS OF MDI & Particulates**

ICI Polyurethanes Group

Revised by:

M. D. Baker
M. D. Baker

Senior Development Specialist

3/25/93

Date

Approved by:

M. D. Baker, M.S.
M. D. Baker, M.S.

Laboratory Director

Date

Reviewed by:

W. W. Brand, Ph.D.
W. W. Brand, Ph.D.

Supervisor Industrial Hygiene Group

Date

THIS DOCUMENT CONTAINS 15 PAGES

ICI Polyurethanes Group
Industrial Hygiene Laboratory
February 1993

METHOD I1024
VALIDATION CLASS
REV. 1.6

Method for the Collection, Storage and Determination of Airborne
4,4'-Methylenediphenylisocyanate (MDI) Monomer, Phenylisocyanate
(PI), and Oligomers as Vapors & Particulates

NOTE

This method is being actively researched and revised in response to a continuing research effort sponsored by isocyanate producers. The research effort involves the determination of sampling efficiency of various samplers including the IOM, 13mm, and impinger in wind tunnel environments of inert and isocyanate aerosols. This method has not been validated by ICI against known atmospheres containing MDI as a monomer or oligomers or PI vapor or aerosols. Method I1024-G represents ICIA's best approach to the sampling and analysis of MDI, and is offered as guidance only.

SCOPE:

This method is applicable to the collection, storage and determination of aromatic isocyanates as vapors or aerosols using impingers or filters. The impingers contain a solution that is 1 mM 1-(2-methoxyphenyl) piperazine (12MP) in dry toluene while the filters are coated with 2 mg (13 mm filter) or 6 mg (25 mm filter) of 12MP. This method is based on MDHS Method 25 and NIOSH Method 5521.

The analytical range of standards for this method depends on the detector, either Fluorescence Detector (FD) or Variable Wavelength Ultra Violet (UVD) and the detector setting used.

Using the FD the analytical range for standards is :

PI: 0.3 to 20 µg

MDI: 0.3 to 25 µg

Triiso Oligomer: 0.3 TO 25 µg L-69

Using the FD the analytical range for standards is :

PI: 0.3 to 20 μg

MDI: 0.3 to 25 μg

Triiso Oligomer: 0.3 TO 25 μg

Using the UVD the analytical range for standards is:

PI: 0.5 to 50 μg

Page 2 of 15

Method I1024G - Rev. 1.6

The ranges referenced above for the FD are valid when the Excitation Wavelength is set at 236 nm, the Emission Wavelength is set for 367 nm and the Gain is set at 13. The ranges referenced above for the UVD are valid at a wavelength of 242 nm and an AUFS of 2.

The analytical ranges correspond to collecting a 15 minute sample at a flow rate of 1 L/min (15 L sample) from an atmosphere containing 0.02 mg/M^3 to 1.67 mg/M^3 for each MDI and Triiso using the FD or 0.033 mg/M^3 to 4 mg/M^3 using the UVD.

ANALYTICAL METHOD LIMIT OF DETECTION AND LIMIT OF QUANTIFICATION

In an effort to establish the Limit of Detection (LOD) and Limit of Quantification (LOQ) for the method the laboratory considers it important to look at the precision of analyte recovery from the sampling medium as well as standard ranges. The criteria the laboratory intends to use is stated below:

LOD is defined by a statistical analysis of spike recoveries from the filter medium. The proposed equation for determination of LOD is presented below:

$$\text{LOD } (\mu\text{g}) = \mu\text{g (added at 80\% recovery)} + (3 * \text{SD})$$

Where SD = Standard Deviation of the measurement

The LOD will be established at the mass of analyte that yields an average recovery $\geq 80\%$ (with no single value $< 75\%$) for 85% of the sample population ($n \geq 13$).

LOQ is defined by a statistical analysis of spike recoveries from the filter medium. The proposed equation for determination of LOQ is presented below:

LOQ is defined by a statistical analysis of spike recoveries from the filter medium. The proposed equation for determination of LOQ is presented below:

$$\text{LOQ } (\mu\text{g}) = \mu\text{g (added at 90\% recovery)} + (3 * \text{SD})$$

Where SD = Standard Deviation of the measurement

The LOQ will be established at the mass of analyte that yields an average recovery $\geq 90\%$ (with no single value $< 85\%$) for 85% of the sample population ($n \geq 13$).

Method I10246 - Rev. 1.6

The laboratory has collected recovery data on quadruplicate DE's at three levels (1 μg , 0.6 μg , and 0.31 μg). The results to date indicate that the 0.36 μg mass may be close to the LOQ for MDI.

The values obtained for the LOQ and LOD will be published when the studies are completed in 1993.

PRINCIPLE:

Air is pulled through the impinger solution or the filter at a known flow rate. Isocyanate vapor or aerosol will react with 12MP to form a stable urea derivative. Diethylphthalate is also added to the filters to act as a solvent for the aerosols and vapors collected. The derivative is dissolved in an acetonitrile:water solvent, chromatographed and detected with the FD as the primary detector followed by the UVD.

SAMPLING AND ANALYTICAL ERROR:

The sampling and analytical error for this method has not been determined.

REFERENCES:

1. NIOSH Method 5521, Isocyanates, NIOSH Manual of Analytical Methods, 3rd Ed., 1989.
2. MDHS Method 25, Organic Isocyanates in Air, Health and Safety Executive: Occupational Medicine and Hygiene Laboratory, 1987.

HAZARDS AND SPECIAL PRECAUTIONS:

1. Isocyanates are potent sensitizers and respiratory irritants. Skin contact should be avoided by use of appropriate protective equipment, gloves and lab coat. All work with isocyanates is to be done in a hood. The TLV for MDI has been established at 0.051 mg/M^3 or 5 ppb. No TLV has been established for PI or isocyanate oligomers.
2. Toluene is identified as a "HAZARDOUS MATERIAL" by the USDOT and proper labeling, packaging and shipping procedures must be followed to ship the 12MP solutions in toluene referenced in this method.

Method I1024G - Rev 1-6

APPARATUS:

1. HP Model 1090 HPLC: equipped with a programable Fluorescent Detector, HP Model 1046A or equivalent and a variable wavelength Ultra-Violet Detector (UV), HP Model 1050 or equivalent.
2. Analytical Column: Spherisorb ODS-2, 5 μ m packing, 250 mm x 4.6 mm i.d. Guard Column: Spherisorb ODS-2, 5 μ m packing, 10 mm x 4.6 mm i.d.
3. Nylon-66 filters 47 mm. 0.45 μ m: for filtration of mobile phase. MSI No. N04SP04700 or equivalent.
4. Nylon 66 filters 0.45 mm: Whatman, Uniprip Syringeless Filters Cat. NO. UN113ENYL AQOR.45, or equivalent.
5. Dropping Pipettes.
6. Automatic Sampler Vials: 12 mm X 32 mm, crimp seal with PTFE lined septa, or equivalent.
7. Analytical Balance: Sartorius 1602 MP, 0.1 mg accuracy, or equivalent.
8. Volumetric flasks: Class A, 10.0 mL and 25.0 mL.
9. Pipettes: Class A, 1.00 mL thru 3.00 mL as needed.
10. Syringes: 10 μ L, 25 μ L, and 50 μ L as needed.
11. Micro-pipets: 25 μ L, 50 μ L, 100 μ L, 200 μ L, 250 μ L.
12. Shaker: IKA Werke, Model HS500, or equivalent.
13. Vials: Two and four dram with screw caps and PTFE lined septa.
14. Impingers: {SKC No. 226-36-1 (standard), SKC No. 226-36-4 (spill resistant), or equivalent}, containing 15 mL of 1,2-MP solution, 1 mL 1,2-MP in dry toluene.

Method I1024G - Rev 1.6

15. Glass Fiber Filters: Type A/E, binder free. Filter sizes may vary depending on sampling requirements. The 13 mm filters are precoated with two 50 μ L aliquots of a 20 mg/mL 1,2-MP solution in 98:2 (V/V) dry toluene:diethylphthalate (DEP). The 25 mm filters are treated with three 100 μ L aliquots of the same 1,2-MP solution. Filters are allowed to dry between applications of 1,2-MP solutions.

Filters can be stored in a brown, wide mouth jar capped with a PTFE lined lid and kept in the freezer for up to 3 weeks or until used.

NOTE: FILTERS MUST BE FREE OF ACRYLATE BINDERS SINCE THESE BINDERS CONTRIBUTE MANY PD AND UV ACTIVE PEAKS TO THE SAMPLE.

16. Swinnex Disc Filter Holders: Swinnex, 13 mm, Millipore Catalog No. SX00-013-00.
17. Institute of Occupational Medicine Sampler: Available as the conductive plastic IOM available from SKC.
18. SKC Constant Air Flow Pump: Cat. No. 224-PCXR7 or PCXR8, with battery charger, or equivalent.

CHEMICALS AND REAGENTS:

1. Milli-Q HPLC Grade Water: Type II reagent grade water.
2. 1-(2-Methoxyphenyl)piperazine (12MP), 98% purity or better, Aldrich Catalog No. M2-260-1. Order sufficient quantities so that the same lot is used for at least one year. This material should be received as a solid but it has also been received as a liquid. Aldrich melts the material to load it into the package. The material may be seeded with crystalline 12MP to return it to a solid state. It is advised that an IR spectrum be obtained on each new lot to verify identity. Store over desiccant (e.g., Drierite) - 12MP is very hygroscopic.

The 12MP may be recrystallized from pentane to remove unwanted impurities.

3. Concentrated 12MP Solution, 20 mg/mL: Weigh 1.00 grams of 12MP into a 50.0 mL volumetric flask and add 1.0 mL of diethylphthalate then bring to volume with dry toluene. Prepare fresh monthly.

Method I1024G - Rev 1.6

4. Dilute 12MP Solution, 1 mMolar (mM): pipet 1.00 mL of the 20 mg/mL 12MP toluene solution into a 100 mL volumetric flask and bring to volume with dry toluene. Prepare fresh for each sampling project.
5. Potassium Acetate, Biochemika Microselect, >99%, Fluka No. 60033, or equivalent.
6. Acetic Acid Glacial, Fluka puriss >99.5%, for use as Perchloric acid solvent, Fluka No. 45730, or equivalent.
7. Acetic Anhydride, Fluka puriss >99.5%, Fluka No. 45830, or equivalent.
8. Acetonitrile, Burdick and Jackson distilled in glass HPLC quality, or equivalent.
9. Dry Toluene, Burdick and Jackson distilled in glass HPLC grade toluene, or equivalent. Store over molecular sieve 5A which was dried overnight at 350°C.
10. Diethylphthalate, reagent grade, 98%.
11. Desorbing Solution, solution used to reconstitute sample for HPLC analysis. Acetonitrile:Water:1-propanal:acetic acid (650:350:30:6) containing 2.46 grams potassium acetate.
12. 4,4'-Methylenediphenylisocyanate, ICIA Rubinate 44, 99+%, or equivalent.
13. Phenylisocyanate, Fluka puriss >99%, Fluka No. 78750, or equivalent.
14. Oligomeric (Triiso) standard, ICI in-house standard, 95+%.

SAMPLING PROCEDURE:

FILTERS

1. Assemble cassette with 12MP impregnated filter and label according to the operation being performed.
2. With a representative sampler in line calibrate the air

1. Assemble cassette with 12MP impregnated filter and label according to the operation being performed.
2. With a representative sampler in line calibrate the air sampling pump using an appropriate soap film flowmeter or other primary calibration standard. Calibrate to 2 L/min for the IOM sampler and to 1 L/min for the 13 mm Swinnex filter.

Page 7 of 15

TOTAL P.06

Method I1024G - Rev 1.6

3. Connect the air sampling pump to the filter cassette.
4. Attach the filter cassette to the operator's uniform. Place the pump on the operator's belt and turn on the sampling pump.
5. After sampling is completed, turn off the pump, record the time of monitoring, and recheck the flow rate of the pump with a representative sampler in line.
6. Blanks (1 for every 10 samples) should be included with each set of samples. These blanks should be handled in the same fashion as samples with the exception of the sampling period.
7. If sampling an area in which MDI containing aerosols of any kind are produced, the following procedure must be followed:
 - a) Immediately after sampling, disassemble the cassette and place the filter in a 2 dram vial. A larger, wider mouth vial is recommended for the IOM filters.
 - b) For the 13 mm Swinnex cassettes, take the cassette top (the part with the inlet) and turn upside down on the top of the vial so that the inlet is in the vial. For the IOM samplers, take a small funnel with a shortened stem, place funnel stem in vial and place IOM nozzle upside down in the funnel.
 - c) Rinse the inlet of the 13 mm Swinnex cassette with 1 mL of dilute 12MP solution. For the IOM samplers, rinse the nozzle with 2 mL of dilute 12MP solution.
 - d) Tightly seal the vials with PTFE lined cap and ship to the laboratory by next day courier service or mail.

IMPINGERS

1. With a filled impinger in line calibrate the air sampling pump using an appropriate soap film flowmeter or other primary calibration standard. Calibrate to 1 L/min using an impinger containing 12MP solution. Make certain that pump is protected with in-line carbon cartridge to adsorb toluene vapors.

Page 3

Post-It® brand fax transmittal memo 7571		# of pages >
To	Perry Lomas	
From	Mark Baker	
Co.	Co.	
Dept.	Phone #	
Fax # 612-786-7854	Fax #	

Method I1024G - Rev 1.6

2. Just prior to sampling, pipet 15 mL of 1 mM 12MP in dry toluene into a midget impinger and assemble the impinger. Label according to the operation being performed and with a unique sample number.
3. Connect the air sampling pump to the impinger.
4. Attach the impinger to the operator's uniform as close to the breathing zone as possible. Place the pump on the operator's belt and turn on the sampling pump.
5. Collect a sample no less than 15 minutes and no more than four hours. Since toluene evaporates during sampling, the impinger must be periodically checked and the solution volume maintained at about 15 mL. Addition of 1 mM 12MP in dry toluene is recommended.
6. After sampling is completed, turn off the pump, record the time of monitoring, and recheck the flow rate of the pump with a filled impinger in line.
7. Blanks (1 for each 10 samples) should be included with all samples. Handle blanks in the same manner as samples with the exception of the sampling period. This includes rinsing the impinger.
8. Transfer the sample solution to 20 mL vials for shipment. Rinse the impinger with 2-3 mL of 12MP solution. Be certain that the inlet is completely rinsed. Finish rinsing with an additional 2-3 mL of dry toluene. Tightly seal vials with PTFE lined cap and ship to the laboratory by next day courier service or mail.

STORAGE:

1. Samples, in toluene, may be shipped at ambient temperature but should be shielded from temperature extremes. Upon laboratory receipt, samples should be stored at < 5 °C prior to analysis. Samples have been shown to be stable at < 5 °C up to 14 days prior to analysis.

STOCK STANDARD PREPARATION:

1. Accurately weigh about 25 mg each (recording the mass to the nearest ± 0.1 mg) of MDI (Rubinate 44) and Triiso standard and transfer both into a 25.0 mL volumetric flask. Add about 5 mL of dry toluene and then pipet 25.0 μ L of phenylisocyanate into the same 25.0 mL flask. The density of PI is reported as 1.093 g/mL and this should be used to convert the PI

Method I1024G - Rev 1.6

concentration to 1.09 mg/mL. Dilute flask contents to volume with dry toluene and mix well. Transfer to a 20 mL vial fitted with a PTFE lined septum. Label this as standard solution A.

NOTE: The inclusion of PI is not required for all analyses. If an unknown peak appears in chromatograms at or near the retention time of PI a standard can be prepared and analyzed.

NOMINAL CONCENTRATION: 1 mg/mL or 1 µg/µL.

2. Pipet 3.00 mL of solution A into a 25.0 mL volumetric flask, dilute to volume with dry toluene, and mix well. Label this as standard solution B. Transfer to a vial and cap with a PTFE lined septum.

NOMINAL CONCENTRATION: 0.1 mg/mL or 0.1 µg/µL.

3. Pipet 1.00 mL of solution A into a 25.0 mL volumetric flask, dilute to volume with dry toluene, and mix well. Label this as standard solution C. Transfer to a vial and cap with a PTFE lined septum.

NOMINAL CONCENTRATION: 0.04 mg/mL or 0.04 µg/µL.

4. Prepare working standards over the range of 0.1 µg to 15 µg per vial. Prepare at least 3 standards per each solution.

WORKING STANDARD PREPARATION:

1. Pipet 1 mL of 1 mM 12MP solution into a 2 dram vial and add 100 µL (13 mm filter) or 300 µL (25 mm filter) of the 20 mg/mL 12MP solution used for filter preparation to each vial.
2. Using a syringe, add the appropriate volume of the stock standard to the vial and cap with a PTFE lined septum.
3. The recommended working standards may be prepared from 3 µL - 25 µL per stock standard.
4. Shake the working standard for 1 hour at about 50 cycles/minute.
5. Handle standards as for samples. Proceed as per **SAMPLE PREPARATION 1.a)**, found below.

Method I1024G - Rev 1.6

DESORPTION EFFICIENCY (DE's) and CONTROL (CT's) PREPARATION:

1. For each set of 20 samples, the analysts will spike at least two duplicate sets of 12MP treated filters or 15 mL impinger solutions at the desired level using the appropriate stock standard solution.
2. One set of DE's should be at or near 1 µg per filter.
3. A second analyst will spike 2 sets of duplicate filters or impingers as per step 1 above. The second analyst will use an independently prepared standard solution for these samples.
4. Allow the spiked impinger solutions to equilibrate for at least one hour.
5. Allow the spiked filters to air dry in a hood and place in separate 2 dram vials.
6. Pipet 1 mL of 1 mM 12MP solution into each filter vial and seal with a PTFE lined cap. Place DE's in shaker and shake for 1 hour.
7. Handle standards as for samples. Proceed as per **SAMPLE PREPARATION 1.e)**, found below.

SAMPLE PREPARATION:

FILTERS

1. With a minimum 24 hour shipment period between the time dilute 12MP solution was added to filters in the field and sample delivery to lab, proceed as follows:
 - a) Pipet 100 µL (13 mm) or 200 µL (25 mm) of acetic anhydride into each filter vial and mix well.
 - b) Uncap the vial, place in a heating block set at about 40 °C, and evaporate to dryness under a gentle stream of Nitrogen.
 - c) When dry remove the samples from the heating block and pipet 2.00 mL of Desorbing Solution into each. Cap and label each sample.
2. Pass sample through a 0.45 mm Nylon-66 filter and transfer into an autosampler vial, cap, and analyze.

Method I1024G - Rev 1.6

3. Samples may be stored at 0 °C up to one week.

IMPINGERS

1. With a minimum 24 hour shipment period between, proceed as follows:
 - a) Pipet 50 μ L of acetic anhydride into each sample vial and mix well.
 - b) Uncap the vial, place in a heating block set at about 40 °C, and evaporate to dryness under a gentle stream of Nitrogen.
 - c) When dry remove the samples from the heating block and pipet 2.00 mL of Desorbing Solution into each. Cap and label each sample.
2. Samples may be stored at 0 °C up to one week.

PREPARATION OF BULK ISOCYANATE SAMPLE

Bulk "SAMPLES" of the isocyanate used in the plant for which sampling is being conducted may be analyzed to assist in identification of unknown peaks. This analysis is not necessary for all plant visits and is left to the discretion of the analyst or lab supervisor.

1. Obtain a sample of the bulk isocyanate used at the customer or plant location. The bulk sample is used to prepare a diluted stock polymeric standard for qualitative analysis of prepolymers and MDI oligomers in air samples collected at the site.
2. If the concentration of monomeric MDI is about 50% (w/w) in the polymeric mixture, the following preparation technique may be used:
 - a) Pipet 100 μ L of the bulk isocyanate into a 25.0 mL volumetric flask. Bring to volume dry Toluene and mix well.
3. Run a 25 μ L aliquot this stock as in Sample Preparation Step 1 through 3. Use the chromatogram with air samples and pure standards to assist in the identification of polymeric peaks.

3. Run a 25 μ L aliquot this stock as in Sample Preparation Step 1 through 3. Use the chromatogram with air samples and pure standards to assist in the identification of polymeric peaks.

Page 12 of 15

Method I1024G - Rev 1.6

CHROMATOGRAPHIC CONDITIONS:

Column: Sperisorb ODS-2, 5 μ m, 250 mm x 4.6 mm i.d.
Guard Column: Sperisorb ODS-2, 5 μ m, 10 mm x 4.6 mm i.d.
Injection Volume: 20 μ L
Column Temperature: 50 $^{\circ}$ C
Flow Rate: 1 mL/min.

MOBILE PHASE COMPOSITION:

WEAK MOBILE PHASE (PUMP A) [FOR $\approx$ 1 LITER]:

Acetonitrile: 500 mL
Water: 500 mL
1-Propanol: 30 mL
Acetic Acid: 6 mL
Potassium Acetate: 2.46 grams

STRONG MOBILE PHASE (PUMP B) [FOR $\approx$ 1 LITER]:

Acetonitrile: 800 mL
Water: 200 mL
1-Propanol: 30 mL
Acetic Acid: 6 mL
Potassium Acetate: 2.46 grams

Mobile Phase Preparation:

Measure components in proportions given above and mix well.
Filter mobile phase through a 0.45 μ nylon filter.

HPLC Gradient Conditions:

TIME (min)	A %	B %	Flow rate	Comments
---------------	--------	--------	--------------	----------

HPLC Gradient Conditions:

TIME (min)	A %	B %	Flow rate	Comments
4	75	25	1	Isocratic first 4 min.
17	25	75	1	Gradient Portion
20	25	75	1	Hold
21	75	25	1	Return to initial conditions
28	75	25	1	Reequilabration

Total Run Time: 28 minutes

Method I1024G - Rev 1.6**DETECTOR SETTINGS:****FLUORESCENCE DETECTOR**

Excitation Wavelength: 246 nm
Emission Wavelength: 367 nm
Gain: 13
Response Time: 0.5 seconds

ULTRAVIOLET DETECTOR

Wavelength: 242 nm
Range: 2 AUFS

RETENTION TIMES:

Phenylisocyanate: 5 min $\pm$ 0.5
MDI: 9 min $\pm$ 0.5
Triiso: 14.5 min $\pm$ 0.5

Various Polymeric components may be observed at retention times up to 25 minutes. These must be addressed on a sample to sample basis.

QUALITATIVE IDENTIFICATION OF ISOCYANATES:

1. Particular attention should be given to "correct" qualitative identification of isocyanates, including PI, MDI and oligomers. In a typical chromatographic run, "correct" identification is based on:
 - a. Agreement of chromatographic retention times between standards, DE's, and samples.
 - b. Detector response by both FD and UV detectors.
 - c. The ratio of the FD/UV response for an unknown peak, divided by the ratio of the FD/UV response for the corresponding monomer, should be between 0.75 and 1.5.
2. Additional confirmation of the "correct" identification of isocyanates may be found by comparing the ratio of the FD/UV response for unknown peaks with those for DE's and controls. The ratio of responses for the peaks in DE and control chromatograms should be approximately the same as for the "unknown" peaks in sample chromatograms, (i.e. the ratio of the ratios will be approximately 1).

Method I1024G - Rev 1.6

CALCULATIONS:INDIVIDUAL COMPONENTS:

1. Verify that each chromatographic peak of interest is properly identified and integrated. There should be no more than a 3% difference between peak areas for replicate injections.
2. Quantification will be performed using the FD response as the primary detector. Since the FD is set to obtain sensitivity some samples may be outside the linear range of the detector. In this case the UV detector may be used for quantification since its linear range is greater than the FD.
3. A calibration curve of average peak versus μg compound for the working standards should be constructed using a least squares curve fitting procedure.

Be certain to include at least 5 standards. The relationship should be linear over the range investigated, but a second calibration may be required for proper quantification of samples containing less than 5 μg mass.

4. The absolute quantity of each compound found on each filter is determined from this calibration curve and the corresponding chromatographic peak areas.
5. The absolute quantity of each compound found of DE's determined in Step 4. must be "corrected" for the efficiency of desorption (DEcorr).

$$[\mu\text{g Found for DE Sample} / \mu\text{g Added}] = \text{DEcorr}$$

6. The actual quantity of each compound found on CT's and IH air sample filters is determined from the expression:

$$[\mu\text{g Found for Sample} / \text{DEcorr}] = \text{Corr. Amount Found } (\mu\text{g}).$$

7. The corresponding atmospheric concentrations for each sample are then determined from the expression:

$$\text{Corr. Amount Found } (\mu\text{g}) / \text{Air Volume } (\text{M}^3) = \text{Air Conc. } (\mu\text{g}/\text{M}^3).$$

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

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

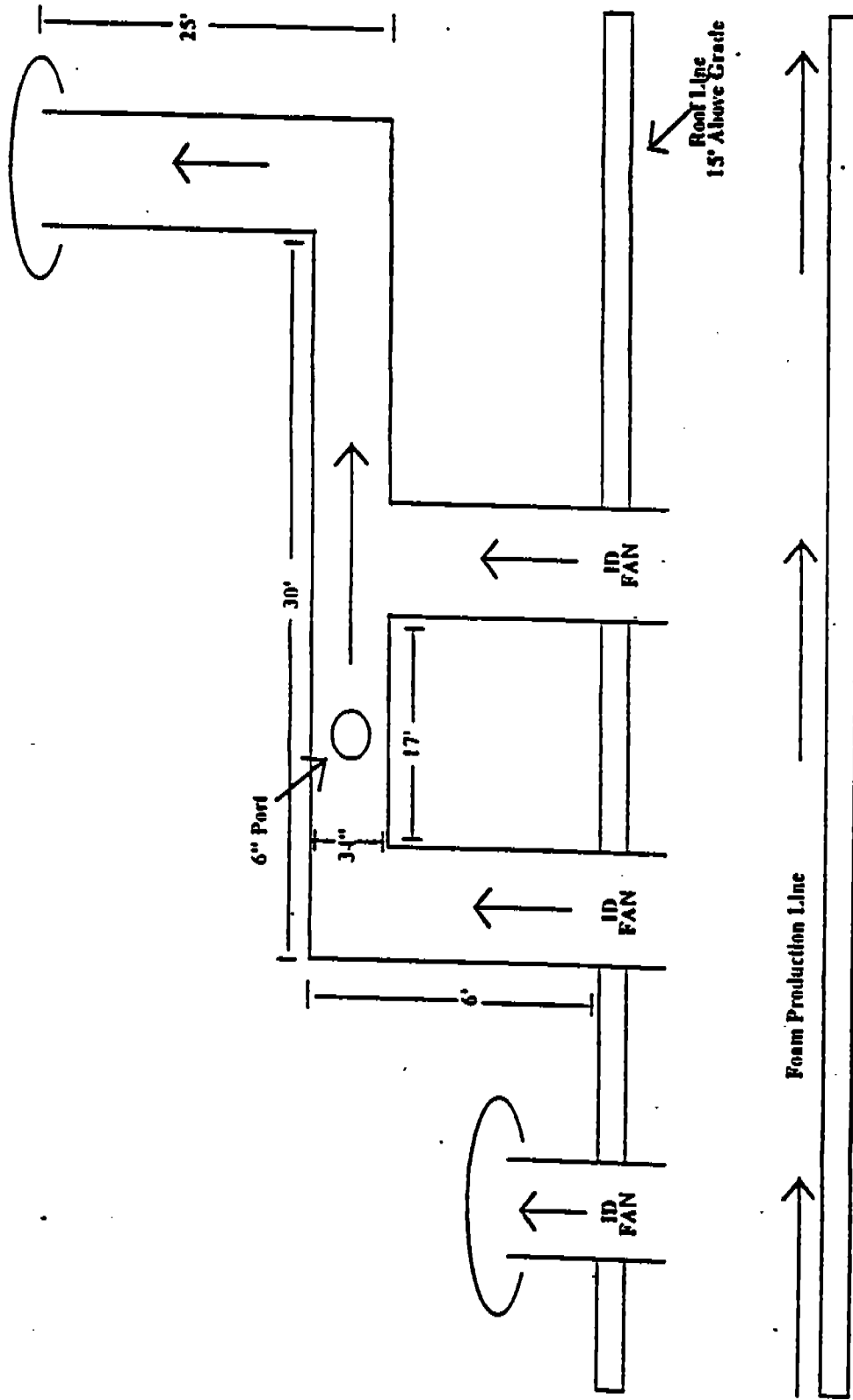


Figure 3-1. Sample Location

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 conveyor 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 conveyor 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

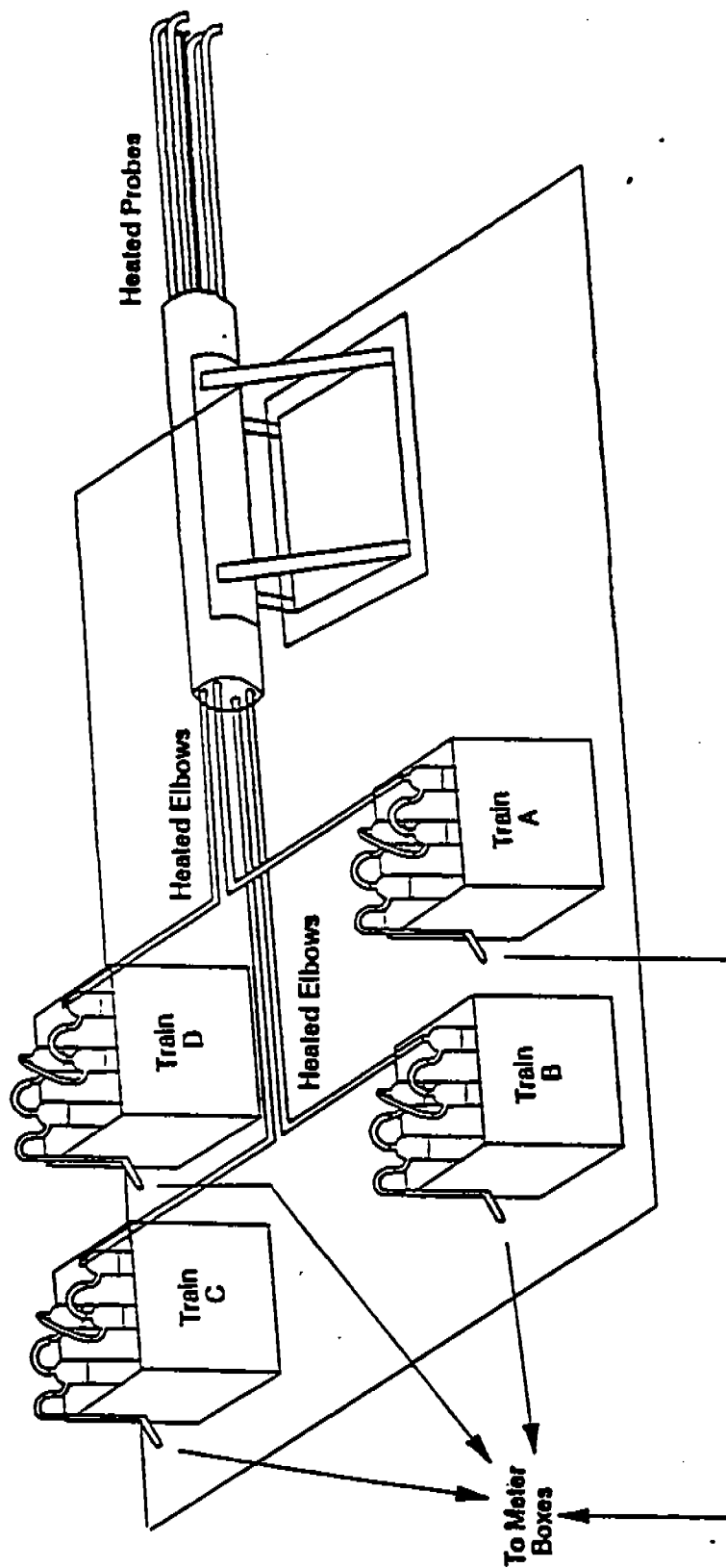


Figure 3-2. Schematic of Quad Train Setup

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 a 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.

3.5.4 Sampling Equipment Preparation

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 (O₂) and carbon dioxide (CO₂) 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 $120^{\circ} \pm 12^{\circ}\text{C}$ ($248^{\circ} \pm 25^{\circ}\text{F}$).

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

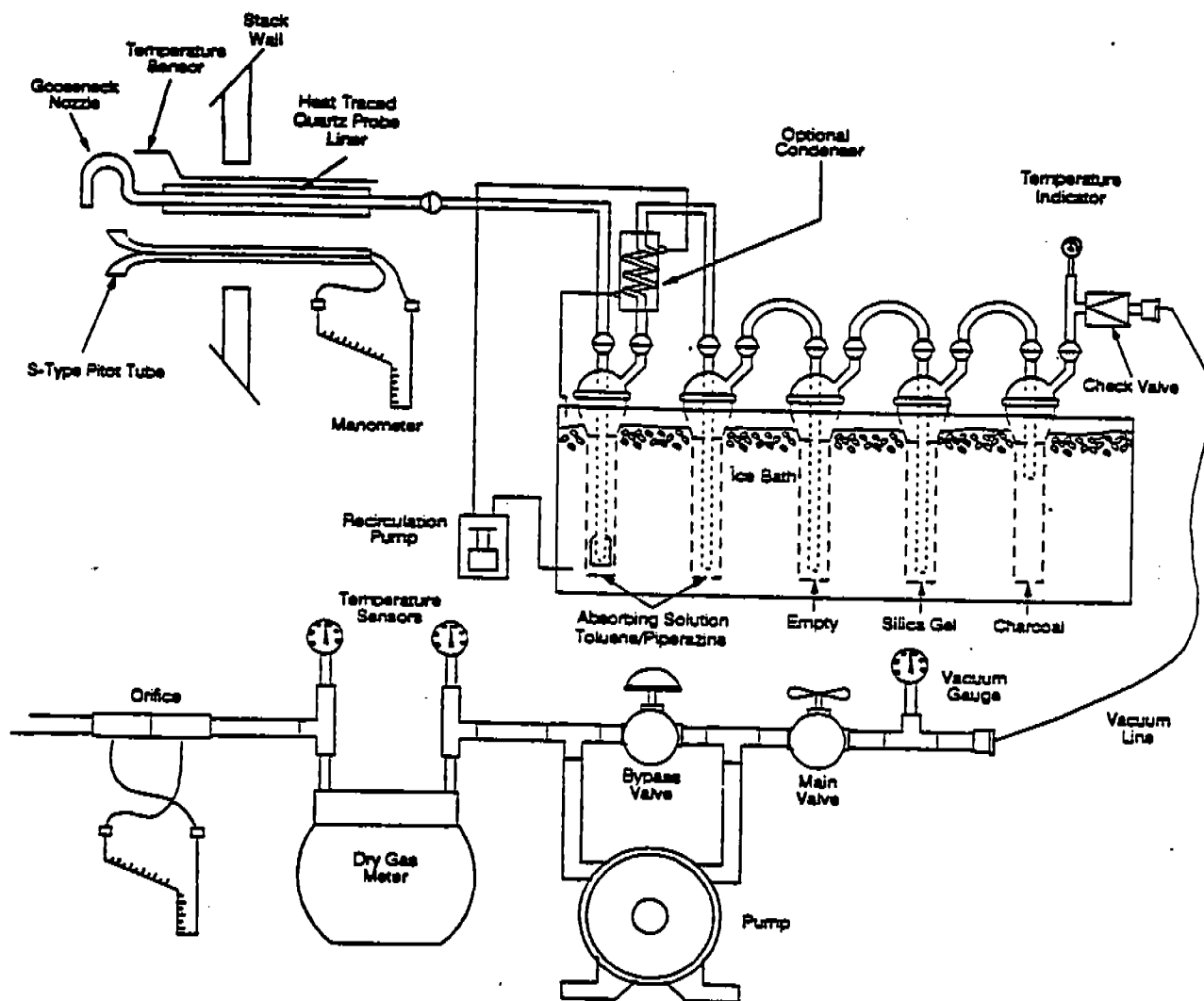


Figure 3-3. Sampling Train for Isocyanate

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° (ft ³)	Train B Vm @ 68° (ft ³)	Train C Vm @ 68° (ft ³)	Train D Vm @ 68° (ft ³)
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

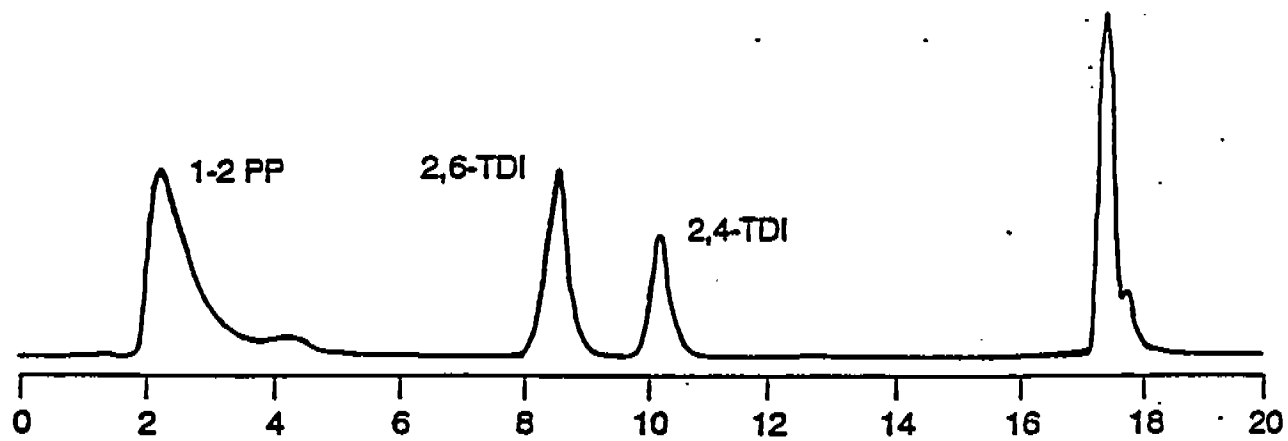


Figure 4-1. Chromatogram of Unspiked Train

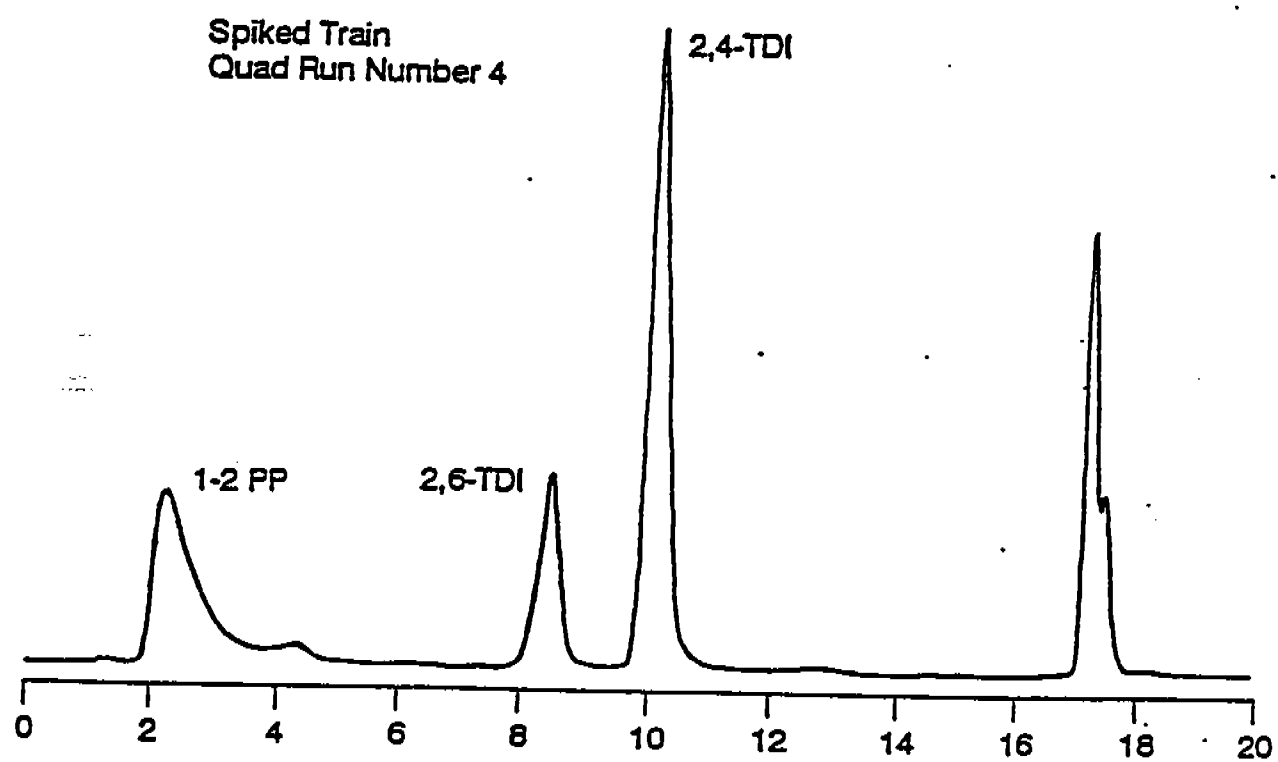


Figure 4-2. Chromatogram of Spiked Train

L-122

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 ft³ 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 ft³ which is equivalent to 1m³. The following stepwise calculations were used to normalize the data. The data from QUAD run number 1 are used as an example.

SENT BY:

0-21-31 0-0/00

ADULTS: 330.0

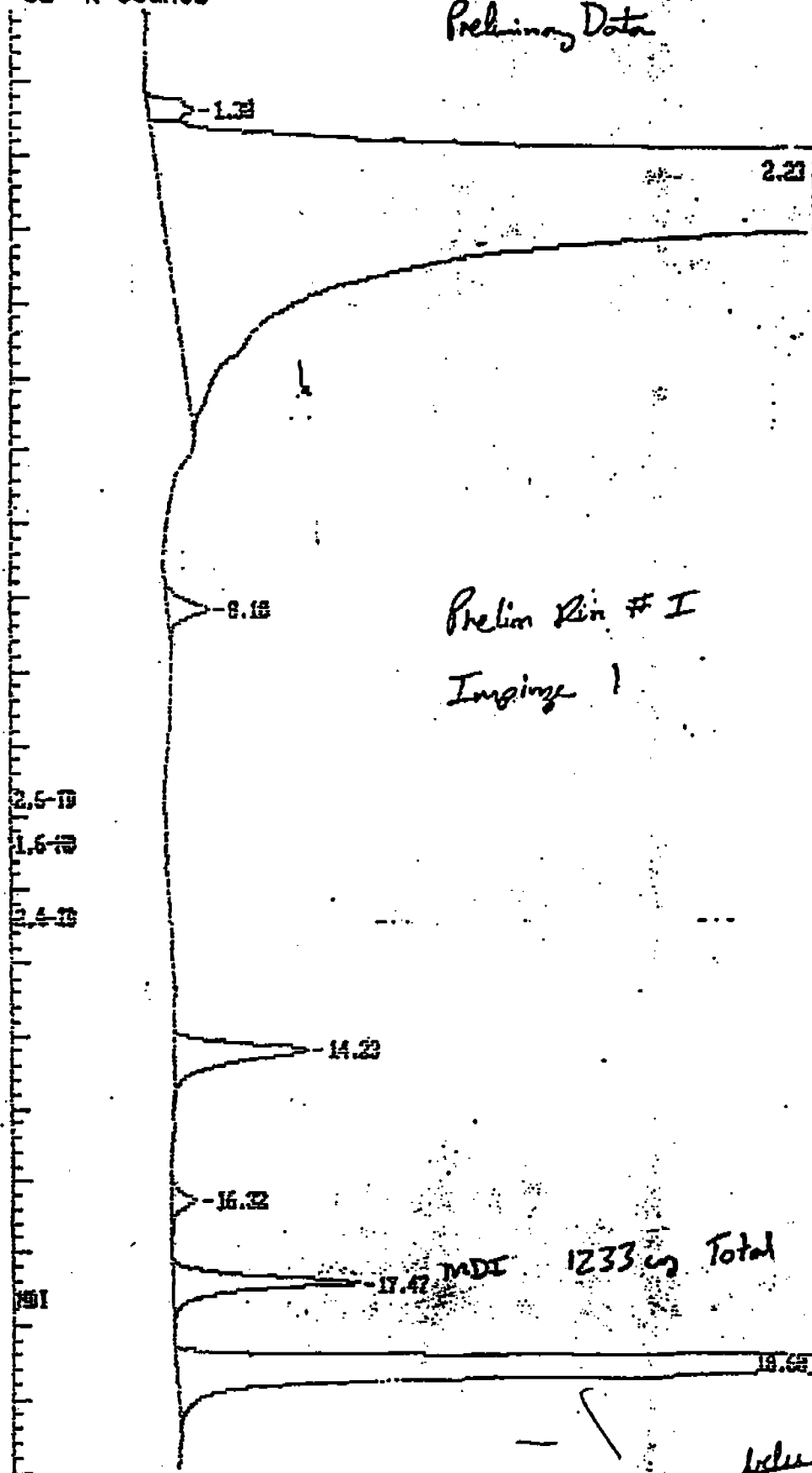
ADULTS: 330.0

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

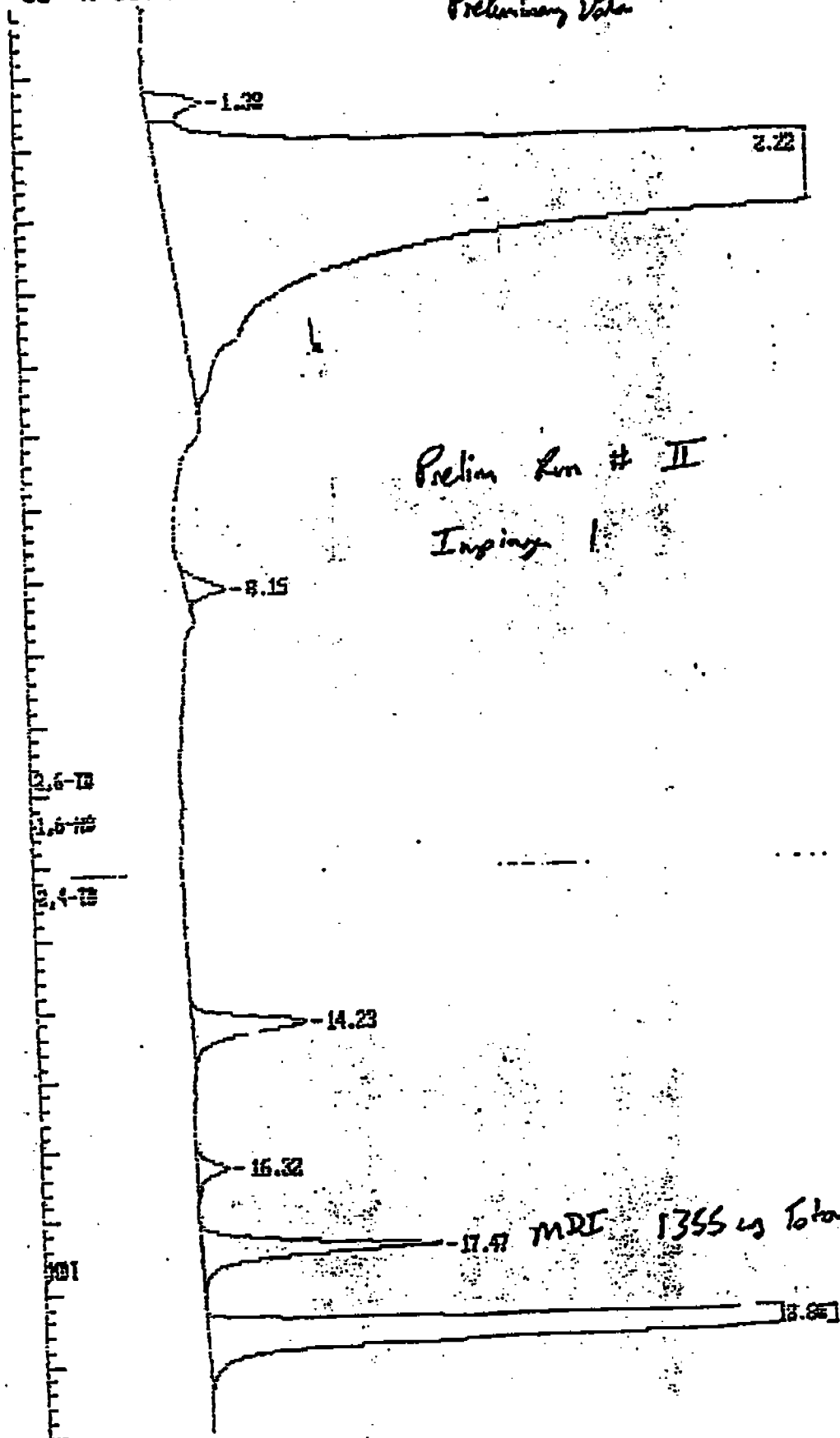


SENT BY:

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:

07-21-93 9:00-01:00

ADULTS 4.00

ADULTS 4.00

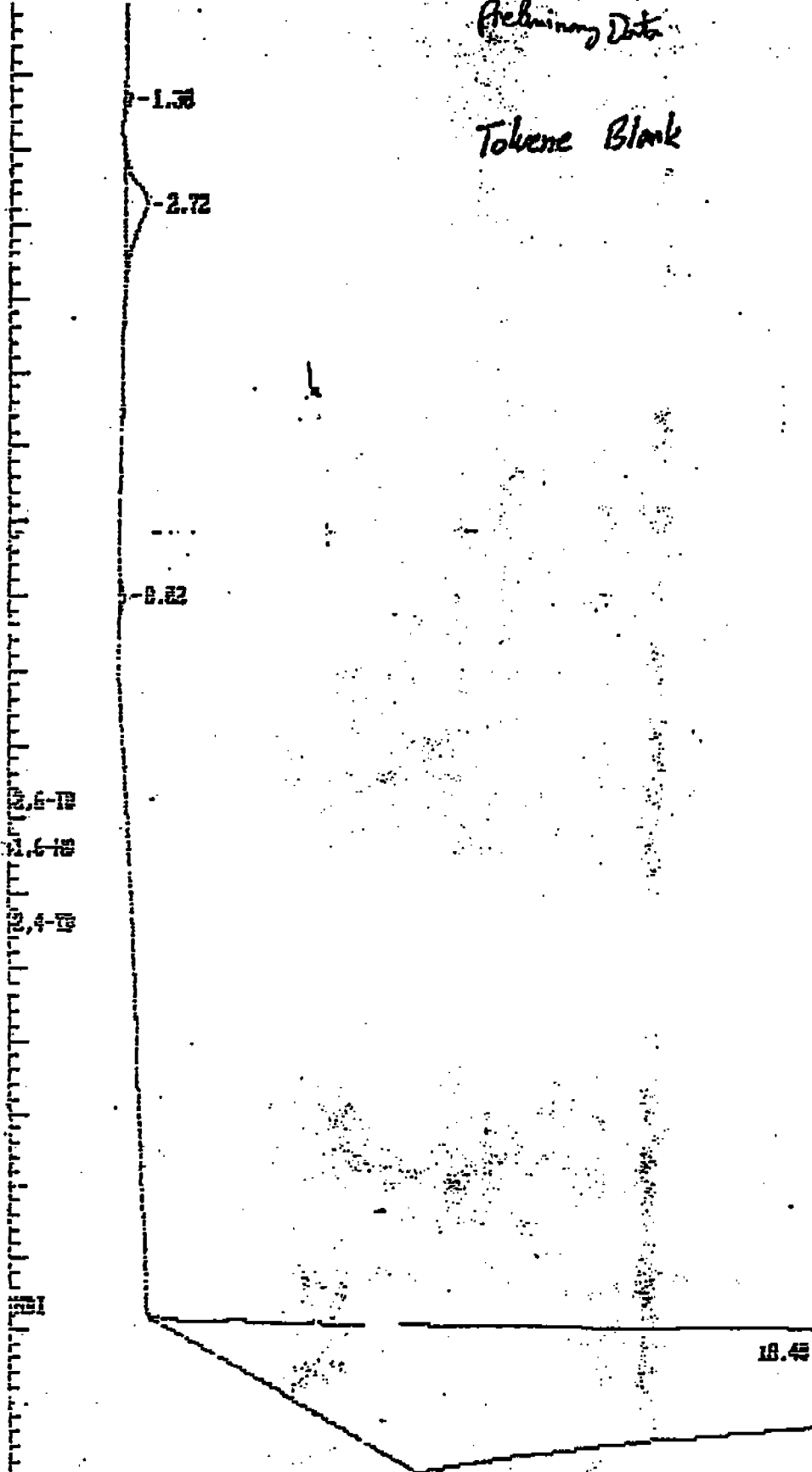
Date File = E:\93256F7.PTS Printed on 09-13-1993 at 14:43:58

Start time: 0.00 min. Stop time: 20.00 min. Offset: 0 o/s

Full Range: 50 K-Counts

Preliminary Data

Toluene Blank



SENT BY: 3-21-55 10-00 AM
Data File: 1004507 1.1 10 11 20.00 min. Stop time: 20.00 min. Offset: 0 cts
Start time: 0.00 min. Stop time: 20.00 min. Offset: 0 cts
Full Range: 50 K-Counts

Preliminary Data

Quantitative Standard
23 ug each

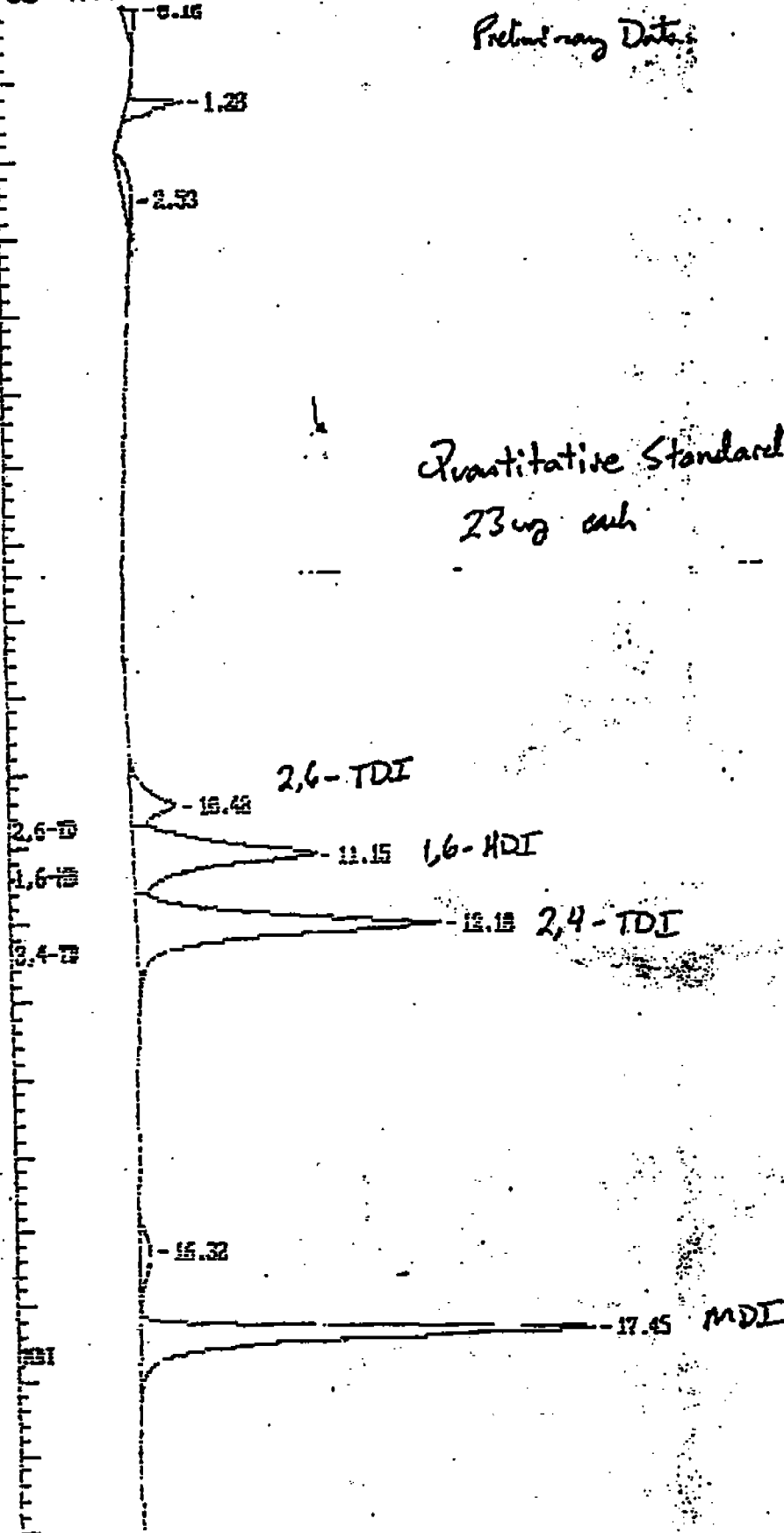


Table 4-1
2,4-TDI Detected in Unspiked Trains, μg

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	Imp 2	Total
A	--	--	--	7880	105	7993	--	--	--	3521	53	3574
B	--	--	--	7488	89	7577	--	--	--	3805	50	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			
	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

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.

5.2.2 Recovery

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

Run 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 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
ISO-SCF-32293-4	1263013	5.90	5.40641	9%										
ISO-SCF-32293-4	1253783	5.86	5.40641	8%										
ISO-SCF-32293-4	1249399	5.84	5.40641	8%										
ARL-1	1277072	5.97			2000	11931.6	11942.9	33.42	1.05669	12196.0	12263.5	7827.81	95.69%	I-A-1
ARL-1	1276918	5.97			2000	11930.1								
ARL-1	1280852	5.98			2000	11966.8								
ARL-2	135291	0.64			100	64.1	63.9	33.42	1.05669	67.5				I-A-2
ARL-2	135913	0.64			100	64.4								
ARL-2	133152	0.63			100	63.1								
ARL-3	1196354	5.59			2000	11178.7	11300.8	33.89	1.04204	11491.1	11520.1	7827.81	86.19%	I-B-1
ARL-3	1214532	5.67			2000	11348.3								
ARL-3	1217429	5.69			2000	11375.3								
ARL-4	59159	0.29			100	28.6	27.8	13.89	1.04204	29.0				I-D-2
ARL-4	57134	0.28			100	27.7								
ARL-4	56201	0.27			100	27.2								
ISO-SCF-32293-4	1255771	5.87	5.40641	9%										
ISO-SCF-32293-4	1251918	5.85	5.40641	8%										
ISO-SCF-32293-4	1242330	5.80	5.40641	7%										
ARL-5	471546	2.21			2000	4418.4	4409.3	33.02	1.06949	4715.7	4735.0			I-C-1
ARL-5	470785	2.21			2000	4411.3								
ARL-5	469380	2.20			2000	4398.2								
ARL-6	35898	0.18			100	17.8	18.1	33.02	1.06949	19.3				I-C-2
ARL-6	37029	0.18			100	18.3								
ARL-6	36906	0.18			100	18.2								
ARL-7	469526	2.20			2000	4399.5	4416.1	33.04	1.06885	4720.1	4811.1			I-D-1
ARL-7	461467	2.16			2000	4324.4								
ARL-7	482909	2.26			2000	4524.4								
ARL-8	180144	0.85			100	85.0	85.1	33.04	1.06885	90.9				I-D-2
ARL-8	179633	0.85			100	84.8								
ARL-8	181047	0.85			100	85.4								
ISO-SCF-32293-4	1238919	5.79	5.40641	7%										
ISO-SCF-32293-4	1245039	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 Cu 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	5314.9	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	5.75	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	1291043	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	101848	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-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	12047.7								
ARL-19	1288725	6.02			2000	12040.3								
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	3323.0								
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	1189454	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	1.01441	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	1.01441	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	64462	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	1.08160	5476.5	5521.9			5-D-1
ARL-39	544154	2.55			2000	5095.6								
ARL-39	542088	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	1199484	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 Bins %	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	809084	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	1573883	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	1.04543	15509.0	15609.8	7827.81	99.46%	6-D-1
ARL-47	1634325	7.63			2000	15263.7								
ARL-47	1589878	7.42			2000	14847.3								
ARL-48	220417	1.04			100	103.8	96.3	33.78	1.04543	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	1183884	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	10016.4								
ARL-49	1084020	5.07			2000	10111.0								
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	41.0								
ARL-51	963252	4.50			2000	9004.6	9002.6	31.94	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	8911.4								
ARL-52	83965	0.40			100	40.2	39.5	31.94	1.10566	43.6				7-B-2
ARL-52	83998	0.40			100	40.2								
ARL-52	79455	0.38			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	21.3	30.14	1.17169	27.3				7-C-2
ARL-54	49749	0.24			100	24.2								
ARL-54	44489	0.22			100	21.8								
ARL-55	237247	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	228680	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-58	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 Fl	Sampling Factor	Adjusted Avg ug	Total Train ug	Amount Spiked ug	Spike Recovery %	Train ID
ARL-57	374801	1.76			2000	3516.0	1520.7	30.89	1.14324	4025.0	4086.0			8-A-1
ARL-57	377410	1.77			2000	3540.4								
ARL-57	373681	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	113068	0.54			100	53.7								
ARL-59	408883	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	1197542	5.59	5.40641	3%	1	5.6								
ISO-SCF-32293-4	1200068	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	1120589	5.24			2000	10471.9								
ARL-61	1132853	5.29			2000	10586.4								
ARL-62	94847	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	91667	0.44			100	43.8								
ISO-SCF-32293-4	1186551	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 Amt Sample	Amount Spiked	Spike Recovery	Train ID
ISO-SCF-32293-4	S3083F4	1263013	5.90	5.41	9%	1	5.9	5.9			QC
ISO-SCF-32293-4	S3083F5	1253783	5.86	5.41	8%	1	5.9				
ISO-SCF-32293-4	S3083F6	1249399	5.84	5.41	8%	1	5.8				
ARL-81	S3083F19	30452	0.15			10	1.5	1.6			FBA
ARL-81	S3083F20	31446	0.16			10	1.6				
ARL-81	S3083F21	33523	0.17			10	1.7				
ARL-104	S3083F22	809699	3.79			2000	7572.4	7569.9	7827.81	97%	FS-1
ARL-104	S3083F23	808659	3.78			2000	7562.7				
ARL-104	S3083F24	809952	3.79			2000	7574.7				
ISO-SCF-32293-4	S3083F25	1253771	5.87	5.41	9%	1	5.9	5.8			QC
ISO-SCF-32293-4	S3083F26	1251918	5.85	5.41	8%	1	5.8				
ISO-SCF-32293-4	S3083F27	1242330	5.80	5.41	7%	1	5.8				
ARL-82	S3083F40	16055	0.08			10	0.8	0.9			FBA
ARL-82	S3083F41	16597	0.09			10	0.9				
ARL-82	S3083F42	16113	0.09			10	0.9				
ARL-105	S3083F43	832058	3.89			2000	7780.9	7686.3	7827.81	98%	FS-2
ARL-105	S3083F44	822507	3.85			2000	7691.8				
ARL-105	S3083F45	811167	3.79			2000	7586.1				
ISO-SCF-32293-4	S3083F46	1238919	5.79	5.41	7%	1	5.8	5.8			QC
ISO-SCF-32293-4	S3083F47	1245039	5.82	5.41	8%	1	5.8				
ISO-SCF-32293-4	S3083F48	1235673	5.77	5.41	7%	1	5.8				
ARL-83	S3084F13	163746	0.77			10	7.7	7.7			FBB
ARL-83	S3084F14	162706	0.77			10	7.7				
ARL-83	S3084F15	164806	0.78			10	7.8				
ARL-106	S3084F16	869707	4.07			2000	8132.1	8120.1	7827.81	104%	MS-1
ARL-106	S3084F17	867360	4.06			2000	8110.2				
ARL-106	S3084F18	868206	4.06			2000	8118.1				
ISO-SCF-32293-4	S3084F19	1220899	5.70	5.41	6%	1	5.7	5.7			QC
ISO-SCF-32293-4	S3084F20	1232003	5.76	5.41	6%	1	5.8				
ISO-SCF-32293-4	S3084F21	1230936	5.75	5.41	6%	1	5.8				
ARL-84	S3084F34	33054	0.16			10	1.6	1.6			FBB
ARL-84	S3084F35	32381	0.16			10	1.6				
ARL-84	S3084F36	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	1237852	5.78	5.41	7%	1	5.8				
ISO-SCF-32293-4	S3084F42	1239959	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 Bias %	Dilution Factor	Amount Sample	Avg Amt Sample	Amount Spiked	Spike Recovery	Train ID
ARL-92	S3098F11	28248	0.13			10	1.3	1.2			T-RB4
ARL-92	S3098F12	22809.08	0.12			10	1.2				
ARL-92	S3098F13	22154	0.11			10	1.1				
ISO-SCF-32293-4	S3098F14	1202.86	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	8438	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	5.53	5.41	3%	1	5.5	5.6			QC
ISO-SCF-32293-4	S3098F45	1199251	5.60	5.41	4%	1	5.6				
ISO-SCF-32293-4	S3098F46	1206008	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	427833.1	2.01			10	20.1				
ARL-119	S3098F55	452112	2.12			10	21.2				
ISO-SCF-4893-1	S3098F56	1164184	5.44	5.41	1%	1	5.4	5.5			QC
ISO-SCF-4893-1	S3098F57	1176245	5.50	5.41	2%	1	5.5				
ISO-SCF-4893-3	S3098F58	1160212	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. Train ID	1		2		3		4		5		6		7		8		Average	RSD
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D		
% Recovery	95.69%	96.18%	89.16%	95.22%	106.14%	111.93%	96.56%	97.97%	89.41%	95.59%	97.69%	99.46%	100.45%	85.63%	88.48%	83.01%	95%	8%
Total ug	12263	11520	13258	13733	11825	12078	9694	9805	12233	12717	15471	15810	10450	9290	11197	10770	11062	16%

Amount Collected in Unspiked Quad Trains

Quad No. Train ID	1		2		3		4		5		6		7		8		Average	RSD
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D		
Total ug	4735	4811	6287	6270	3466	3166	2132	2139	4947	5522	8042	7608	2558	2616	4086	4579	4560	41%

Percent Carry over from 1st Impinger in Spiked Quad Trains

Quad No. Train ID	1		2		3		4		5		6		7		8		Average	RSD
	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%	99.22%	98.83%	98.71%	98.03%	97.02%	98.44%	98.35%	98.52%	0.81%
2nd Impinger	1.52%	0.79%	0.79%	1.03%	0.98%	0.89%	3.62%	1.54%	1.05%	0.78%	1.17%	1.29%	1.97%	2.98%	1.56%	1.65%	1.48%	54.38%

Percent Carry over from 1st Impinger in Unspiked Quad Trains

Quad No. Train ID	1		2		3		4		5		6		7		8		Average	RSD
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D		
1st Impinger	99.59%	98.11%	98.81%	98.24%	99.04%	98.94%	99.14%	98.76%	99.84%	99.18%	98.69%	98.83%	98.93%	98.38%	98.51%	98.71%	98.91%	0.41%
2nd Impinger	0.41%	1.89%	1.19%	0.76%	0.96%	1.06%	0.86%	1.24%	0.36%	0.82%	1.31%	1.17%	1.07%	1.62%	1.49%	1.20%	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			

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	237.150	29.644	5.205
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			
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		Precision of Spiked Samples			Bias			
	A	B	C	D	Spiked	Diff	SDs	SDm	RSD	Run	Compound	SD	t Test
1	12263.0	11520.0	4735.0	4011.0	7827.81	743.00	407.50	144.07	3.40	-709.31	-394.53	471.48	-2.367
2	6287.0	6270.0	13256.0	13733.0	7827.81	-475.00				-610.81			1.053
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				-1086.31			

critical Value
is 2.131

C O N F I D E N T I A L

Version 1.1

Interpoll Laboratories

Method II-8791

Determination of 4,4'-Methylenebis
(phenyl isocyanate)(MDI) in
Wood Board Press Vent Exhausts

This method is a modification of NIOSH Method 347 in which a known volume of stack gas is drawn out of the stack through a glass-fiber filter impregnated with N-p-nitrobenzyl-N-propylamine to collect MDI. MDI reacts with this reagent to form a stable urea. The urea derivative is analyzed by HPLC. The modifications and the rationale therefor are enumerated below. The modifications used in this work were chosen expressly to accomodate the conditions normally encountered in board press exhaust gas stacks and may not be appropriate for other sources.

The method was modified by Interpoll Laboratories to 1) protect the urea derivative from exposure to high temperature; 2) to provide for isokinetic collection of samples, since some MDI will be associated with particles larger than 3 microns in diameter; 3) to make possible field recovery of samples, since stack testing requires repetitive determinations with large sophisticated sampling trains; 4) to increase the sensitivity of the determination; 5) and to more rigorously protect the collected samples since stack sampling normally requires transport of the samples by truck for extended periods of time.

The NIOSH was modified to meet the requirement of isokinetic collection by using a larger filter so that the same or a lower face velocity than that specified in the NIOSH Method is maintained, since the

superficial face velocity is the controlling parameter in analyte breakthrough.

A non-heated probe liner and out-stack filter holder assembly will be used to sample the vents since the gas is essentially ambient air (100-110 °F) with very low moisture content. The filter holder will be of the "out-stack" type to minimize the effect of increased temperature on breakthrough. Sampling will be isokinetic to ensure representative collection of particles which may have MDI adsorbed on their surfaces.

Sample recovery will be quantitative using methylene chloride as the recovery solvent. Samples will be recovered into amber jars with Teflon lids and stored on ice or in a refrigerator until analysis. The filter and probe rinse will be recovered into the same container to initiate extraction immediately upon recovery in the field.

Criteria used in developing stack procedure:

1. The method as conceived for OSHA work uses a filter with an effective filtering area diameter of 1 cm. A flow rate of 1 LPM is recommended. At this superficial velocity, the collection efficiency for MDI was found to be >99.3%.

If $t_{amb} \leq 18^{\circ}\text{C}$ then $\phi \leq 10$ HRS

$18 \leq t_{amb} \leq 29^{\circ}\text{C}$ then $\phi \leq 5.5$ HRS

$29 \leq t_{amb} \leq 40^{\circ}\text{C}$ then $\phi \leq 3$ HRS

where ϕ = total sampling time

2. Since some of the MDI or other diisocyanates (DIs) could and will be associated with particulate material, samples will be collected isokinetically.
3. Since breakthrough is temperature dependent, it is necessary to use an out-stack filter holder. The probe and filter holder should not be heated.
4. Since interferences form on long standing especially in the presence of light, samples are to be recovered into amber bottles and stored at 4 °C.
5. Methylene chloride should be used as the recovery solvent. The filter and the probe wash should be placed in the same container. The filter must be preweighed as well as the sample container. After the sample is recovered, the container is weighed again. The total volume of methylene chloride may then be calculated from the above weights and the density of methylene chloride.

Note: This method of recovery initiates extraction of the urea derivative immediately and probably increases the stability of the samples.

The total volume of CH_2Cl_2 should be about 35-50 ml. The aliquot for HPLC analysis may then be drawn directly from the sample container (after sonication).

Alternatively, the entire mixture may be filtered through a methylene chloride rinsed glass fiber filter, the filter

rinsed and combined with the filtrate and brought to a known volume. This method, however, results in some dilution and also increases the possibility of contamination.

6. A 2.5 inch glass fiber filter with an effective filtration diameter of 5.69 cm will allow sampling at a flow rate 32.4 times greater than the NIOSH procedure and still maintain the same superficial velocity. Thus a flow rate of up to 1.14 CFM can be used and still give a collection efficiency of $\geq 99.3\%$.
7. For an M5 sampling train, this means that an orifice pressure drop as high as 4.3 IN.WC. can be used without concern about reduction in the collection efficiency of MDI. At a temperature up to 104 °F (40 °C), sampling can be performed for a period up to three hours without concern of breakthrough.
8. Based on the above consideration, a normal MDI sampling will consist of three one-hour samplings at a flow rate not to exceed 1.14 CFM.

Note: $(\text{ppb v/v}) = 0.0978 \times (\text{ug/Nm}^3)$

4,4'-METHYLENEBIS(PHENYL ISOCYANATE) (MDI)

Methods Research Branch

Analytical Method
II-8791

Analyte:	A urea derivative of MDI	Method No:	P&CAM 347 0.43 to 78 ppb
Matrix:	Air	Range:	4.4 to 800 $\mu\text{g}/\text{m}^3$
Procedure:	Collection and derivatization on impregnated filter, HPLC	Precision:	0.078

$PPB = 0.0978 (\mu\text{g}/\text{m}^3)$

Date Issued: 8/31/81

Date Revised:

Classification: E (Proposed)

1. Synopsis

- 1.1 A known volume of air is drawn through a glass-fiber filter impregnated with a reagent, N-p-nitrobenzyl-N-propylamine, to collect MDI. MDI reacts with the reagent to form N,N''-(methylenedi-4,1-phenylene)bis[N'-[(4-nitrophenyl)methyl]-N'-propylurea] (MDIU) as a derivative. (Reference 11.1)
- 1.2 The impregnated filter is treated with dichloromethane to recover the urea derivative.
- 1.3 The dichloromethane solution is analyzed by high pressure liquid chromatography (HPLC) with an ultraviolet detector set at 254 nm to determine the concentration of MDIU.
- 1.4 The concentration of MDI in air is calculated from the quantity of MDIU on the filter and the volume of air sampled.

2. Working Range, Sensitivity and Detection Limit

- 2.1 MDI in air can be quantified at concentrations ranging from 4.4 to 800 $\mu\text{g}/\text{m}^3$ for 180-L air samples and at ceiling concentrations ranging from 80 to 1000 $\mu\text{g}/\text{m}^3$ for 10-L air samples. The range useful for quantitation of the urea derivative (MDIU) in solution is equivalent to 0.8 to more than 150 μg MDI per mL of solution when 50- μL aliquots are injected into the HPLC.

- 2.2 The impregnated filter can collect more than 298 μg of MDI (greater than 99.3% of the MDI) at a concentration of 500 $\mu\text{g}/\text{m}^3$ during a 10-hour sampling period at 1 L/min when the air temperature is 18 °C.
- 2.3 It has been estimated that MDI at a concentration of 0.6 $\mu\text{g}/\text{m}^3$ could be detected in a 180-L air sample. The detection limit of MDIU in solution is equivalent to approximately 0.1 μg of MDI per mL if a 50- μL aliquot is injected into the HPLC.

3. Interferences

- 3.1 When other compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
- 3.2 N-p-Nitrobenzyl-N-propylamine on glass fiber filters is unstable in the presence of light and is unstable to a smaller degree during storage in the dark at room temperature. Interference during HPLC analysis may result if impregnated filters in filter holders are exposed to light for an excessive period or are stored in the dark at room temperature for an excessive period. Exposure of two impregnated filters inside filter holders to fluorescent lighting for 25 hours gave rise to interferences during HPLC analysis which corresponded to roughly 2 μg of MDI per filter. Storage of three impregnated filters for 41 days in the dark (33 days at room temperature and 8 days at -21 °C) gave rise to interferences which corresponded to an average of roughly 0.4 μg MDI per filter. Storage of six impregnated filters for 42 days in the dark at -21 °C gave rise to no interferences during HPLC analysis.
- 3.3 The following compounds would not interfere with the analysis of MDI in this method: toluene-2,4-diisocyanate (2,4-TDI), toluene-2,6-diisocyanate (2,6-TDI), and hexamethylene diisocyanate (HDI).
- 3.4 Any compound which has the same retention time as that of MDIU and is detected under the HPLC conditions indicated in this method is an interference.

4. Precision and Accuracy

- 4.1 The pooled relative standard deviation for the sampling and analytical method in the approximate range from 170 to 800 $\mu\text{g}/\text{m}^3$ was 0.060 when critical orifices were used to maintain sampling rates near 1 L/min. The relative standard deviation for the sampling and analytical method in the same approximate range of concentrations would be 0.078 if a pump error of 0.05 is assumed for personal-sampling pumps.

4.2 Average recoveries of MDIU from impregnated filters ranged from 0.96 to 0.99 over the range 0.8 to 67 μg of MDI per filter. The pooled relative standard deviation for the average recoveries was 0.030.

4.3 MDIU on impregnated filters is stable during storage at room temperature in the dark for at least 15 days.

5. Advantages and Disadvantages

5.1 Advantages of the method are: (a) the sampler is small, portable and convenient for personal sampling; (b) the sampler can collect MDI in both vapor and aerosol forms; and (c) the analytical method is specific for MDI.

5.2 Disadvantages of the method are: (a) a time limitation of approximately 21 days for storage of impregnated filters at room temperature in the dark because of the instability of the reagent, N-p-nitrobenzyl-N-propylamine; (b) a need to protect impregnated filters from light; and (c) a need to wash the HPLC column when N-p-nitrobenzyl-N-propylamine causes a large detector response (see Sections 3.2 and 8.3.6).

6. Apparatus

6.1 Sampling Equipment

6.1.1 Samplers. Each sampler contains a glass-fiber filter, 13 mm in diameter, which has been impregnated with N-p-nitrobenzyl-N-propylamine. The impregnated filter is housed in a 13-mm filter holder (Catalogue No. SX00 013 00, Millipore Corporation, Bedford, MA, or equivalent). The internal diameter of the inlet of the filter holder is 4 mm. The filter holders may be wrapped with black tape in order to help protect the impregnated filters from light. Seal the inlets and outlets of the filter holders with plastic tape for storage. The samplers may be stored at -21°C in the dark for at least 6 weeks. Limit the storage time of the samplers at room temperature in the dark to approximately 21 days (see Section 3.2).

6.1.2 Impregnated Filters. Place 300 mg (0.0013 mole) of N-p-nitrobenzyl-N-propylamine hydrochloride into a 125-mL separatory funnel. Add 25 mL of deionized water and shake the mixture until all of the hydrochloride has dissolved. Cause free amine to separate from the solution by adding 15 mL of 1 N NaOH solution and shaking the mixture. Extract the N-p-nitrobenzyl-N-propylamine with 50 mL of hexane.

Place six glass-fiber filters which are free of binders and 6 mL of the hexane solution into a 50-mL beaker. In dim light, allow hexane to evaporate from the beaker with the aid of a stream of nitrogen. Occasionally swirl the mixture. The filters are sufficiently dry when they no longer cling to the beaker. It has been estimated that there is 4.5 mg of N-p-nitrobenzyl-N-propylamine on each impregnated filter.

- 6.1.3 Calibrated Personal-Sampling Pump. The personal sampling pump should be calibrated for the recommended flow rate of 1 L/min with a representative sampler in line.
- 6.1.4 Stopwatch.
- 6.1.5 Thermometer.
- 6.2 High pressure liquid chromatograph with an ultraviolet detector set at 254 nm.
- 6.3 HPLC column, 25-cm x 4.6-mm internal diameter, packed with Partisil 10 (a porous silica packing; diameter, 10 μ m; surface area, 400 m²/g; Whatman, Inc., Clifton, NJ).
- 6.4 Frits, 0.5-micrometer pore diameter, for use in front of the packing in the HPLC column.
- 6.5 Partisil 10 or other silica packing for use in replacing packing which may be lost from the HPLC column (see Section 8.3.7).
- 6.6 Spectrophotometer set at 555 nm.
- 6.7 Quartz cells for spectrophotometer, 5-cm path length.
- 6.8 Glass vials, 1-mL, with caps lined with polytetrafluoroethylene.
- 6.9 Volumetric flasks, 5-mL and other convenient sizes.
- 6.10 Graduated cylinders, 10-, 25-, 100-, and 1000-mL.
- 6.11 Tweezers.
- 7. Reagents

Except where otherwise indicated, each reagent should be of ACS reagent grade or better.

- 7.1 4,4'-Methylenebis(phenyl isocyanate) (MDI), practical grade or better.

- 7.2 N-p-Nitrobenzyl-N-propylamine hydrochloride.
- 7.3 Dichloromethane, distilled in glass.
- 7.4 Solution of MDI in dichloromethane. Mix 2.0 g of MDI with 200 mL of dichloromethane. Filter the solution with a glass frit of fine porosity. Determine the concentration of MDI according to Section 9.1.
- 7.5 Water, deionized.
- 7.6 MDIU. Mix 1.500 g (0.00650 mole) of N-p-nitrobenzyl-N-propylamine hydrochloride with 25 mL of deionized water in a 125-mL separatory funnel. Cause free amine to separate from the solution by adding 15 mL of 1 N NaOH and shaking the mixture. Extract the N-p-nitrobenzyl-N-propylamine with 50 mL of hexane. Determine the volume of the solution prepared according to Section 7.4 which would contain 577 mg (0.00231 mole) of MDI, and add 577 mg of MDI in solution to 40 mL of the hexane solution. Reduce the volume of the mixture to approximately 25 mL with a rotary evaporator. Collect the solid by filtration. Wash the solid with several portions of hexane. Recrystallize the product from benzene by dissolving the product in hot benzene, filtering the solution quickly, and allowing the filtrate to cool. Collect the crystals in a Buchner funnel, and dry the product in vacuo at 80 °C. Melting point = 161-162 °C. (Reference 11.2)
- NOTE: Benzene is a carcinogen and should be handled with care in a ventilated fume hood.
- 7.7 4,4'-Methylenedianiline, high purity.
- 7.8 Acetic acid, glacial.
- 7.9 Standard solution of 4,4'-methylenedianiline. Dissolve 238 mg of 4,4'-methylenedianiline in 700 mL of glacial acetic acid. Dilute the solution to 1 liter with deionized water.
- 7.10 Hydrochloric acid, 12 M.
- 7.11 Hydrochloric acid-acetic acid solution. Add 35 mL of 12 M hydrochloric acid and 22 mL of glacial acetic acid to 600 mL of deionized water. Dilute the solution to 1 liter with deionized water.
- 7.12 Sodium nitrite-sodium bromide solution. Dissolve 3.0 g of sodium nitrite and 5.0 g of sodium bromide in deionized water and dilute the solution to 100 mL. Discard the solution after 1 week.

- 7.13 Sulfamic acid solution. Dissolve 10.0 g of sulfamic acid in 100 mL of deionized water.
- 7.14 Sodium carbonate solution. Dissolve 16.0 g of anhydrous sodium carbonate in deionized water and dilute the solution to 100 mL. Discard the solution after 1 week.
- 7.15 N-(1-Naphthyl)ethylenediamine dihydrochloride solution. Dissolve 1.0 g of N-(1-naphthyl)ethylenediamine dihydrochloride in 50 mL of deionized water, add 2 mL of 12 M hydrochloric acid, and dilute the solution to 100 mL. Discard the solution after 1 week.
- 7.16 N,N-Dimethylformamide-hydrochloric acid solution. Mix 90 mL of N,N-dimethylformamide with 10 mL of 6 M hydrochloric acid. Discard the solution after 1 week.
- 7.17 2-Propanol, distilled in glass.

8. Procedure

- 8.1 Cleaning of Equipment. All glassware to be used for laboratory analysis should be washed with detergent and rinsed thoroughly with tap water and deionized water.
- 8.2 Collection and Shipping of Samples
- 8.2.1 In each set of samplers consisting of six or fewer samplers, label two samplers as "blank" samplers. The "blank" samplers and the corresponding samplers used in actual air sampling should contain impregnated filters from the same batch (Section 6.1.2).
- 8.2.2 Handle the "blank" samplers and other samplers under the same conditions of temperature, light exposure and storage time. Do not unseal and do not draw air through the "blank" samplers.
- 8.2.3 Immediately before sampling, unseal the inlet and outlet of the sampler.
- 8.2.4 Connect the sampler to a calibrated personal-sampling pump with flexible tubing.
- 8.2.5 Sample at a flow rate of 1 L/min for 10 hours or less if the maximum air temperature will be 18 °C or less. (Experiments were performed at air temperatures near 18 °C, and 12 hours of sampling was borderline for breakthrough to occur. Breakthrough volumes would be expected to decrease with increases in concentration

of MDI vapor, and the maximum vapor concentration of MDI would increase with temperature. Maximum sampling periods should be decreased with increases in air temperature.) Sample at 1 L/min for 5.5 hours or less if the maximum air temperature will be between 18 °C and 29 °C. Sample at 1 L/min for 3 hours or less if the maximum air temperature will be between 29 °C and 40 °C.

8.2.6 Record pertinent data in regard to sampling including sampling time, air temperatures, and atmospheric pressures. If pressure data are not available, record the elevation.

8.2.7 After sampling, seal the inlets and outlets of the samplers with plastic tape. Store these samplers and the "blank" samplers in the dark and, if practical, at -21 °C until analyses are performed. If the samplers are stored at room temperature, limit the total storage time at room temperature to approximately 21 days. Consider storage time before sampling as part of the total storage time. The samplers may be stored in the dark at -21 °C for at least 6 weeks.

8.2.8 If a bulk sample of material suspected to contain MDI is to be submitted to the laboratory, place the bulk sample into a glass container, and seal it with a cap lined with polytetrafluoroethylene. Secure the cap in place with tape.

8.2.9 Do not transport the bulk sample and the air samples in the same container.

8.3 Analysis of Samples

8.3.1 Preparation of Samples. Remove the impregnated filter from the filter holder with tweezers, and place the filter into a 1-mL glass vial. Place 1 mL of dichloromethane into the vial. Seal the vial with a cap lined with polytetrafluoroethylene. Shake the vial vigorously for approximately 1 minute.

8.3.2 HPLC Conditions. Operating conditions for high pressure liquid chromatography are:

Column temperature:	Room temperature
Mobile phase:	1.4:98.6 2-Propanol- dichloromethane (v/v)
Flow rate:	2.0 mL/min
Detector:	UV (254 nm)

Injection volume: 50 μ L
Column efficiency: Approximately 300
theoretical plates
for MDIU

Compound*	Adjusted Retention Volume (V_R')	Capacity Factor (k')
MDIU	4.1 mL	1.9
2,4-TDIU	11.1 mL	5.0
2,6-TDIU	>18.4 mL	>8.3
HDIU	>30 mL	>13.6

*2,4-TDIU, 2,6-TDIU, and HDIU are the corresponding urea derivatives of toluene-2,4-diisocyanate (2,4-TDI), toluene-2,6-diisocyanate (2,6-TDI), and hexamethylene diisocyanate (HDI), respectively.

NOTE: If HPLC conditions are employed which are different from those mentioned for this method, "blank" impregnated filters should be analyzed after storage of such filters and after exposure of such filters to light in order to help determine possibilities of interference.

- 8.3.3 Inject a 50- μ L aliquot of sample solution into the high pressure liquid chromatograph, and determine the size of the peak corresponding to MDIU.
- 8.3.4 If the quantity of MDIU is above the lower quantitation limit, analyze another aliquot of the sample solution with two standards at concentrations above and below that of the MDIU in the sample solution. Precede and follow an injection of sample solution with an injection of standard solution.
- 8.3.5 Analyze the "blank" samples with the field samples.
- 8.3.6 After an aliquot of sample solution has been injected into the liquid chromatograph, N-p-nitrobenzyl-N-propylamine will emerge eventually from the HPLC column and cause a large response in the detector. Wash the column periodically to remove excess N-p-nitrobenzyl-N-propylamine by pumping 50:50 2-propanol-dichloromethane (v/v) at 2 mL/min through the column for at least 1 minute. Then pump 1.4:98.6

2-propanol-dichloromethane (v/v) at 2 mL/min through the column for 15 minutes before the next injection.

8.3.7 Replace the frit in front of the column packing when pressure becomes excessive (see Section 6.4). If a small quantity of packing is lost, replace the lost packing with fresh Partisil 10 or other silica packing.

8.3.8 Measure either peak heights or peak areas.

8.3.9 Construct a calibration curve for each sample based on the two adjacent standards (see Section 8.3.4).

8.4 Determination of Analytical-Method Recovery

8.4.1 Significance of Determination. The determination of analytical-method recovery may provide information which would aid in correcting for bias, if any, in the analytical method. Analytical-method recoveries should be determined at three levels of MDI which span the range of interest.

8.4.2 Procedure. Prepare three solutions of MDI in dichloromethane at concentrations appropriate for the application of approximately 10- μ L aliquots to filters (a solution at a concentration of 0.08 μ g/ μ L would be appropriate for the application of 0.8 μ g of MDI per filter). Determine the concentrations of MDI according to Section 9.2. Place 18 impregnated filters (six filters for each level of MDI) into separate 1-mL glass vials, and add a known quantity of MDI in approximately 10 μ L of dichloromethane solution to each filter. Seal each vial with a cap lined with polytetrafluoroethylene, and store each vial at room temperature in the dark for several hours. Analyze the samples and nine "blanks" (three "blanks" for each level) according to Section 8.3.

The analytical-method recovery for a level of MDI equals the average quantity of MDIU found in the samples corrected for the average blank and divided by the quantity of MDIU corresponding to the quantity of MDI applied.

Construct a curve of recovery versus average quantity of MDIU found.

100
100
100

9. Calibration and Standardization

9.1 Determination of Concentration of MDI in Dichloromethane Solution by a Colorimetric Method. (Reference 11.3)

- 9.1.1 Mix 10 mL of the standard solution of 4,4'-methylenedianiline (Section 7.9) with 35 mL of 12 M hydrochloric acid and 15 mL of glacial acetic acid, and dilute the solution to 1 liter with deionized water.
- 9.1.2 Prepare a series of standards in the range from 1.2 to 12 μ g 4,4'-methylenedianiline per 15 mL of solution by diluting aliquots of the diluted standard solution (Section 9.1.1) with hydrochloric acid-acetic acid solution (Section 7.11).
- 9.1.3 Take 15 mL of hydrochloric acid-acetic acid solution (Section 7.11) as a blank.
- 9.1.4 Mix 0.5 mL of sodium nitrite-sodium bromide solution with 15 mL of each standard solution prepared according to Section 9.1.2 and with the blank (Section 9.1.3).
- 9.1.5 Add 1 mL of sulfamic acid solution to each mixture, stir each mixture for 0.5 minute, and allow each mixture to stand for 2 minutes.
- 9.1.6 Add 1.5 mL of sodium carbonate solution to each mixture, and stir each mixture.
- 9.1.7 Add 1 mL of N-(1-naphthyl)ethylenediamine dihydrochloride solution to each mixture, and stir each mixture.
- 9.1.8 Transfer a portion of each solution to a 5-cm cell 15 minutes after the addition of N-(1-naphthyl)ethylenediamine dihydrochloride solution, and measure the absorbance of each solution within 15 minutes after transfer. Water may be placed into the reference cell.
- 9.1.9 Construct a calibration curve of absorbance versus quantity of 4,4'-methylenedianiline in μ g per 15 mL of solution.
- 9.1.10 Mix four 0.5-mL samples of the solution of MDI in dichloromethane with quantities of N,N-dimethylformamide-hydrochloric acid solution

(Section 7.16) in 10-mL graduated cylinders sufficient to make 9.5 mL of solution for each sample.

- 9.1.11 Add 10 μ L of each solution prepared according to Section 9.1.10 to a separate 14-mL quantity of hydrochloric acid-acetic acid solution (Section 7.11), and dilute each solution to 15 mL with hydrochloric acid-acetic acid solution.
- 9.1.12 Analyze each sample solution according to Sections 9.1.3 through 9.1.8.
- 9.1.13 Determine the quantity of 4,4'-methylenedianiline in each 15-mL quantity of the sample solution (Section 9.1.11) from the calibration curve.
- 9.1.14 Calculate the concentration, D, of MDI in each sample of dichloromethane solution in mg/mL according to the following equation:

$$D = 2.39 \times B$$

where: 2.39 = a value based on three volumes (9.5 mL, 10 μ L and 0.5 mL) specified in Sections 9.1.10 and 9.1.11 and the molecular weights of MDI and 4,4'-methylenedianiline (250.26 and 198.27, respectively)

B = quantity of 4,4'-methylenedianiline in μ g in 15 mL of solution according to the calibration curve (see Section 9.1.13).

- 9.1.15 Calculate the average concentration of MDI.
- 9.2 Determination of Concentration of MDI in Dichloromethane Solution by an HPLC Method.

- 9.2.1 Mix four 10- μ L aliquots of the solution of MDI in dichloromethane with separate volumes of a solution of N-p-nitrobenzyl-N-propylamine in hexane sufficient to make 1-mL quantities of solution (see Section 6.1.2 for preparation of a solution of N-p-nitrobenzyl-N-propylamine in hexane).
- 9.2.2 Analyze each solution according to Section 8.3.
- 9.2.3 Determine each concentration of MDIU from a calibration curve (see Section 8.3.9).

- 9.2.4 Calculate the concentration of MDI in each sample of dichloromethane solution, D' , in $\mu\text{g}/\mu\text{L}$ according to the following equation:

$$D' = 0.0392 \times J$$

where: 0.0392 = a value based on the 10- μL aliquot of solution of MDI and the molecular weights of MDI and MDIU (250.26 and 638.73, respectively)

J = the concentration of MDIU in $\mu\text{g}/\text{mL}$.

- 9.2.5 Calculate the average concentration of MDI.

- 9.3 Construction of Calibration Curve. A calibration curve will be an aid in selecting standards to be analyzed with samples. Prepare 5 mL of a dichloromethane solution containing 50 mg of MDIU. Prepare a series of standard solutions at concentrations ranging from 0.3 to 380 μg MDIU per mL of solution. Analyze 50- μL aliquots of the standards according to the HPLC conditions indicated in Section 8.3. Construct a calibration curve of either peak height or peak area versus concentration of MDIU.

10. Calculations

- 10.1 Determine the quantity of MDIU in μg found on the impregnated filter from the appropriate calibration curve (see Section 8.3.9).
- 10.2 Correct the quantity of MDIU for the corresponding "blank" value.
- 10.3 Determine the value of the recovery, R , from the recovery curve (see Section 8.4.2).
- 10.4 Correct the quantity of MDIU for recovery by dividing the quantity by R .
- 10.5 Calculate the concentration of MDI, C , in $\mu\text{g}/\text{m}^3$ in the air sample according to the following equation:

$$C = \frac{392 \times Q}{V}$$

where: 392 = a value based on 1000 liters/ m^3 and the molecular weights of MDI and MDIU (250.26 and 638.73, respectively)

Q = the corrected quantity of MDIU in μg

V = the volume of air sampled in liters.

11. References

- 11.1 Tucker, S. P., and J. E. Arnold, "Sampling and Analytical Methods for Toluene-2,4-diisocyanate and 4,4'-Methylenebis(phenyl isocyanate) in Air" (report in preparation).
- 11.2 Hastings Vogt, C. R., C. Y. Ko and T. R. Ryan, "Simple Ureas Derived from Diisocyanates and Their Liquid Chromatography on a 5-cm Column," J. Chromatogr., 134, 451-458 (1977).
- 11.3 Method No. P&CAM 142, "p,p- Diphenylmethane Diisocyanate (MDI) in Air," in NIOSH Manual of Analytical Methods, Vol. 1, Second Ed., D. G. Taylor, Ed., National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977. DHEW (NIOSH) Publication No. 77-157-A.

Samuel P. Tucker, Ph.D.
James E. Arnold
Alexander W. Teass, Ph.D.
Organic Methods Development Section

APPENDIX M

CALCULATION EQUATIONS

CALCULATION EQUATIONS

METHOD 2

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

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

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

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

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

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

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

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

12-2893-G:\STACK\WPMETHODS\EQ.M5

CALCULATION EQUATIONS

METHOD 2

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

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

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

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

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

$$B_{ws}^* = RH(vp_{adb}) / P_s$$

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

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

12-2893-G\STACK\WP\METHODS\EQ.M5

P_s	=	Absolute pressure of stack gas, IN. HG.
P_{std}	=	Standard absolute pressure, 29.92 IN. HG.
A_s	=	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-GASTACK\WPMETHODS\EQ.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

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

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

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

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

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

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

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

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

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

122893-G:\STACK\WP\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.
m_g	=	Mass flow of wet flue gas, LB/HR
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
$T_{(mavg)}$	=	Absolute average dry gas meter temperature, °R
$T_{(savg)}$	=	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
$v_{p_{tab}}$	=	Vapor pressure at T_{db} , IN. HG.

CALCULATION EQUATIONS

METHOD 7

$$V_{m(std)} = 17.64 (V_f - 25) \left[\frac{P_f}{T_f} - \frac{P_i}{T_i} \right]$$

$$C_s = 6.243 \times 10^{-5} \frac{M}{V_{m(std)}}$$

$$E = \frac{2090 C_s F}{20.9 - \bar{B}'_{O_2}}$$

$$C_s (GR/DSCF) = 7000 C_s$$

$$C_s (MG/DSCM) = 1.60186 \times 10^7 C_s$$

$$C_s (ppm-dry) = 8.37552 \times 10^6 C_s$$

$$C_s (ppm-3\% O_2) = 8.37552 \times 10^6 C_s \left\{ 1 + \left[\frac{\bar{B}'_{O_2} - 3}{20.9 - \bar{B}'_{O_2}} \right] \right\}$$

$$C_s (ppm-wet) = 8.37552 \times 10^6 C_s \left(1 - \frac{MC}{100} \right)$$

GASTACK\WPMETHODS\EQ.M7

SYMBOLS

$\bar{B} O_2$	=	Average oxygen content in flue gas, % v/v
C_s	=	Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, LB/DSCF
C_s (GR/DSCF)	=	Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, GR/DSCF
C_s (MG/DSCM)	=	Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, MG/DSCM
E	=	Emission factor, LB/10 ⁶ BTU
F	=	F-Factor for given fuel type, DSCF/10 ⁶ BTU
M	=	Mass of nitrogen oxides as nitrogen dioxide in gas sample, ug
MC	=	Moisture content of flue gas, %
P_f	=	Final absolute pressure in flask, IN. HG
P_i	=	Initial absolute pressure in flask, IN. HG
C_s (ppm-dry)	=	Concentration of nitrogen oxides in flue gas, dry basis, (v/v), ppm
C_s (ppm-3% O_2)	=	Concentration of nitrogen oxides in flue gas, dry basis, corrected to 3% O_2 , (v/v) ppm
C_s (ppm-wet)	=	Concentration of nitrogen oxides in flue gas, wet basis, (v/v), ppm
T_f	=	Final absolute temperature in flask, °R
T_i	=	Initial absolute temperature in flask, °R
V_f	=	Volume of flask and valve, cc
$V_{m(std)}$	=	Sample volume at standard conditions, dry basis, cc

G:\STACK\WPMETHODS\SEQ.M7

PM - 10 Equations

Preliminary Run Calculations:

$$Md = 0.44 B_{CO_2} + 0.32 B_{O_2} + 0.28 (B_{N_2} + B_{CO})$$

$$M_s = M_d \left(1 - \frac{MC}{100}\right) + 0.18 (MC)$$

$$P_s = P_b + \frac{P_g}{13.6}$$

$$\mu = 152.418 + 0.2552 t_s + 3.2355 \times 10^{-5} t_s^2 + 0.53147 (B_{O_2}) - 0.74143 MC$$

$$Q_s = 2.837 \times 10^{-3} \mu \left[\frac{(t_s + 460)}{(M_s P_s)} \right]^{0.2949}$$

$$\Delta H = \frac{1.083 (t_m + 460) M_d \Delta H @ P_b}{P_b} \left[\frac{Q_s \left(1 - \frac{MC}{100}\right) P_s}{t_s + 460} \right]^2$$

$$\Delta_p^{M201A} = \Delta_P^{M2} \left(\frac{C_P^{M_2}}{C_P^{M201A}} \right)^2$$

Dwell Times:

First point

$$\Delta t_1 = \left[\frac{\sqrt{\Delta \dot{P}_i}}{(\sqrt{\Delta \dot{P}})_{AVG}} \right]$$

Other points

$$\Delta t_n = \left(\frac{\Delta t_1}{\sqrt{\Delta P_1}} \right) \sqrt{\Delta P_n} \text{ where } n = 2, 3, \dots, 12$$

Post Test Calculations:

$$V_{m(szd)} = 17.64 \gamma V_m \left(\frac{P_b + \frac{\Delta \bar{H}}{13.6}}{\bar{t}_m + 460} \right)$$

$$Q_s = \frac{5.669 \times 10^{-2} (\bar{t}_s + 460)}{\theta P_s} [V_{m(szd)} + 0.04707 (V_f - V_i)]$$

$$\mu = 152.418 + 0.2552 \bar{t}_s + 3.2355 \times 10^{-5} \bar{t}_s^2 + 0.53147 B_{O_2} - 0.74143 MC$$

$$M_s = M_d \left(1 - \frac{MC}{100} \right) + 0.18 MC$$

$$D_{50} = 0.15625 \left(\frac{\bar{t}_s + 460}{M_s P_s} \right)^{0.2091} \left(\frac{\mu}{Q_s} \right)^{0.7091}$$

where:

M_d	-	dry molecular weight of exhaust gas
B_{CO_2}	-	percent volume of CO_2 in exhaust gas on a dry basis
B_{O_2}	-	percent by volume of O_2 in exhaust gas on a dry basis
B_{N_2}	-	percent by volume of N_2 in exhaust gas on a dry basis
B_{CO}	-	percent by volume of CO in exhaust gas on a dry basis
MC	-	percent by volume of water vapor in exhaust gas
M_s	-	actual molecular weight of exhaust gas
P_s	-	absolute pressure of exhaust gas, IN.HG
P_g	-	static pressure of exhaust gas, IN.WC
P_b	-	absolute barometric pressure, IN.HG
t_s	-	average exhaust gas temperature from preliminary determination or point gas temperature, °F
Q_s	-	cyclone flow rate at actual (or stack) conditions, ACFM
Q_{std}	-	cyclone flow rate at dry standard conditions, DSCFM
ΔH	-	pressure drop across calibrated orifice, IN.WC
$\Delta H@$	-	orifice coefficient or pressure drop across calibrated orifice @ 0.75 DSCFM, IN.WC
t_m	-	temperature of dry test meter, °F
Δp^{M201A}	-	velocity pressure of gas stream as measured with S - type pitot attached to cyclone, IN.WC
Δp^{M2}	-	velocity pressure of gas stream as measured with S-type pitot tube as per EPA Method 2 (preliminary traverse), IN.WC
C_p^{M201A}	-	pitot tube coefficient of S - type pitot attached to cyclone, dimensionless
C_p^{M2}	-	pitot tube coefficient of S - type pitot tube used in preliminary traverse, dimensionless
Δt_n	-	dwelt time at traverse point n, where n = 2,3,...12, minutes
Δt_1	-	dwelt time at the first sampling point, minutes
$\bar{t}_s$	-	average stack gas temperature during test run, °F
θ	-	total run time, minutes
$V_{m(std)}$	-	total dry volume of gas sampled, DSCF
V_f	-	final volume of water in sampling train condenser system, ml
V_i	-	initial volume of water in sampling train condenser system, ml
$\bar{t}_m$	-	average temperature of dry test meter during run, °F
γ	-	dry test meter coefficient, dimensionless
$\Delta \bar{H}$	-	average pressure drop across the calibrated orifice in the sampling train during the run, IN.WC
V_m	-	volume of dry gas sampled as measured by the dry test meter at meter conditions, CF
D_{50}	-	actual or achieved 50% cutpoint for a given run of the device or cyclone used to remove or skim off those particles with aerodynamic equivalent diameters greater than or equal to 10 microns, microns

CALCULATION EQUATIONS

METHOD 10

$$\text{CO-PPM-DRY} = \text{CO}_{\text{CO}_2\text{-free,dry,avg}} (1 - \text{CO}_{2,d}/100)$$

$$\text{CO-PPM-WET} = \text{CO-PPM-DRY} (1 - \text{MC}/100)$$

$$\text{GR/DSCF} = 5.0885 \times 10^{-4} (\text{CO-PPM-DRY})$$

$$\text{mg/dscm} = 1.165 (\text{CO-PPM-DRY})$$

$$\dot{m} = 8.5714 \times 10^{-3} (\text{GR/DSCF})(Q_{s,d})$$

$$E = \frac{2.9857 \times 10^{-3} F_d (\text{GR/DSCF})}{20.9 - O_{2,d}}$$

Where

$\text{CO}_{\text{CO}_2\text{-free,dry,avg}}$ = average of two determinations of carbon monoxide on a dry, CO_2 -free integrated flue gas sample reported in ppm by volume

$\text{CO}_{2,d}$ = 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.)
m	= emission 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)

Method 25A

... Total Gaseous Organics Calculation Equations

$$\text{GR C/SCF} = 2.180 \times 10^{-4} (\text{ppm,w})$$

$$\text{GR C/DSCF} = 2.180 \times 10^{-4} (\text{ppm,w}) / (1 - \text{MC}/100)$$

$$\text{LB C/HR} = 8.5714 \times 10^{-3} (\text{GR/DSCF}) (\text{DSCFM})$$

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 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)

[illegible]

CALCULATION EQUATIONS

Chromotropic Acid Method for Formaldehyde

$$m_t = \frac{m_a \times V_{\text{soln}}}{V_{\text{aliq}}}$$

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

$$\text{PPM-DRY} = \frac{.0283 m_t}{V_{\text{std}}}$$

$$\text{PPM-WET} = \text{PPM DRY} (1-\text{MC}/100)$$

$$\text{GR/DSCF} = 5.45 \times 10^{-4} (\text{PPM-DRY})$$

$$\text{mg/dscm} = 1.249 (\text{PPM-DRY})$$

$$\dot{m} = 8.5714 \times 10^{-3} (\text{GR/DSCF}) (Q_{s,d})$$

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)

CALCULATION EQUATIONS

Gas Chromatographic Method for Phenol in Air

$$\text{PPM-DRY} = \frac{9.03 \times 10^{-3} m_t}{V_{\text{std}}}$$

$$\text{PPM-WET} = \text{PPM-DRY} (1 - \text{MC}/100)$$

$$\text{GR/DSCF} = 1.709 \times 10^{-3} (\text{PPM-DRY})$$

$$\text{mg/dscm} = 3.913 (\text{PPM-DRY})$$

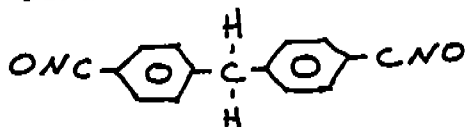
$$\dot{m} = 8.5714 \times 10^{-3} (\text{GR/DSCF}) (Q_{s,d})$$

- where
- PPM-DRY = concentration of phenol in gas in parts per million by volume on a dry basis
 - PPM-WET = concentration of phenol in gas 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 phenol in gas on a grains per dry standard cubic foot basis (68°F, 29.92 IN.HG.)
 - $\dot{m}$ = emission or mass rate of phenol in pounds per hour (LB/HR)
 - $Q_{s,d}$ = volumetric flow rate of stack gas in dry standard cubic feet per minute (DSCFM)

INTERPOLL LABORATORIES, INC

Concentration Calculation Equations for 4,4-Methylenebis (MDI,
(phenyl isocyanate))

1. Structure:



2. Molecular weight:

250.27 g/g-mole

3. Mass/volume Concentration:

$$C_{ug/Nm^3} = \frac{35.314 \text{ m}}{V_{std}}$$

where m = Total mass of MDI
in sample in micrograms (ug), and

Vstd = Total volume of exhaust gas or air
sampled in dry standard cubic feet
(DSCF).

4. Volume/volume Concentration:

$$C_{ppmv} = \frac{\mu g}{Nm^3} \left[\frac{Nm^3}{1000 L} \times \frac{24.46 \mu L}{250.27 \mu g} \right]$$

$$C_{ppmv} = 0.0978 \times 10^{-3} C_{ug/Nm^3}$$

5. Notes:

$$C_{ppbv} = 0.0978 \frac{\mu g}{Nm^3}$$

Derived by: DJD/PL

Date: 1/15/93

			LOUISIANA PACIFIC CORPORATION - DUNGANNON, VIRG				
			REPORT NO. 3-1906				
PRESS VENT							
			MDI CALCULATIONS				
NP2							
	TIME		Mass	Flow	Conc	Conc	Mass Rate
RUN #	(HRS)	Vstd (CF)	(ug)	DSCFM	(mg/Nm3)	ppm	(LB/HR)
1	1135-1246	45.61	420	77421	0.325	0.0312	0.0943
2	1407-1528	44.15	438	74166	0.350	0.0337	0.097323
3	1628-1738	44.61	658	75922	0.521	0.0501	0.148124
1,2-PP							
	TIME		Mass	Flow	Conc	Conc	Mass Rate
RUN #	(HRS)	Vstd (CF)	(ug)	DSCFM	(mg/Nm3)	ppm	(LB/HR)
1	1135-1246	40.21	252	79251	0.221	0.0213	0.065696
2	1407-1528	40.35	298	78420	0.261	0.0251	0.076606
3	1628-1738	39.89	394	78619	0.349	0.0335	0.102713

Interpoll Laboratories, Inc.
(612) 786-6020

**CALCULATION OF EMISSION FACTORS
FROM (GR/DSCF) AND (PPM,D)**

$$E = \left[\frac{DSCF}{10^6 \text{ BTU}} \right] \left[\frac{LB}{DSCF} \right] \left[\frac{20.9}{20.9 - O_2} \right]$$

$$C_s^{LB} \left(\frac{LB}{DSCF} \right) = \left[\frac{GR}{DSCF} \right] \times \frac{LB}{7000 \text{ GR}}$$

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

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

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

$$\left[\frac{LB}{DSCF} \right] = \left(\frac{\mu L}{L} \right) \times \frac{28.316 \text{ L}}{DSCF} \times \frac{M (\mu g)}{24.054 \mu L} \times \frac{g}{10^6 \mu g} \times \frac{LB}{453.6 g}$$

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

Substitution gives:

$$E = F_d (2.595 \times 10^{-9}) M(ppm, d) \times \frac{20.9}{20.9 - O_2}$$

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

DS-010

APPENDIX N

SAMPLING TRAIN CALIBRATION DATA

INTERPOLL LABORATORIES
EPA Method 5 Gas Metering System
Quality Control Check Data Sheet

Job L.P. (DUNGANNON)
 Operator DUKE BRENNAN

Date 12/14/93
 Module No. 6

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 28.48 in. Hg. $\tau =$.9991 ΔH_0 1.93 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(4/6500)		
2.5	417.97	57	49
5.0	419.84	53	45
7.5	421.71	55	46
10	423.575	56	47
	$V_m = 7.475$	Avg(t_m) = 51.0 °F	

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(.2391)(7.475)(.9991)} \left[\frac{(51.0) + 460}{(28.48)} \right]^{0.5}$$

$$Y_{cn} = \underline{1.0123}$$

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 LPI DUNBANNON
 Operator E. T. T. T. T.

Date 12-13-78
 Module No. 5

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

Bar press 28.58 in. Hg. $\tau =$.9949 ΔH 1.75 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(51.000)		
2.5	52.850	55	49
5.0	54.750	57	49
7.5	56.700	58	50
10	58.550	60	50
	$V_m = 7.55$	Avg(t_m) = 53.50°F	

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(.9949)(7.55)} \left[\frac{(53.5) + 460}{(28.58)} \right]^{0.5} = 1.2387$$

$$Y_{cn} = \underline{1.0078}$$

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.1 DUNLASHION
 Operator DUILE BILLENHAY

Date 12/15/93
 Module No. 6

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 28.43 in. Hg. $\tau =$.9991 ΔH_0 1.43 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(525.00)		
2.5	526.88	50	45
5.0	528.76	52	46
7.5	530.64	54	47
10	532.537	55	47
	$V_m = 7.537$	$Avg(t_m) = 49.375^\circ F$	

Calculate Y_{cn} as follows:

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

$$Y_{cn} = \frac{1.786}{(7.537)(.9991)} \left[\frac{(49.375) + 460}{(28.43)} \right]^{0.5}$$

$$Y_{cn} = \underline{1.0040}$$

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. / DUNBANNON

Date 12/15/93

Operator ED TROWBRIDGE (PIL DOG)

Module No. 5

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

Bar press 28.43 in. Hg. $\tau =$.9949 ΔH_e 1.78 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(207.000)		
2.5	208.93	54	50
5.0	210.82	55	50
7.5	212.72	57	50
10	214.602	58	51
	$V_m = 7.602$	Avg(t_m) = 53.125 °F	

Calculate Y_{on} as follows:

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

$$(.234) Y_{on} = \frac{1.786}{(.7602)(.9949)} \left[\frac{(53.125) + 460}{(28.43)} \right]^{0.5}$$

$$Y_{on} = \underline{1.0030}$$

If Y_{on} 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 LR/DUNSMAN

Date 12-17-93

Operator E. T. [Signature]

Module No. 5

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

Bar press 28.88 in. Hg. $\tau =$ 1.9949 ΔH_e 1.78 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(541.50)		
2.5	543.40	52	46
5.0	545.24	55	46
7.5	547.13	57	47
10	548.990	60	47
	$V_m = 7.49$	Avg(t_m) = 51.2 °F	

Calculate Y_{on} as follows:

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

$$Y_{on} = \frac{1.786}{(1.9949)(7.49)} \left[\frac{() + 460}{()} \right]^{0.5} \quad 4.2074$$

$$Y_{on} = \underline{1.0084}$$

If Y_{on} 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, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: December 21, 1993

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

Date of Last Calibration: December 8, 1993

Calibration Technician: D. Brennan

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.)
December 14, 1993	3-1906	59.20	687.8	628.6	628.6

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: December 21, 1993

Meter Box No. : 6 (Rockwell Dry Test Meter Serial No. 712852)

Date of Last Calibration: December 6, 1993

Calibration Technician: D. Brennan

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.)
December 9, 1993	3-1853	236.30	395.06	158.76	158.76
December 14, 1993	3-1906	423.80	995.05	571.25	730.01

* Total volume through meter since last calibration.

Date 12/8/93

Bar. Press. 29.12 in. Hg

INTERPOL LABORATORIES, INC.
METER CALIBRATION SHEET

9.0012H Yd3

Control Module No. 5

Serial No. DTH 949 230

Net Test Meter No. AL-20

Technician D. BRENNAN

[illegible]

Positive leak check performed by D. Brennan

Water was in tolerance

Water was not in tolerance ☐; readjusted linkage

Water was not in tolerance ☒: changed dry test meters

Approved by [Signature] Date 12/10/93

* Based on AL-20 wet test meter calibration in Nov. 1991 against Bell Prover (NBS Traceable) - Carl Poe Co.

SN102RR 11/91

Bar. Press. 29.18 In. Hg

INTERPOLL LABORATORIES, INC.
METER CALIBRATION SHEET

EPA METHOD 5

Control Module No.

Serial No. 87H

Mat Test Meter No. AL-20

Technician

29/03/05

positive leak check performed by D. (SIGNED)
Water was in tolerance ☒
Water was not in tolerance ☐; readjusted linkage
Water was not in tolerance ☐; changed dry test meters

Approved by  Date 12/10/93

* Based on AL-20 wet test meter calibration in Nov. 1991 against Bell Prover (NBS Traceable) - Carl Poe Co.

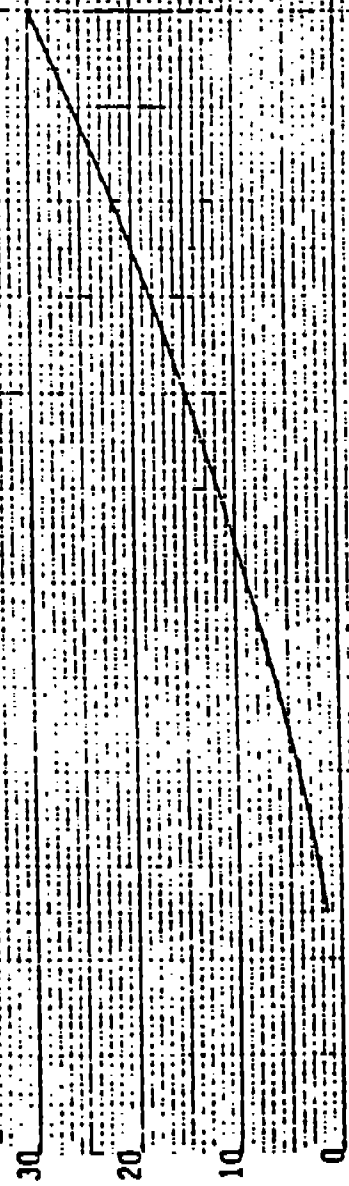
S0102RR 11/91

DIFFERENTIAL PRESSURE AND PROOF CALIBRATION CURVES

WET TEST METER

PULSATION RANGE

DIFFERENTIAL - INCHES H2O



Calibrated with a 10 Ft. American Bell Prover, Serial No. 3157. Traceable to the Bureau of Standards. Reference No. 5249068, PI-TAPE.

AL-20 American Met Test Meter

Serial No. p-717

Stainless Steel w/Removable Back

Calibrated w/Saturated Air

Water Temp. 74° F.

Air Temp. 74° F.

Inlet Pressure 2" H2O Constant

Calibration Rate: 60 CFH Per/Hr.

Capacity Rate: 120 CFH Per/Hr.

Restricted Outlet for Rate Deviation

PROOF

PROOF

101

100

99

CORRECT VOLUME = INDEX READING x PROOF + 100

DAVID BANKS

FLOW RATE - CUBIC FEET OF AIR PER HOUR

November, 1991

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 12-16-93

Nozzle Number 1-3

Technician: Ed Trowbridge

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	.187
2	.189
3	.185
Average:	.187

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 12-15-93

Nozzle Number 1-4

Technician: Eugene Brennan

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	.250
2	.248
3	.249
Average:	.249

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 12-14-93
Technician: Ed Trowbridge

Nozzle Number 1-5

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	.309
2	.305
3	.307
Average:	.307

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 12-15-93

Nozzle Number 2-4

Technician: Ed Trowbridge

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	.247
2	.245
3	.249
Average:	.247

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 12-17-93

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	.173
2	.173
3	.174
Average:	.173

Interpoll Laboratories, Inc.

(612) 786-6020

Nozzle Calibration

Data Sheet

Date of Calibration: 12-14-93

Nozzle Number PM10-7

Technician: Eugene Brennan

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	.232
2	.232
3	.232
Average:	.232

Interpoll Laboratories, Inc.

Temperature Measurement Device
Calibration Sheet

Unit under test:

Vendor FLUKE 12
Model 51 Serial Number 5030376
Range 0 - 2100 °F Thermocouple Type K
Date of Calibration 7-28-93 Technician G. Trawler

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	1.0	1.0	.21
100	100	101.2	0.2	.03
200	200	202.2	0.2	.03
300	300	301	1.0	.13
400	400	399.4	0.6	.07
500	500	500.4	0.4	.04
600	600	602.2	2.2	.21
700	700	700	0	0
800	800	801.5	1.5	.14
900	900	899.8	1.2	.01
1000	1000	1001.8	1.8	.12
1100	1100	1100.6	0.6	.04
1200	1200	1203.2	3.2	.19
1300	1300	1300.2	0.2	.01
1400	1400	1403.4	3.4	.18
1500	1500	1500.4	0.4	.02
1600	1600	1601.6	1.6	.07
1700	1700	1700.4	0.4	.02
1800	1800	1801.8	1.8	.08
1900	1900	1899.2	0.8	.03
2000	2000	2001.2	1.2	.05
2100	2100	2098.8	1.2	.04
		Averages:	1.045	.078

OF = off scale response by unit under test (°F)
% dev = $100 \Delta t / (460 + t)$

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

S-433

Interpoll Laboratories, Inc.

Temperature Measurement Device
Calibration Sheet

Unit under test:

Vendor BeckmanModel HD110 TSerial Number 18Range 0-1999

°F

Thermocouple Type KDate of Calibration 10/21/93Technician D. VAN HOEVER

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		97	3	.53
200		200	0	0
300		298	2	.26
400		396	4	.46
500		495	5	.52
600		598	2	.19
700		699	1	.09
800		804	4	.32
900		906	6	.44
1000		1012	12	.82
1100		1115	15	.96
1200		1221	21	1.27
1300		1322	22	1.25
1400		1427	27	1.45
1500		1525	25	1.28
1600		1626	26	1.26
1700		1722	22	1.02
1800		1820	20	.88
1900		1913	13	.55
2000				
2100				
		Averages:		1.68

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 BELLMAN INDUSTRIAL (PDT-23)
Model HD110 T Serial Number 20109031
Range 0-2000 °F Thermocouple Type K
Date of Calibration 10/6/93 Technician DUKE BRENNAN

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	+2	2	.0043
100	100	99	1	.178
200	200	203	3	.454
300	300	301	1	.132
400	400	398	2	.232
500	500	498	2	.208
600	600	601	1	.094
700	700	701	1	.086
800	800	807	7	.555
900	900	909	9	.662
1000	1000	1014	14	.959
1100	1100	1117	17	1.09
1200	1200	1224	24	1.446
1300	1300	1324	24	1.364
1400	1400	1429	29	1.554
1500	1500	1527	27	1.377
1600	1600	1628	28	1.359
1700	1700	1723	23	1.065
1800	1800	1822	22	.973
1900	1900	1914	14	.593
2000				
2100				
		Averages:	12.55	.7195

OF = off scale response by unit under test (°F)
% dev = $100 \Delta t / (460 + t)$

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

S-Type Pitot Tube Inspection SheetPitot No. 22-6Pitot tube dimensions:

1. External tubing diameter (D_t) 3/6 IN.
2. Base to Side A opening plane (P_A) 462 IN.
3. Base to Side B opening plane (P_B) 462 IN.

Alignment:

4. $\alpha_1 < 10^\circ$ 0
5. $\alpha_2 < 10^\circ$ 0
6. $B_1 < 50$ 1
7. $B_2 < 50$ 1
8. $Z < .125"$.02
9. $W < .0625"$.02

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .760 IN.
11. Pitot to probe sheath 3.00 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:

4-9-93[Signature]

CFR Title 40 Part 60 Appendix A Method 2

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) 1.750 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:

4-7-93

Inspected by:

G. T. [Signature]

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. $B_1 < 50^\circ$ 1
7. $B_2 < 50^\circ$ 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

CFR Title 40 Part 60 Appendix A Method 2

S-Type Pitot Tube Inspection Sheet

Pitot Tube No. 24-4

Pitot tube dimensions:

1. External tubing diameter (D) .316 IN.
2. Base to Side A opening plane (P_A) .460 IN.
3. Base to Side B opening plane (P_B) .460 IN.

Alignment:

4. α_1 < 10° 0
5. α_2 < 10° 0

6. B_1 < 5° 0
7. B_2 < 5° 1

8. Z < .125" .01
9. W < .0625" .01

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:

4-7-93

Inspected by:

E. T. M. Hodge

S-Type Pitot Tube Inspection Sheet

Pitot Tube No. 24-5

Pitot tube dimensions:

1. External tubing diameter (D) .316 IN.
2. Base to Side A opening plane (P_A) .460 IN.
3. Base to Side B opening plane (P_B) .460 IN.

Alignment:

4. α_1 < 10° 0
5. α_2 < 10° 0

6. B₁ < 5° 2
7. B₂ < 5° 2

8. Z < .125" 0
9. W < .0625" .001

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:

4-1-93

Inspected by:

[Signature]

Interpoll Laboratories, Inc.
(612) 786-6020

S-Type Pitot Tube Inspection Sheet

Pitot Tube No. 24-6

Pitot tube dimensions:

1. External tubing diameter (D) .316 IN.
2. Base to Side A opening plane (P_A) .460 IN.
3. Base to Side B opening plane (P_B) .460 IN.

Alignment:

4. α_1 < 10° 0
5. α_2 < 10° 1
6. B_1 < 5° 1
7. B_2 < 5° 1
8. Z < .125" 0
9. W < .0625" .01

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:

4-7-93

Inspected by:

[Signature]

CFR Title 40 Part 60 Appenidix A Method 2

S-348

4-7-93 G:\STACK\WP\FORMS\S-348

INTERPOLL LABORATORIES
(612)786-6020
Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 10/6/93
Technician DUKE BRENNAN
Mercury Column Barometer No. LAB 1
Aneroid Barometer No. 9022200

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjusted Mercury Barometer Read	Initial Aneroid Barometer Read	Difference (P _{ba} -P _{bm})
29.08	74	.119	28.961	28.99	.03

Has this barometer shown any consistent problems with calibration? Yes/No. If yes, explain. NA

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

INTE-7'S

Stack S
Aneroid Ba

Date 11-15-43
 Technician E. Trow
 Mercury Column Barometer No. _____
 Aneroid Barometer No. _____

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor (m)
29.39	70	.111

Has this barometer shown any consistency? If yes, explain. _____

Has problem been alleviated? Yes/No _____

***Note**

Aneroid barometers will be calibrated by the aneroid barometer in proximity to the mercury barometer before calibrating. Aneroid barometer readings.

193
 Van Ho
 ometer
 No. _____

Ambient
Temp.

70

eter shown

been alleviated

barometers
 The aneroid
 to the mercury
 calibrating.
 barometer readings

INTERPOLL LABORATORIES

(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 11/15/93
Technician D. Van Hoover
Mercury Column Barometer No. Lab 1
Aneroid Barometer No. Dust

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjusted Mercury Barometer Read	Initial Aneroid Barometer Read	Difference (P _{ba} -P _{bm})
29.39	70	.111	29.28	29.23	.05

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